



# **C**OMMITTEE OF **F**EDERATED **C**ENTERS AND **I**NSTITUTES

**ANNUAL REPORT**

**2007-2008**





## COMMITTEE OF FEDERATED CENTERS AND INSTITUTES

August 29, 2008

We are pleased to provide the enclosed collection of annual reports from members of the Committee of Federated Centers and Institutes (CFCI). This report documents the innovative research and outreach that was conducted in 2007-2008 by the 32 of 33 centers and institutes that comprise the CFCI. Each annual report documents activities and personnel of a center and describes how annual CFCI funding enhanced its research, outreach, external funding and student support.

As part of the annual review process, CFCI membership reviewed the activities of 9 centers and institutes during the 2007-2008 academic year. In addition, CFCI welcomed a new center to our ranks. The *Center for Promotion of Health in the New England Workplace* applied for membership, presented its research, and was approved by the unanimous vote of the members.

The CFCI has continued to be a vehicle for promotion of interdisciplinary collaboration in support of the University's research mission. We hope you will find this report of CFCI work a demonstration of that contribution. Please contact us if you need additional information.

Judith Boccia

Craig Armiento



## TABLE OF CONTENTS

01. ADVANCED ELECTRONICS TECHNOLOGY CENTER	1
03. CENTER FOR ADVANCED MATERIALS	9
04. CENTER FOR ATMOSPHERIC RESEARCH	21
05. CENTER FOR BIOGRADABLE POLYMER RESEARCH	40
06. CENTER FOR BIOMOLECULAR AND MEDICAL INFORMATICS	44
07. THE CENTER FOR CELLULAR NEUROBIOLOGY AND NEURODEGENERATION RESEARCH	49
08. ANNUAL REPORT FOR THE CENTER FOR COMPLEX ENVIRONMENTAL SYSTEMS	54
09. CENTER FOR COMPUTER MACHINE/HUMAN INTELLIGENCE, NETWORKING & DISTRIBUTED SYSTEMS	66
10. CENTER FOR ELECTRIC CAR AND ENERGY CONVERSION	78
11. CENTER FOR ELECTROMAGNETIC MATERIALS AND OPTICAL SYSTEMS (CEMOS)	86
12. CENTER FOR FAMILY, WORK, AND COMMUNITY	95
13. CENTER FOR FIELD SERVICES AND STUDIES	114
14. CENTER FOR GREEN CHEMISTRY	122
15. CENTER FOR HEALTH AND DISEASE RESEARCH	129
16. CENTER FOR INDUSTRIAL COMPETITIVENESS	134
17. THE CENTER FOR INTELLIGENT BIOMATERIALS	152
18. CENTER FOR NETWORK AND INFORMATION SECURITY	163
19. THE CENTER FOR HEALTH PROMOTION AND RESEARCH	170
20. CENTER FOR SUSTAINABLE ENERGY	182



21. CENTER FOR WOMEN & WORK	191
22. CENTER FOR THE PROMOTION OF HEALTH IN THE NEW ENGLAND WORKPLACE	209
23. COMBUSTION LAB	218
24. INSTITUTE FOR NANOSCIENCE AND ENGINEERING TECHNOLOGY	222
25. INSTITUTE FOR PLASTICS INNOVATION	230
26. INSTITUTE FOR VISUALIZATION AND PERCEPTION RESEARCH	234
27. THE KERR ERGONOMICS INSTITUTE	240
28. LOWELL CENTER FOR SUSTAINABLE PRODUCTION	258
29. CHN/NCOE NANOMANUFACTURING CENTER	279
30. PHOTONICS CENTER	293
31. RADIATION LABORATORY	303
32. TOXICS USE REDUCTION INSTITUTE	315
33. TSONGAS INDUSTRIAL HISTORY CENTER	331



## 01. ADVANCED ELECTRONICS TECHNOLOGY CENTER (AETC)

### **Annual report (2007-2008 Academic Year)**

#### Mission Statement

The AETC was established in November of 1990 by a seed grant from the MITRE Corporation. AETC sees its educational mission in giving an opportunity to all ages of school students to try scientific topics, to study engineering. This program, called Young Engineers Academy, was initiated in 1988. In spring semester of 1996 for the first time a group of 10-12 year old school students joined this Science and Technology Early Reach-out program. Educational tree developed by our center has at roots elementary and middle school students, which will be active later in our Gifted High School program (the body of the tree) and then eventually become freshmen and graduate students of UMASS (research productive top of the tree). In its educational mission, the Center promotes graduate, undergraduate, and high school research. After exposure to a number of years in professional training, students are ready to the challenges of a technology-oriented workplace. In 2003 and 2004 the first two doctoral degrees were awarded to students associated with Young Engineers Academy, namely, Joel Therrien and David Kharas. In September 2005 Joel Therrien had joint ECE Department as Assistant Professor.

Development of reliable manufacturing for giga-scale miniaturization technology is the task to be performed in linkage with supporting companies as M/A-COM, Raytheon, RFMD, Skyworks, and others. AETC contributes to UMASS technology transfer and applied research, yet working at the same time in such fundamental fields as solid-state physics and quantum electronics.

**AETC goals** during 2007-08 academic year were development of new Bipolar Junction Transistors (BJTs) technology. These new BJTs have both, base and emitter designed as a quantum wells. AETC also planed to expedited commercialization of IR Medical Diagnostics. The outreach operation “Young Engineers Academy” was expected to help High Schools



students to participate in local competition of solar and electric cars as well as to build new solar/electric commuting trike.

Current research focuses on:

1. High Electron Mobility Transistors (HEMTs) with increased power.
2. Development of novel quantum well bipolar transistors (QBQEHBTs).
3. **Infra Red imaging for medical applications.**
4. **Design of simultaneous fingerprinting and finger' vein mapping.**
4. **Design quantum well solar cells in polymers.**

Associated Faculty:

S.Mil'shtein, Professor, ECE Dept., Director of AETC

**A. Elbirt, Assistant Professor, Computer science ECE Dept., Co-Director of Computer Security Lab.**

S. Paikowsky, Professor, ME dept.

D. Schmidt, Assistant Professor, PE dept.

Technical staff of associated companies. (involved part-time in AETC research).

P. Ersland, M.Sc.	M/A-COM
C. Formosis, Ph.D.	M/A-COM
B. Rizzi, Ph.D.	M/A-COM
F. Rose, M.Sc,	Raytheon
M. Adlerstein, Ph.D.	Raytheon
S. Broadband, M.Sc	Silvaco Ltd.
C.Paludi, M.Sc.	Telledine Co.
D. Teeter, Ph.D.	RFMD Ltd.
F. Schindler, M.Sc.	RFMD Ltd.
L. Long, M.Sc.	Homeland Sec. Consult.

AETC cooperation with research groups of universities

M. Henini, Ph.D.	Univ. of Nottingham, Eghland
M. Greenberg, Ph.D.	Univ. of Warsaw, Poland



S. Shaham, Ph.D.	Univ. of Ariel, Israel
L. Samualson, Ph.D.	Univ. of Lund, Sweden
A. Freindlich, Ph.D.	Univ. of Texas, Huston
S. Shridhar, Ph.D.	North Eastern University, Boston

#### Student at AETC

*In the last three years students of AETC received awards of honors:*

- a) C. Liesner received Dean' gold medal in 2005-2006 academic year,*
- b) J. Palma was named best graduate student of ECE dept. 2006-2007 academic year,*
- c) A. Churi was named best graduate student of ECE dept. 2007-2008 academic year.*

In the reported year 2 doctoral, 10 master degree and 4 undergraduate students have been working at AETC. Since most of the financial support comes from local companies, all students of the AETC work part time during academic year and full time in summer at the research laboratories of the companies, MACOM/Tycoelectronics, Raytheon Co, RFMD Co.

The AETC students are encouraged to participate in conferences and be part of best student papers competitions. In these cases, students are asked to do most of the work in writing their papers. The following projects are in work:

#### Graduate Students during 2007-2008 Academic Year

##### Ph.D:

- 1) C. Liessner "High Frequency Switches and Mixers." Ph.D.
- 2) J. Palma "Quantum Well Transistors with Tailored Field" Ph.D.

##### M.Sc:

- 1) H. Bui, "Daugherty Amplifier", M.Sc.
- 2) A. Chury, "Bipolar Transistor with Quantum Well Base", M.Sc.
- 3) P. Kurlawala, "Transistor with Razor Gate", M. Sc.
- 4) A. Pillai, "Line Scanning and Recognition Algorithm for Fingerprinting" M.Sc.
- 5) A. Shendye, "IR Scanner", M.Sc.
- 6) J. Valensuela, "Polymer Based Heterostructured Solar Cells", M.Sc.
- 7) B. Putnam, "Novel Optical Alignment for Fiber Networks", M.Sc.



- 8) D. Sathe, “IR Mammography”, M.Sc.
- 9) D. Kulkarni, “Enhancement Algorithms for IR Imaging”, M.Sc.
- 10) B. Shrinivasan, “Solar – Electric Commuting Trike”, M.Sc.

#### B.Sc. Students working on graduation design projects 2007-2008 Academic Year

- 1) V. Piper,”Design Principals of Linear Amplifier”, (2007)
- 2) M. Baier,”Automatic Control of Scanning Equipment”, (2008)
- 3) A. Dyson, “Power Supplies Controlling Light Intensity” (2008)
- 4) D. Mailloux, “Design of Face Recognition System” (2008)

#### AETC Interaction with Industrial Companies and UMass Centers

Joint team of company’s technical staff and university researchers do all of the research and development projects.

1. “High Frequency Circuits Based on Quantum Well Transistors” with M/A-COM.
2. “Single and Multy-Gate HEMTs with high breakdown voltage” with M/A-COM.
- 3.” Infra Red Scanner for Medical Applications” with Leominster hospital (UMass Medical School)

#### Companies Working with the AETC

M/A-COM

**Raytheon**

RFMD Ltd.

Silvaco Ltd

Skyworks Co

#### 2007-2008 Funding

- 1) “Design of Novel Hats”, MACOM, 33,511 (2007)
- 2) “AETC transistor technology”, MACOM, 30,644 (2008)
- 3) “Transistor with Razor Gate”, MACOM, 35,683 (2008)
- 4) “Atomic Force Microscope, Probe-500”, MACOM, 250,000 (2008)



## Technology Transfer

As mentioned in the Mission Statement, the research product of AETC target development of novel semiconductor devices, new semiconductor processing and testing in such a way, that any semiconductor company willing to implement novel development would do so at minimal cost and time. In reported period, AETC designed and manufactured novel bipolar transistors with quantum well base and quantum well emitter (see attached report). High breakdown voltage quantum well field effect transistors were designed, fabricated and tested.

## Publications and Registered Patents (2007 – 2008)

1. S. Mil'shtein, J. Palma, C. Liessner, and C. Gil, "Light Emission from Semiconductor Triode", *Microelectr. J.*, Vol. 38, 1217-1219, (2007).
2. S. Mil'shtein and P. Ersland, "Progress of Quantum Electronics and Future of Wireless Technologies", **review paper**, *Microelectr. J.*, Vol. 39, 669-673, (2008).
3. S. Mil'shtein, A. Churi and J. Palma, "Bipolar Transistor with Quantum Well Base", *Microelectr. J.*, Vol. 39, 631-634, (2008).
4. Hien D. Bui, Douglas A. Teeter, David Widay, and Sam Mil'shtein, "The Doherty Power Amplifier with Collector Current and Voltage Controls for Handset Application", *IEEE Bipolar/BiCMOS Circuits and Techn. Conf.*, 102-105, (2008).
5. J. Valenzuela, S. Mil'shtein, "Quantum Wells in Heterojunction Polymer Based Solar Cell", *Workshop on Recent Advances of Low Dimensional Structures and Devices*, p.26, April, 2008.
6. S. Mil'shtein, A. Churi, "Is HEMT Operating in 2-D Mode?", *Workshop on Recent Advances of Low Dimensional Structures and Devices*, p.87, April, 2008.
7. S. Mil'shtein, J. Palma, C. Liessner, M. Baier, A. Pillai, and A. Shendye, "Line Scanner for Biometric Applications" *IEEE Intern. Conf. on Technologies for Homeland Security*, ISBN 978-1-4244-1978-4 P 205-208, (2008).
8. S. Mil'shtein, A. Pillai, A. Shendye, C. Liessner, and M. Baier, "Recognition Algorithm for Partial and Full Fingerprint" *IEEE Intern. Conf. on Technologies for Homeland Security*, ISBN 978-1-4244-1978-4 P 449-452, (2008).



9. S. Mil'shtein, B. Srinivasan, "Solar-Electric Commuting Trike with Manual Peeling", Intern. Conf. on Clean Technology, CTSI-08, ISBN 978-4200-8502-0, p. 124-127, (2008).
10. J. Valenzuela, S. Mil'shtein, "Design of Triple Layer Polymer Solar Cell", Intern. Conf., on Clean Technology, CTSI-08, ISBN 978-4200-8502-0, p. 124-127, (2008).
11. B. Srinivasan, A. Solanki, S. Mil'shtein, "Design of a Solar Cell with Better Spectral Utilization Using Down-Conversion", Intern. Conf. Phys. Semicond., ICPS-29, p, 582, 2008.
12. A. Churi, P. Kurlawala, L. Magaldi, and S. Mil'shtein, "Shaping Electric Field in MESFET" with Moving Gate", Intern. Conf. Phys. Semicond., ICPS-29, p. 603, 2008.
13. A. Shendye, A. Pillai and S. Mil'shtein, "Near Infrared Photodetector with Uniform Response for Medical Applications", Intern. Conf. Phys. Semicond., ICPS-29, p.567, **2008**.
14. S. Mil'shtein, A. Churi "Variable Quantum Well Along p-HEMT Channel", Intern. Conf. Superlat. Nanostructures & Nanodev., p.184, (2008).
15. S. Mil'shtein, P. Kurlawala, "Patterning 0.05 $\mu$ m Gate on pHEMT", Intern. Conf. Superlat. Nanostructures & Nanodev., Brazil, p.40, (2008).

#### Non-refereed Publications and Patent Applications (2007 – 2008)

1. A. Churi, P. Kurlawala, L. Magaldi, S. Mil'shtein, "Transistor with Moving Gate to Control Electron Flow", Inter. Semicon. Device Research Symp., ISBN: 978-1-4244-1892-3, (2007)
2. A. Shendye, A. Pillai, S. Mil'shtein, "Photodetector with Uniform Response in 620 nm to 870 nm Range", Inter. Semicon. Device Research Symp., ISBN: 978-1-4244-1892-3, (2007)
3. J. Palma, S. Mil'shtein, "Relationship between Breakdown Voltage and Field Plate Bias in High Electron Mobility Transistor", Ann. UMass Res. Confer. pp. 104, 2008,
4. D. Sathe, D. Kulkarni, S. Mil'shtein, "Design of Semiconductor Devices with Diffusion Coefficient Dependence on Electric Field", Ann. UMass Res. Confer. pp. 105, 2008,
5. D. Kulkarni, D. Sathe, S. Mil'shtein, "Colorizing Infra-red Images for Medical Applications", Ann. UMass Res. Confer. pp. 106, 2008,
6. M. Baier, S. Mil'shtein, "Blood Vessel Mapping via Contact less Scanning", Ann. UMass Res. Confer. pp. 108, 2008,
7. B. Srinivasan, S. Mil'shtein, "Solar Electric Commuting Trike", Ann. UMass Res. Confer. pp. 109, 2008,



8. P. Kurlawala, S. Mil'shtein, "Patterning 0.05  $\mu\text{m}$  Gate on p-HEMT", Ann. UMass Res. Confer. pp. 110, 2008,
9. A. Pillai, S. Mil'shtein, "Algorithms for Fingerprint Authentication", Ann. UMass Res. Confer. pp. 114, 2008,
10. A. Churi, S. Mil'shtein, "Is HEMT operating in 2-D Mode?", Ann. UMass Res. Confer. pp. 118, 2008,
11. D. Mailloux, M. Baier, S. Mil'shtein, "Automatic System for Face Recognition", Ann. UMass Res. Confer. pp. 15, 2008,

### **Recognition of AETC**

Prof. S. Mil'shtein continues to serve as a member of the Editorial Board of "Scanning" Journal, where he is responsible for publications in the area of electronics, nanotechnology and, bio-engineering.

The research activities of AETC in the field of quantum electronics resulted in continuation of Prof. S Mil'shtein work in the organizing committee of several international conferences; the next Conference on Low Dimensional Structures and Devices 2009 (LDS-2009). The conference covers design and development of quantum electronics, optoelectronics and quantum computing.

The research activities of AETC in the field of biometric technology was the base to elect Prof. S Mil'shtein to the organizing committee of IEEE International Conference on Homeland Security Technologies - 2009

Prof. S. Mil'shtein is selected to serve as a book reviewer for Oxford Press, science division; he is also a reviewer of several leading electronic journals.

Professor S. Mil'shtein was again elected for the coming in December 2008 issue of WHO IS WHO AMONG AMERICAN TEACHERS, as a "teacher who made a difference". One can be nominated into this prestigious publication only by former and current students, who excelled themselves by being on the National Dean's List. Starting from year 2000 Prof. S. Mil'shtein is listed in WHO IS WHO AMONG AMERICAN TEACHERS as "Multiple Year Honoree".

### **New Directions**



In 2007-2008 academic year AETC efforts were focused on development of scientific cooperation with research groups of various universities in USA and abroad: Univ. of Nottingham, England; Univ. of Warsaw, Poland; Univ. of Ariel, Israel; Univ. of Lund, Sweden; Univ. of Texas, Huston; North Eastern University, Boston. The joint research with these groups will focus on development of quantum wire transistors, phonon engineering, polymer solar cells and imaging technology for medical diagnostics.

Attached bellow is the report on the project supported by CFCI (half RA) in academic year 2007-2008. One can see from the report that all deliverables stated in the initial proposal are fulfill, namely the novel bipolar transistors with quantum well built in the base and the emitter were designed, manufactured and successfully tested.



### 03. CENTER FOR ADVANCED MATERIALS

#### **CFCI Annual Report 2007/2008**

#### **1. Mission Statement**

Founded in 1992, the Center for Advanced Materials (CAM) has become the focus of advanced materials synthesis and characterization at UMass Lowell. CAM is an association of scientists, engineers, and technicians encompassing a wide range of technical disciplines that overlap UMass Lowell's Colleges of Arts and Sciences and Engineering. The Center has been established as a multi-disciplinary research and resource center, bringing together state-of-the-art instrumentation, facilities and expert personnel. Its goal is the development of a knowledge base in the design, synthesis, characterization and intelligent processing of advanced materials, driven by the needs of potential technological applications. CAM adds in a significant and fundamental manner to the University's mission in the creation of a sustainable industrial economy.

#### **Activities in Memory of Sukant Tripathy**

Each year, the Center for Advanced Materials sponsors several activities in memory of the late Sukant Tripathy, a founder and Director of CAM and former UMass Lowell Provost. Dr. Tripathy died in a swimming accident at North Kohala, Hawaii on December 12, 2000.

##### **Sukant Tripathy Annual Memorial Symposium**

This annual event brings together researchers and colleagues from universities and industries, as well as former and present students and associates of the Center to discuss latest research activities in materials science. On 12/30/07, a seventh anniversary symposium was held. The speakers were: Dr. Anil Netravali (Cornell University, Ithaca, NY), Dr. Xinqiao Jia (University of Delaware, Newark, DE), Dr. Robert Miller (Genzyme Corp., Waltham, MA), Dr. Fotios Papadimitrakopoulos (University of Connecticut, Storrs, CT), Dr. Todd Emrick (University of MA Amherst), Dr. Bruce Foxman (Brandeis University, Waltham, MA), Dr. Sanjeev Manohar, University of MA Lowell), and Dr. Russell Gaudiana (Konarka Technologies, Inc., Lowell, MA).

##### **Tripathy Memorial Summer Graduate Fellowship**

An endowed memorial fund that will lead to graduate research fellowships for outstanding graduate students in the last year of a Ph.D. program has been established in Dr. Tripathy's name. This fund, to date, has led to the award of eight fellowships for summer support. The winners of this prestigious award in 2008 were Rahul Tyagi (Chemistry Dept.) and Rahul Panchal (Plastics Dept.).

##### **Sukant K. Tripathy Endowed Memorial Lecture**

In addition, an endowment fund for an annual endowed lectureship has been established. Each year, near the time of Tripathy's death, a leading scientist in the area of polymer science or related materials science comes to UMass Lowell and presents a lecture. The



sixth lecture, held on October 17, 2007, was given by Professor Robert H. Grubbs, Victor and Elizabeth Atkins professor of Chemistry, California Institute of Technology.

Susan Thomson-Tripathy has played an important role in these activities.

## **2. General Description and Goals**

The Center for Advanced Materials is an association of approximately 30 faculty, research associates, technical specialists, and graduate and undergraduate students engaged in research on advanced materials that are primarily polymers, organic dyes, and ceramics. CAM has major instrumentation in areas of microscopy, diffraction, spectroscopy, including laser sources and nuclear magnetic resonance, and electrochemistry.

CAM is committed to excellence in its programs such that they will bring national and international recognition to UMass Lowell. The means to this end involve keeping and expanding research support for our programs and our state-of-the-art instrumentation.

## **3. Research Focus Areas**

Dr. Jayant Kumar, Director of CAM, conducts research in the focus areas of optical and electronic properties of materials with emphasis on organic and polymeric materials. He has also been involved in processing and characterization of polymeric and organic materials and their applications in optical and electronic devices, as well as polymers with flame retardant properties.

Dr. Daniel J. Sandman, associate director, leads a group of researchers involved in the synthesis and physico-chemical study of conjugated polymers of interest for electrical and optical properties, the use of sugars for synthesis of conjugated polymers, and the use of conjugated polymers and organic compounds for sensor applications.

Dr. James Whitten's group is performing fundamental research in the areas of surface science and surface modification. Presently, the group's efforts are focused on five major projects: 1) The electronic properties of the interface between two different organic layers; 2) Adsorption of silanes and thiols on single crystal and nanocrystalline zinc oxide surfaces; 3) Development of thermally stable self-assembled monolayers as templates for polymer adsorption; 4) Measurements of forces present at surfaces using atomic force microscopy; 5) Development of sensors based on monolayer-protected colloidal gold particles.

Dr. Ashok Cholli is the director of the Nuclear Magnetic Resonance Center. He supervises and trains students at the University who wish to use the NMR instrumentation.

Dr. Long Chiang's focus areas include the design and synthesis of starburst nonlinear photonic fullerene derivatives; the design and synthesis of near-infrared absorbing emerald green fullerenes for near-infrared sensing and imaging, near-infrared filter, and broadband photovoltaic



devices; the design and synthesis of multiphoton absorptive fullerene-fluorene chromophores for nonlinear photonic sensor protection and optical limiting applications.

#### 4. Associated Personnel

**Director:**

Professor Jayant Kumar, Department of Physics and Applied Physics

**Associate Director**

Professor Daniel J. Sandman, Department of Chemistry

**Associated Faculty and Research Faculty:**

Professor James Whitten, Department of Chemistry

Dr. Ashok Cholli, NMR Laboratory Director

Professor Emeritus Arthur Watterson, Department of Chemistry

Professor Emeritus Alexandre Blumstein, Department of Chemistry

Professor Long Chiang, Department of Chemistry

Adjunct: Dr. Lynne A. Samuelson

**Staff:**

Technical Specialists:

Milton Downey

Daniel Oblas

Sandip Sengupta

Dean Alexander

**Post-Doctoral Research Associates:**

Robinson Anandakathir

Mukesh Pandey

Vijayendra Kumar

**Administrative Support:**

Michele Vercellin

Rita Kelleher

5. **New and Temporary Faculty Affiliations:** none.

#### 6. Student Research Support

**Graduate Students/Research Assistants:**

Pil Ho Huh (supported by CFCI)

Fadong Yan

Abhishek Kumar

Subhalakshmi Nagarajan

Yan Ge

JiSun Im

Jagdeep Singh

Seaho Jeon

Sammiah Thota



## **7. Current Research Projects**

### **(P.I. Kumar)**

Nanostructured Materials for Photovoltaic Applications

Sponsor: U.S. Army Natick

Nanomanufacturing of Multifunctional Sensors

Sponsor: U.S. Army Research Office

NMR Measurements

Sponsor: Triton Systems, Inc.

Basic Research

Sponsor: Agiltron, Inc.

TGA, DSC, Flammability Characterization of LCP Resins

Sponsor: Linden Photonics, Inc.

AFM Analysis

Sponsor: Resonrtics Micromachining Technology

NMR Spectroscopy Measurements

Sponsor: Konarka Technologies, Inc.

Biocatalytic Polymerization of Naturally Occurring “Green Tea” Flavonoids for Anti-cancer Applications

Sponsor: U.S. Environmental Protection Agency

Fabrication of Sub-Micron-Scale Electronic and Photonic Structures Using Direct Photo-Patterning Techniques

Sponsor: National Science Foundation

### **(P.I. Sandman)**

Research and Engineering Apprentice Program

Sponsor: Academy of Applied Sciences

### **(P.I. Whitten)**

“Surface Modification and Characterization of Nanocrystalline Zinc Oxide”

Sponsor: Natick Army Soldier Center Research Laboratory



“Studies of Interfaces between Conjugated Oligomers and Self-Assembled Monolayers”  
Sponsor: Petroleum Research Fund

**(P.I. Chiang)**

Starburst Nonlinear Photonic Fullerene Derivatives  
Sponsor: Air Force Office of Scientific Research (AFOSR)

## **8. Publications**

**(Kumar)**

“Fabrication of SnO<sub>2</sub> Nano Patterns Using Surface Relief Grating” (F. Yan, L. Li, P. Huh, Y. Wang, L. A. Samuelson, J. Kumar), *Mater. Res. Soc. Symp. Proc.*, Vol. 1059, 2008.

“Detection of Explosives Using Nanofibrous Membranes” (Abhishek Kumar, Ignaty Leshchiner, Subhalakshmi Nagarajan, Ramaswamy Nagarajan, Jayant Kumar), *IEEE*, pp. 390-394, 2008.

“Simple Fabrication of Zinc Oxide Nanostructures” (P. Huh, F. Yan, L. Li, M. Kim, R. Mosurkal, L. A. Samuelson, J. Kumar), *Journal of Materials Chemistry*, 18, pp. 637-639, 2008.

“Biocatalytically Synthesized Poly(3,4-ethylenedioxythiophene)” (S. Nagarajan, J. Kumar, F. Bruno, L. A. Samuelson, R. Nagarajan), *Macromolecules*, 41, pp. 3049-3052, 2008.

“Optical and Electrochemical Detection of Saccharides with Poly(aniline-co-3-aminobenzeneboronic acid) Prepared from Enzymatic Polymerization” (P. Huh, S-C. Kim, Y. Kim, Y. Wang, J. Singh, J. Kumar, L. A. Samuelson, B-S. Kim, N-J. Jo, J-O. Lee), *Biomacromolecules*, 8, (11), pp. 3602-3607, 2007.

“Fabrication of TiO<sub>2</sub> Grating with Composites of Azobenzene Polymer and TiO<sub>2</sub> Nanoparticles” (Mario Cazeca, Lian Li, Fadong Yan, Lynne A. Samuelson, Jayant Kumar) *Journal of Macromolecular Science, Part A: Pure and Applied Chemistry*, Vol. 44, No. 12, pp. 1329-1332, 2007.

“Fabrication of Gold Nano-Structures with Azopolymer Templates” (Lian Li, Fadong Yan, Mario Cazeca, Lynne Samuelson, Jayant Kumar), *Journal of Macromolecular Science, Part A: Pure and Applied Chemistry*, Vol. 44, No. 12, pp. 1299-1303, 2007.

“Design and Synthesis of Novel Pegylated 4-Methylcoumarins” (Mukesh K. Pandey, Rahul Tyagi, Shilpi Tomar, Jayant Kumar, Virinder S. Parmar, Aertur C. Watterson), *Journal of Macromolecular Science, Part A: Pure and Applied Chemistry*, Vol. 44, No. 12, pp. 1293-1298, 2007.



“Controlled Release of Covalently Bound Organic Molecules by Slow Hydrolysis for Potential Biocide Applications” (Ravi Mosurkal, Jayant Kumar, Virinder S. Parmar, Arthur C. Watterson), *Journal of Macromolecular Science, Part A: Pure and Applied Chemistry*, Vol. 44, No. 12, pp. 1289-1292, 2007.

“Determination of Electron and Hole Mobility of Regioregular Poly(3-hexylthiophene) by the Time of Flight Method” (Ke Yang, Yanping Wang, Alope Jain, Lynne Samuelson, Jayant Kumar) *Journal of Macromolecular Science, Part A: Pure and Applied Chemistry*, Vol. 44, No. 12, pp. 1261-1264, 2007.

“Synthesis and Characterization of a Ruthenium(II) complex for Photovoltaic Cells” (Young-Gi Kim, Ravi Mosurkal, Lian Li, John Walker, Jinan He, Lynne A. Samuelson, Jayant Kumar) *Journal of Macromolecular Science, Part A: Pure and Applied Chemistry*, Vol. 44, No. 12, pp. 1255-1260, 2007.

“Biosynthesis of Liquid Crystalline Azo –Polyesters” (Langang Niu, Lynne A. Samuelson, Jayant Kumar) *Journal of Macromolecular Science, Part A: Pure and Applied Chemistry*, Vol. 44, No. 12, pp. 1245-1248, 2007.

“Polydiacetylene/TiO<sub>2</sub> Nanocomposites for Photovoltaic Applications” (Y. Wang, L. Li, F. Yan, L. A. Samuelson, J. Kumar), *Polymeric Materials: Science and Engineering*, 96, pp. 809-810, 2007.

“Biocatalytic Synthesis of Organosiloxane Copolyimide” (R. Mosurkal, L. A. Samuelson, V. S. Parmar, J. Kumar, A. C. Watterson), *Macromolecules*, 40, pp. 7742-7744, 2007.

“Nanocrystalline TiO<sub>2</sub>-Catalyzed Solid-State Polymerization of Diacetylene in the Visible Region” (Y. Wang, L. Li, K. Yang, L. A. Samuelson, J. Kumar), *Journal of American Chemical Society*, 129, pp. 7238-7239, 2007.

“Synthesis of Polyaniline Derivatives via Biocatalysis” (S-C. Kim, P. Huh, J. Kumar, B. Kim, J-O. Lee, F. Bruno, L. Samuelson), *Green Chemistry*, 9, pp. 44-48, 2007.

“Design and Synthesis of Novel Amphiphilic Polymers for MRI and Selective Targeting in Cancer Diagnosis/Therapy” (M. Pandey, R. Tyagi, R. Kumar, V. S. Parmar, A. C. Watterson, J. Kumar, M. T. Hardiman, J. Zhou, K. P. Brower, R. J. Fisher, C. K. Colton), *Polymeric Materials: Science and Engineering*, 96, pp. 855-856, 2007.

### **(Sandman)**

X. Wang, D.J. Sandman, V. Enkelmann, H.-L. Chen, B.M. Foxman, “Crystal and Molecular Structure of the bis-Ethyl urethane of 5,7-dodecadiyn-1,12-diol”, *J. Macromol. Sci., Pure Appl. Chem.*, submitted.



X. Wang, D.J. Sandman, S. Chen, and S.P. Gido, "Thermochromic Micro- and Nanocrystals of Polydiacetylenes: An Unusual Size Effect in Electronic Spectra", Macromolecules, **41**, 773-778 (2008).

X. Wang, J.E. Whitten, and D.J. Sandman, "Ultraviolet photoelectron spectroscopy studies of the thermochromic phase transition in urethane-substituted polydiacetylenes", J. Chem. Phys., **126**, 184905 (2007).

X. Wang, L. Li, K. Yang, Y. Wang, and D.J. Sandman, "Fabrication of Micro- and Nanoscale Crystals and Thin Films of a Phthalocyanine", J. Macromol. Sci., Pure Appl. Chem., **A44**, 1323-1327 (2007).

X. Wang, D.J. Sandman, S. Chen, and S.P. Gido, "Thermochromic Polydiacetylene Micro- and Nanocrystals: Comparison with Bulk Crystals", Polymer Preprints, **48** (2), 71-72 (2007).

### (Whitten)

J.W. Soares, J.E. Whitten, D.W. Oblas, D.M. Steeves, "Novel Photoluminescence Properties of Surface-Modified Nanocrystalline Zinc Oxide: Toward a Reactive Scaffold", Langmuir, **24**, 371-374 (2008).

Y. Ge, J.E. Whitten, "Interfacial Electronic Properties of Thiophene and Sexithiophene Adsorbed on a Fluorinated Alkanethiol Monolayer", J. Phys. Chem. C, **112**, 1174-1182 (2008).

Y. Ge, J.E. Whitten, "Energy Level Alignment between Sexithiophene and Buckminsterfullerene Films", Chem. Phys. Lett., **448**, 65-69 (2007).

X. Wang, J.E. Whitten, D.J. Sandman, "Ultraviolet Photoelectron Spectroscopy Study of the Thermochromic Phase Transition in Urethane-Substituted Polydiacetylenes" J. Chem. Phys., **126**, 184905-1-184905-5 (2007).

### (Chiang)

"Synthesis and Characterization of C60 Dyads with Highly Photoactive Dicyanoethylenylated Diphenylaminofluorene Chromophore Antenna," J. Macromol. Sci. A, Pure Appl. Chem. **2008**, *45*, Jeon, S.; So, G.; Anandakathir, R.; Canteenwala, T.; Tan, L.-S.; Pritzker, K.; Chiang, L. Y. (accepted)

"Solvent and Concentration-Dependent Aggregation Study of C60 Dyads and Multiads on Nonlinear Photonic Properties" J. Macromol. Sci. A, Pure Appl. Chem. **2008**, *45*, Lau, K. H. V.; Anandakathir, R.; Pritzker, K.; Chiang, L. Y. (accepted)

"Nonlinear Optical Transmission Properties of C60 Dyads Consisting of a Light-Harvesting Diphenylaminofluorene Antenna," J. Phys. Chem. B, **2008**, Elim, H. I.; Jeon, S.-H.; Verma, S.; Ji, W.; Tan, L.-S.; Urbas, A.; Chiang, L. Y. (accepted)

"Large Enhancement of Singlet Oxygen Generation by Dicyanoethylene-bridged C60-diphenylaminofluorene Chromophores. Synthesis and Photophysical Properties," Padmawar, P. A.; Haley, J. E.; So, G.; Canteenwala, T.; Tan, L.-S.; Pritzker, K.; Urbas, A.; Chiang, L. Y. (submitted)

“Large Concentration-dependent Nonlinear Optical Responses of Starburst Diphenylaminofluorenyl methano[60]fullerene Pentaads,” *J. Mater. Chem.* **2007**, *17*, 1826-1838, Elim, H. I.; Anandakathir, R.; Jakubiak, R.; Chiang, L. Y.; Ji, W.; Tan, L. S.

“Starburst Encapsulation of C60 by Multiple Hindered Two-Photon Absorptive Diphenylaminodialkylfluorene Arms,” *J. Macromol. Sci. A, Pure Appl. Chem.* **2007**, *44*, 1265-1273, Anandakathir, R.; Tan, L.-S.; Chiang, L. Y.

“Prolonged Photoinduced Charge-Separated States in Starburst Tetra(Diphenylaminofluoreno) [60]Fullerene Adducts”, *J. Phys. Chem. A* **2007**, *111*, 6938-6944, El-Khouly, M. E.; Anandakathir, R.; Ito, O.; Chiang, L. Y.

“Alternative Synthesis of C60-diphenylaminofluorene Derivatives for Nonlinear Photonic Applications: Method of Preparation and Characterization,” *J. Macromol. Sci. A, Pure Appl. Chem.* **2007**, *44*, 1275-1282, Jeon, S. H.; Anandakathir, R.; Chiang, J.; Chiang, L. Y.

## 8) Conference Presentations

### (Kumar)

“Enzymatically Synthesized Polymeric Catechins Exhibit Potent and Specific Anti-Proliferative Activity” (Nagarajan, S., Nagarajan, R., Braunhut, S. J., Bruno, F. F., McIntosh, D, Samuelson L. A, Kumar, J.) Era of Hope Meeting, Department of Defense, Breast Cancer Research Program, Washington D.C, June 25 – 28, 2008.

“[Biocatalytically Synthesized Polypyrrole](#)” (Nagarajan, R., Garhwal, R., Nagarajan, S., Kumar, J., Bruno, F. F., Samuelson L. A.), The 12th Annual Green Chemistry and Engineering Conference, Washington, DC, June 24-26, 2008.

Ravi Mosurkal, Lynne A. Samuelson, Jayant Kumar, Virinder Parmar, Arthur Watterson, "Organo-Siloxane Copolymers as Environmentally safe Flame Retardant Materials", 19<sup>th</sup> BCC conference on Recent Progress in Flame Retardancy of Polymeric Materials, Stamford, CT, June 9-11, 2008.

“Siloxane-Aryl Copolyimides for Flame Retardant Applications” (Ravi Mosurkal, Lynne A. Samuelson, Kenneth Smith, Phillip Westmoreland, Jayant Kumar, Arthur Watterson), The 7th International Conference on Advanced Polymers Via Macromolecular Engineering, Miami Beach, FL, December 15 - 20, 2007.

“Single-Step Biocatalytic Synthesis of Sexithiophene” (S. Nagarajan, R. Nagarajan, J. Kumar, F. Bruno, L. Samuelson), Sukant Tripathy Annual Memorial Symposium, November 30, 2007.

“Patterning Flexible Substrates Using Surface Relief Structures in Azobenzene Functionalized Polymer Films” (S. Yang, K. Yang, A. Jain, R. Nagarajan, J. Kumar), Sukant Tripathy Annual Memorial Symposium, November 30, 2007.

“Fabrication of Periodic Nanostructures ZnO Arrays” (P. Huh, F. Yan, L. Li, L. Samuelson, J. Kumar), Sukant Tripathy Annual Memorial Symposium, November 30, 2007.



“Photosensitized Solid-State Polymerization of Diacetylene in Nanoporous TiO<sub>2</sub> Structures” (Y. Wang, L. Li, F. Yan, L. Samuelson, J. Kumar), Sukant Tripathy Annual Memorial Symposium, November 30, 2007.

“Two-Photon Induced Surface Relief Grating on Azopolymer Film” (L. Li, F. Yan, H. Huo, M. Shen, L. Samuelson, J. Kumar), Sukant Tripathy Annual Memorial Symposium, November 30, 2007.

“Fabrication of SnO<sub>2</sub> Nanowire Arrays Using Surface Relief Grating” (F. Yan, L. Li, P. Huh, Y. Wang, L. Samuelson, J. Kumar), Sukant Tripathy Annual Memorial Symposium, November 30, 2007.

“Solution and Thin Film Properties of Poly(vinylferrocene-b-isobutylene-b-vinylferrocene) Triblock Copolymer” (F. Yan, T. Higashihara, L. Li, P. Huh, K. Yang, L. Samuelson, J. Kumar, R. Faust), Sukant Tripathy Annual Memorial Symposium, November 30, 2007.

“A Novel Template for the Formation of Water-Soluble Conducting Polymers” (F. Bruno, S. Nagarajan, R. Nagarajan, J. Kumar, L. Samuelson), Sukant Tripathy Annual Memorial Symposium, November 30, 2007.

“A Simple Technique to Submicron Scale Patterning of Silver Using Visible Light Interference” (A. Kumar, S. Nagarajan, K. Yang, A. Robinson, J. Singh, R. Nagarajan, A. Jain, J. Kumar), Sukant Tripathy Annual Memorial Symposium, November 30, 2007.

“A ‘Greener’ Route to the Synthesis of Electrically Conducting Polypyrrole” (Nagarajan, R., Nagarajan, S., Garhwal, R., Kumar, J., Bruno, F. F., Samuelson L. A.), Materials Research Society Conference, Boston, November 25- 28, 2007.

“Fabrication of SnO<sub>2</sub> Nano Patterns Using Surface Relief Grating” (F. Yan, L. Li, P. Huh, Y. Wang, L. Samuelson, J. Kumar), MRS Conference, Boston, MA, November 28, 2007.

“Fabrication of ZnO Nanoarrays: (P. Huh, F. Yan, L. Li, L. Samuelson, J. Kumar), MRS Conference, Boston, MA, November 28, 2007.

“Biocatalytic Synthesis of Environmentally Safe Flame-Retardant Polymers”, (Ravi Mosurkal, Lynne A. Samuelson, Kenneth Smith, Phillip Westmoreland, Jayant Kumar, Arthur Watterson), The Fifth Triennial International Fire & Cabin Safety Research Conference, November 1, 2007.

### **(Sandman)**

“Studies of the Polydiacetylene Bis-p-chlorocinnamate of 10,12-Docasadiyn-1,22-diol” (S. Cankaya, D. Sandman), Sukant Tripathy Annual Memorial Symposium, November 30, 2007.

### **(Whitten)**

“The Interfaces between Buckminsterfullerene and Sexithiophene (Yan Ge and James E. Whitten), Oral Presentation, New England American Vacuum Society, June, 2008.



“Adsorption of 3-Mercaptopropyltrimethoxysilane on Nanocrystalline and Single Crystal Zinc Oxide Surfaces” (Jagdeep Singh, JiSun Im, Jason W. Soares, Diane M. Steeves, James E. Whitten), Oral Presentation, SPIE Conference, Aug., 2008.

“Forces Between Polymer Surfaces and Self-Assembled Monolayers Investigated by Atomic Force Microscopy” (Jagdeep Singh, James Whitten), Sukant Tripathy Annual Memorial Symposium, November 30, 2007.

“Fabrication of Chemiresistor Type Vapor Sensors Using Alkanethiol Monolayer-Protected Gold Nanoparticles” (Amol Chandekar, Ji-Sun Im, James Whitten), Sukant Tripathy Annual Memorial Symposium, November 30, 2007.

### **(Chiang)**

“Ultrafast Intramolecular Nonlinear and Linear Photoresponses of Starburst  $C_{60}$ -Antenna Nanostructures,” AFOSR Review meeting, College Park, Maryland, May 5–9, 2008.

“Potential Utilization of Ultrafast Charge Generation of  $C_{60}(>DPAF-C_n)_x$  Nanomaterials for Photovoltaics Application,” Sin-Ao Energy Group, Beijing, China, March 7–10, 2008.

“Synthesis and Characterization of  $C_{60}$  Dyads with Highly Photoactive Dicyanoethylenylated Diphenylaminofluorene Chromophore Antenna,” Tripathy Memorial Symposium, Lowell, Massachusetts, November 30, 2007.

“Synthesis and Photophysical Properties of  $C_{60}$ -Dicyanoethylenyldiphenylaminofluorene Conjugates” (P. Padmawar, M. El-Khouly, S. Jeon, J. Rogers, T. Canteenwala, O. Ito, L. Tan, A. Urbas, L. Chiang), Tripathy Memorial Symposium, Lowell, Massachusetts, November 30, 2007.

## **10. Collaboration with Other Centers/Institutes and/or Departments**

By virtue of its extensive instrumentation capabilities, CAM is involved in intra-university collaboration with numerous scientists and engineers in the Colleges of Science and Engineering. Of particular interest, CAM faculty and staff continue to interact significantly with the Institute for Nanoscale Science, Engineering, and Technology (INSET), as well as the Center for Green Chemistry, Photonics Center, Plastics Engineering Dept., the Center for High-Rate Manufacturing and Physics Dept.

We have also assisted graduate students to complete their M.S. and Ph.D. degrees in several departments using our instruments at the center.

## **11. Regional/Local Outreach**

Through a grant from the Academy of Applied Sciences (U.S. Army Research and Engineering apprentice Program), CAM furnishes a tutorial research program for minority high school



students. This summer's students are Connie Li from Chelmsford High School and Ankan Dhal from Westford Academy..

Summer Opportunities in Science (SOS): CAM provides research experience for the SOS students every summer. This summer, Arti Tiwari from Andover High School, is working in our laboratories.

The Whitten research group continues its efforts on the development of low-cost spectroscopy experiments for the Physical Chemistry Laboratory. Several of these are being tested at local colleges, such as St. Anselm and Merrimack College. Whitten is also on the board of the New England American Vacuum Society.

Collaboration with other Institutes of Higher Education:

- Dr. Sunil Sharma, University of Delhi, India
- Prof. Pramod Bhatnagar, University of Delhi, India
- Prof. Parmatma Mathur, University of Delhi, India
- Prof. Virinder Parmar, University of Delhi, India
- Dr. Alope Jain, Consultant, Delhi, India

In addition, Prof. Sandman has collaborated with Professor Bruce M. Foxman, Brandeis University, Department of Chemistry, on single crystal X-ray crystallography; and Professor Samuel P. Gido, University of Massachusetts Amherst, Department of Polymer Science and Engineering, on transmission electron microscopy.

## 12. Proposals Submitted/Awarded 2007/2008

Proposal Title: Surface Modification and Characterization of Nanocrystalline Zinc Oxide  
P.I. James Whitten  
Sponsor: Natick Army Soldier Center  
Status: Funded  
Amount: \$40,000  
Period Covered: 02/01/08 to 01/31/09

Proposal Title: Chemisorption on Modified Graphene Surfaces  
P.I. James Whitten  
Sponsor: National Science Foundation  
Status: Not Funded  
Amount: \$303,157  
Period Covered: 06/01/08 to 05/31/11

Proposal Title: Conjugated Monomer and Oligomer Functionalized Silicon Surfaces and Nanoparticles  
P.I. James Whitten  
Sponsor: National Science Foundation  
Status: Not Funded



Amount: \$387,113  
Period Covered: 06/01/08 to 05/31/11

Proposal Title: Research and Engineering Apprentice Program  
P.I. Daniel Sandman  
Sponsor: Academy of Applied Sciences (for U.S. Army)  
Status: Funded  
Total Award: \$5200  
Period Covered: 06/16/08 – 01/31/09

Proposal Title: Nanomanufacturing of Multifunctional Sensors  
P.I. Jayant Kumar  
Sponsor: U.S. Army Research Office  
Status: Funded  
Total Award: \$1,600,000

Proposal Title: TGA, DSC, Flammability Characterization of LCP Resins  
P.I. Jayant Kumar  
Sponsor: Linden Photonics  
Status: Funded  
Amount: \$8000  
Period Covered: 7/2/07-7/19/08

Proposal Title: Biocatalytic/Biomimetic Routes to Synthesis of Polymeric Antioxidants for Industrial Applications  
P.I. Jayant Kumar  
Sponsor: American Chemical Society  
Status: Pending  
Amount: \$60,000  
Period Covered: 8/1/08-7/31/09

Proposal Title: LB Tough Usage  
P.I. Jayant Kumar  
Sponsor: Agiltron  
Status: Funded  
Amount: \$2800  
Period Covered 3/1/08-2/28/09



## Committee of Federated Centers and Institutes

### *University of Massachusetts Lowell*

#### 04. CENTER FOR ATMOSPHERIC RESEARCH

##### 1. Mission Statement of Center/Institute

The Center for Atmospheric Research (UMLCAR) was founded in 1975 with the goal of conducting experimental and analytical research in the atmospheric and space sciences, to provide research opportunities for graduate and undergraduate students, and to demonstrate how research and development tie to solving real world problems. Carrying out these objectives requires tapping the science and engineering expertise residing at the University. Active support of the undergraduate and graduate Atmospheric Sciences Program of the Environmental, Earth, and Atmospheric Sciences Department is a key objective of the Center.

##### 2. General Description and Goals

##### 3. Research Focus Areas

Ionospheric Physics  
Space Physics  
Planetary Physics  
Space Weather  
Radio Science  
Space Instrumentation

##### 4. Associated Personnel (Faculty, Staff)

Dr. Bodo W. Reinisch, Director  
Dr. Paul Song, Co-Director; Professor, Atmospheric Sciences  
Dr. Gary Sales, Senior Scientist  
Dr. Klaus Bibl, Chief Scientist  
Dr. Ivan Galkin, Section Head, Software Applications  
Dr. Jiannan Tu, Research Associate  
Dr. Qiugang Zong, Assistant Research Professor  
Mr. David Kitrosser, Section Head, Systems Development  
Prof. Xueqin Huang, Research Professor, CAR  
Mr. George Cheney, Professor, Elec. & Comp. Engineering  
Dr. Yan Luo, Assistant Professor, Elec. & Comp. Engineering



Mr. Grigori Khmyrov, Scientific Data Analyst  
Mr. Igor Lissyssian, Electrical Engineer  
Mr. Alexander Kozlov, Software Engineer  
Mr. Jason Grochmal, Production Manager  
Mr. Ryan Hamel, Computer and Electronics Engineer  
Ms. Lynne Schaufenbil, Admin. Asst.

#### Visiting Researchers

Dr. David Altadill, Spain  
Dr. Xuzhi Zhou, China  
Dr. Madhu Dhar, India  
Mr. Ke Xiang, China  
Mr. Yongfu Wang, China

#### 5. Identify new and temporary faculty affiliations for 2007/2008 with your Center/Institute

In these sections, identify activities linked to CFCI funding in 2007/2008. This is a **one** year report. Do not provide data about prior years.

#### 6. Students Supported

2 post doctoral research fellows – Patrick Nsume and Vadym Paznukhov  
1 graduate student – Pavel Ozhogin  
5 bachelor-level students – Keith Sorota, Jonathan McElroy, Peter Bonneau, Ebrahim Nasser, and Daniil Khmyrov

#### 7. Current Research Projects (**Awarded**)

Award Principal Investigator: Reinisch, Bodo W  
Award: LCV00000060379 Investigation of Near-Earth Magnetosphere Response to Solar Wind/IMF  
Ref. Award Number: Grant # NNX07AG38G  
Sponsor Name: NATIONAL AERO AND SPACE ADMINISTRATION  
Award Dates: 02/01/2007-01/31/2010  
Total Award Amount: \$300,099.00

Award Principal Investigator: Zong, Qiugang  
Award: 00000000000933 Study of Bow Shock Energetic Particles  
Ref. Award Number: Award No. NNX07AG09G  
Sponsor Name: UNIVERSITY OF ALABAMA  
Total Award Amount: \$79,360.00  
Award Dates: 06/01/2007-03/31/2010



Award Principal Investigator: Reinisch,Bodo W  
Award: LCV000000060042 Equator and High-Latitude Ionosphere-to-Magnetosphere Research  
Ref. Award Number: FA8718-06-C-0072  
Sponsor Name: U.S. AIR FORCE RESEARCH LAB  
Award Dates: 08/25/2006-11/24/2010  
Total Projected Award Amount: \$990,059.00

Award Principal Investigator: Reinisch, Bodo W  
Award: LCV000000050271 Investigating Radiation Belt Remediation with Space-borne Whistler Mode Transmit  
Ref. Award Number: FA8718-05-C-0070  
Sponsor Name: U.S. DEPARTMENT OF THE AIR FORCE  
Award Dates: 06/24/2005-09/08/2008  
Total Award Amount: \$1,242,339.00

Award Principal Investigator: Reinisch, Bodo W  
Award: LCV000000070044 Proposal for DISS Support & Maintenance of AN/FMQ-12 DISS  
Ref. Award Number: Subcontract #: 95227JMY5S (legacy); 7000003829 new  
Sponsor Name: NORTHROP GRUMMAN CORPORATION  
Award Dates: 10/01/2006-04/30/2008  
Total Award Amount: \$646,838.00

Award Principal Investigator: Song, Paul  
Award: LCV000000060263 Analysis of Data From the Cluster Mission  
Ref. Award Number: Subaward # GC 194770NGA  
Sponsor Name: BOSTON UNIVERSITY  
Award Dates: 04/01/2006-03/31/2008  
Total Award Amount: \$196,694.00

Award Principal Investigator: Reinisch,Bodo W  
Award: 00000000002292 16 - 4CX250R transmitting tubes  
Ref. Award Number: Reference #1738  
Sponsor Name: INSTITUT RYL METEOROLOGIQUE DE BELGIQUE  
Award Dates: 12/01/2007-11/30/2008  
Total Award Amount: 2,788.00

Award Principal Investigator: Reinisch,Bodo W  
Award: LCV000000060066 China DPS  
Ref. Award Number: Contract # 050207-1MEXUS158  
Sponsor Name: CETC INTERNATIONAL COMPANY LTD  
Award Dates: 09/08/2005-11/26/2007  
Total Award Amount: \$179,960.00



Award Principal Investigator: Reinisch, Bodo W  
Award: LCV000000060409 DPS-4 for Cyprus  
Ref. Award Number: Contract dated 6-25-07  
Sponsor Name: FREDERICK INSTITUTE OF TECHNOLOGY  
Award Dates: 04/15/2007-04/15/2009  
Total Award Amount: \$213,370.00

Award Principal Investigator: Reinisch, Bodo W  
Award: 00000000001350 VSSC Ionospheric Radio Observatory - DPS-4D  
Ref. Award Number: PO# 9301 20070013540101 FE  
Sponsor Name: VIKRAM SARABHAI SPACE CENTRE  
Award Dates: 09/26/2007-10/15/2008  
Total Award Amount: \$216,210.00

Award Principal Investigator: Reinisch, Bodo W  
Award: 00000000001419 Ionospheric Radio Observatory DPS-4D for Belgrade  
Ref. Award Number: Pmt Recd 11/23/07  
Sponsor Name: GEOMAGNETIC INSTITUTE IN BELGRADE  
Award Dates: 08/01/2007-10/31/2009  
Total Award Amount: \$245,277.00  
Total Obligated Award Amount: \$245,277.00  
Total Projected Award Amount: \$245,277.00

Award Principal Investigator: Reinisch, Bodo W  
Award: LCV000000070075 Ionospheric Radio Observatory for South Africa  
Ref. Award Number: PO # 16432  
Sponsor Name: DEPARTMENT OF COMMUNICATIONS (SO AFRICA)  
Award Dates: 02/09/2007-05/30/2009  
Total Award Amount: \$323,236.00

Award Principal Investigator: Reinisch, Bodo W  
Award: LCV000000070053 ARTIST SW Maintenance  
Ref. Award Number: PO No. 2006/2394  
Sponsor Name: INTA  
Award Dates: 01/01/2007-12/31/2007  
Total Award Amount: \$15,400.00

Award Principal Investigator: Reinisch, Bodo W  
Ref. Award Number: PO# 06GB00009  
Award: LCV 00000000000042 TIS Mission Pursuit  
Sponsor Name: BALL AEROSPACE & TECHNOLOGIES CORP.  
Award Dates: 11/01/06-3/31/07  
Total Award Amount: \$9,991.00



Award Principal Investigator: Reinisch, Bodo W  
Award: PO# 10436  
Award: LCV000000060245 Ionosonde Networking, Databasing, and Webserving,  
Sponsor Name: ASTRO RESEARCH CORPORATIONL630500831, Japan  
Award Dates: 02/09/07-01/31/08  
Total Award Amount: \$212,470.00

Award Principal Investigator: Reinisch, Bodo W  
Ref: PO# 45051649  
Award: 00000000001499 Trimble GPS/RS232 Converter/30m Cable  
Sponsor Name: AUSTRALIAN ANTARCTIC DIVISION  
Dates: 07/01/07-06/30/08  
Amount \$1,680.00

Award Principal Investigator: Reinisch, Bodo W  
Award: LCV000000070044, Proposal for DISS Support & Maintenance of AN/FMQ-12 DISS  
Sponsor Name: NORTHROP GRUMMAN CORPORATION  
Subcontract #: 95227JMY5S (legacy); 7000003829 new  
Dates: 10/01/06-03/31/08  
Amount: \$160,390.00

Award Principal Investigator: Reinisch, Bodo W  
Award: Storm-Time Plasma Redistribution in the Coupled Plasmasphere-Ionosphere System  
Sponsor Name: UNIVERSITY OF CALIFORNIA  
UCLA No. 2090 G JC399  
Dates: 02/01/08-01/31/11  
Amount: \$18,771.00

## Proposed Research

### **FY07 Proposals Submitted**

7/21/06  
Sponsor: NATIONAL AERO AND SPACE ADMINISTRATION  
Title: Sounding the Ionospheric/Thermospheric Effects of Storm Enhanced Density Plumes  
Dates: 10/01/07-09/30/10  
Amount: \$413,176.00

8/21/06  
Sponsor: GEOMAGNETIC INSTITUTE IN BELGRADE  
Title: DPS-4 Belgrade  
Dates: 09/01/06-08/31/07  
Amount: \$205,120.00



8/22/06

Sponsor: VIKRAM SARABHAI SPACE CENTRE

Title: DPS-4

Dates: 02/01/07-01/31/08

Amount: \$200,720.00

8/24/06

Sponsor: INTA

Title: ARTIST SW Maintenance

Dates: 01/01/07-12/31/07

Amount: \$15,400.00

8/30/06

Sponsor: NORTHROP GRUMMAN CORPORATION

Title: Proposal for DISS Support

Dates: 10/01/06-09/30/07

Amount: \$452,765.00

8/31/06

Sponsor: UNIVERSITY OF CALIFORNIA

Title: Storm-time Magnetospheric-ionospheric Density Variations: Data-model Comparison

Dates: 04/01/07-03/31/10

Amount: \$58,086.00

9/15/06

Sponsor: DEPARTMENT OF COMMUNICATIONS (SO AFRICA)

Title: Ionospheric Observatory for South Africa

Dates: 02/09/07-02/08/08

Amount: \$323,236.00

9/15/06

Sponsor: NORTHROP GRUMMAN CORPORATION

Title: DISS PKI/PKE Effort

Dates: 09/30/06-03/31/07

Amount: \$42,912.00

09/28/06

Sponsor: LA TROBE UNIVERSITY

Title: DPS-4 Crossed Receiver Loop Pre-amplifier

Dates: 10/15/06-10/14/07

Amount: \$4,400.00

9/28/06

ERETEC, INC.

Ionospheric Radar University - DPS-4 System for RRL



09/25/07 09/25/07

\$264,410.00

11/13/06

BALL AEROSPACE & TECHNOLOGIES CORP.

TIS Mission Pursuit

Dates: 11/01/06-03/31/07

Amount: \$9,991.00

01/30/07

Sponsor: NASA GODDARD SPACE FLIGHT CENTER

Title: Enhanced Ionospheric Topside-Sounder Science Return from Existing and Future Data

10/01/07-09/30/10

Amount: \$638,716.00

1/31/07

NATIONAL AERO AND SPACE ADMINISTRATION

Title: Distributed Intelligent Resident Archive for Expert Imagery Data Interpretations

Dates: 06/01/07-05/31/10

Amount: \$2,083,218.00

2/05/07

Sponsor: INSTITUT ROYAL METEOROLOGIQUE DE BELGIQUE

Title: DPS-4D for Institut Royal Meteorologique at Dourbes

Dates: 06/01/07-12/31/08

Amount: \$189,460.00

4/26/07

INSTITUTE OF SPACE SCIENCE MALAYSIA

Ionospheric Radio Observatory for Malaysia

Dates: 05/01/07-04/30/08

Amount: \$205,120.00

5/09/07

UNIVERSITY OF CALIFORNIA

Storm-time Plasma Redistribution in the Coupled Plasmasphere-Ionsphere System

12/01/07-11/30/10

\$119,192.00

### **FY08 Proposals (Submitted)**

7/06/07

Sponsor: VIKRAM SARABHAI SPACE CENTRE

Title: VSSC Ionospheric Observatory - DPS-4D

Dates: 09/26/07-10/15/08

Total: \$216,210.00



7/17/07

Sponsor: SRI INTERNATIONAL

Title: DPS-4D

Dates: 08/01/07-12/31/08

Total: \$229,569.00

7/17/07

Sponsor: GEOMAGNETIC INSTITUTE IN BELGRADE

Title: Ionospheric Observatory DPS-4D for Belgrade

Dates: 08/01/07-10/31/08

Total: \$196,221.00

8/01/07

Sponsor: AUSTRALIAN ANTARCTIC DIVISION

Title: Trimble GPS/RS232 Converter/30m Cable

Dates: 07/01/07 06/30/08

Total: \$1,680.00

9/05/07

Sponsor: NORTHROP GRUMMAN CORPORATION

Title: Maintenance of AN/FMQ-12 Digital Ionospheric Sounding System (DISS)

Dates: 09/01/07-03/31/08

Amount: \$350,000.00

9/10/07

Sponsor: BOSTON COLLEGE

Title: Boston College Digisonde Portable Sounder DPS-4D

Dates: 11/01/07 10/31/08

Total: \$201,620.00

9/19/07

Sponsor: DRS CODEM SYSTEMS INC.

Title: DPS-4D for Saudi Arabia

Dates: 10/01/07 09/30/09

Total: \$205,120.00

10/12/07

Sponsor: GENERAL DYNAMICS

Title: Digisonde Portable Sounder - DPS-4D

Dates: 10/15/07-10/14/09

Total: \$188,570.00

10/19/07

Sponsor: NASA GODDARD SPACE FLIGHT CENTER



Title: Multi-Satellite Coordinated Studies of Wave-Particle Interactions in the Radiation Belt Region

Dates: 04/01/08-03/30/11

Total: \$316,561.00

11/15/07

Sponsor: KOREA RADIO RESEARCH LABORATORY

Title: DPS-4D

Dates: 03/01/08 12/31/09

Total: \$231,460.00

11/21/07

Sponsor: GRINTEK EWATION

Title: DPS-4D Systems for GrinTek, South Africa

Dates: 12/01/07-11/30/09

Amount: \$485,401.00

12/10/07

Sponsor: INSTITUT RYL METEOROLOGIQUE DE BELGIQUE

Title: 16 - 4CX250R transmitting tubes

Dates: 12/01/07-11/30/08

Total: \$2,788.00

12/11/07

Sponsor: U.S. DEPARTMENT OF THE AIR FORCE

Title: DPS-4D for AFWA

Dates: 12/15/08-12/14/10

Total: \$232,980.00

1/16/08

Sponsor: NATIONAL SCIENCE FOUNDATION

Title: Space Weather: Development of Empirical Models of Ionospheric Outflow Fluxes at Polar Latitudes

Dates: 10/01/08-09/30/11

Total: \$708,859.00

1/22/08

Sponsor: DRS CODEM SYSTEMS INC.

Title: DPS Training at Center for Atmospheric Research

Dates: 12/1/07-11/30/08

Total: \$8,200.00

1/25/08

Sponsor: UNIVERSITY OF LAGOS

Title: Nigeria - DPS-4D for Ionospheric Research

Dates: 6/1/08-5/31/09

Total: \$202,170.00



2/19/08

Sponsor: ERETEC, INC.

Title: DPS-4D System for RRL Site Jeju Island, Korea

Dates: 2/1/08-1/31/10

Total: \$350,000.00

2/21/08

Sponsor: DIBRUGARH UNIVERSITY

Title: Digisonde 4D for Dibrugarh University

Dates: 3/1/08-2/28/10

Total: \$247,031.00

3/20/08

UNIVERSITY OF CALIFORNIA

Title: Storm-Time Plasma Redistribution in the Coupled Plasmasphere-Ionosphere System

Dates: 2/1/08-1/31/11

Total: \$119,191.00

5/1/08

Sponsor: ERETEC, INC.

Title: Ionospheric Radio Observatory with DPS-4D for the Icheon Branch of Radio Research Laboratory, Korea

Dates: 5/1/08-4/30/09

Total: \$285,046.00

5/1/08

NASA GODDARD SPACE FLIGHT CENTER

Title: Determining the Electron Scattering Regions Along Geomagnetic Field Lines and Their Effects on the Radiation-Belt Slot Structure

Dates: 9/1/08-8/31/12

Total: \$43,126.00

5/8/08

Sponsor: NORTHROP GRUMMAN CORPORATION

Title: DISS Maintenance FY 2008 and 2009

Dates: 6/1/08-4/15/09

Total: \$410,398.00

5/21/08

Sponsor: CHINESE ACADEMY OF SCIENCES

Title: Four-Station Radio Observatory Network with DPS-4Ds in China

Dates: 6/1/08-5/31/10

Total: \$646,520.00

6/5/08

Sponsor: PHYSICAL RESEARCH LABORATORY



Title: Ionospheric Radio Observatory - DPS-4D  
Dates: 07/01/08-06/30/10  
Total: \$204,671.00

6/5/08  
Sponsor: INSTITUTO NACIONAL DE PESQUISAS ESPACIAI  
Title: DPS-4 for Sao Luis  
Dates: 8/1/08-7/31/10  
Total: \$193,740.00

6/10/08  
Sponsor: HERMANUS MAGNETIC OBSERVATORY  
Title: Dual Transmit Balun Assembly  
Dates: 4/1/08-3/31/09  
Total: \$1000

6/18/08  
Sponsor: MINISTRY OF SCIENCE & TECHNOLOGY  
Title: Digital Ionosonde Station in Iraq  
Dates: 7/1/08-6/30/10  
Total: \$208,571.00

#### 8. Publications (Most Recent)

**Highlight:** The paper listed below by Zong et al., 2007, *Geophys. Res. Lett.* was ranked #37 of 100 Top Science Stories of 2007 by Discover magazine.

#### 2008

Abdu, M. A. A., E. R. de Paula, I. S. Batista, **B. W. Reinisch**, M. Matsuoka, P. Camargo, O. Veliz, C. M. Denardini, J. H. A. Sobral, E.A. Kherani, and P. Sequeira, Abnormal evening vertical plasma drift and effects on ESF and EIA over Brazil-South Atlantic sector during the October 30, 2003 super-storm, *J. Geophys. Res.*, doi:10.1029/2007JA012844, in press, 2008.

**Altadill, D.**, D. Arrazola, E. Blanch, and D. Buresova, Solar activity variations of ionosonde measurements modeling results, *Adv. Space Res.*, *42*, 610-616, 2008.

Batista, I. S., M. A. Abdu, A. J. Carrasco, **B. W. Reinisch**, E. R. de Paula, N. J. Schuch, and F. Bertoni, Equatorial spread F and sporadic E-layer connections during the Brazilian Conjugate Point Equatorial Experiment (COPEX), *J. Atmos. Solar Terr. Phys.*, *70*, 1133-1143, 2008

Bilitza, D., and **B. W. Reinisch**, International Reference Ionosphere 2007: Improvements and new parameters, *Adv. Space Res.*, *42*, 599-609, 2008.



- Boardsen, S. A., J. L. Green, and **B. W. Reinisch**, Comparison of kilometric continuum latitudinal radiation patterns with linear mode conversion theory, *J. Geophys. Res.*, *113*(A1), A01219, doi:10.1029/2007JA012319, 2008.
- Cao, X., Z. Y. Pu, H. Zhang, V. M. Mishin, Z. W. Ma, M. W. Dunlop, S. Y. Fu, L. Xie, C. J. Xiao, X. G. Wang, **Q.-G. Zong**, et al., Multispacecraft and ground-based observations of substorm timing and activations: Two case studies, *J. Geophys. Res.*, *113*(A7), A07S25, doi:10.1029/2007JA012761, 2008.
- Echer E., A. Korth, **Q.-G. Zong**, M. Franz, W. D. Gonzalez, F. L. Guarnieri, S. Y. Fu, and H. Reme, Cluster observations of O<sup>+</sup> escape in the magnetotail due to shock compression effects during the initial phase of the magnetic storm on 17 August 2001, *J. Geophys. Res.*, *113*(A5), A05209, doi:10.1029/2007JA012624, 2008.
- Galkin, I. A., and B. W. Reinisch**, The new ARTIST 5 for all digisondes, *INAG Bulletin*, No. 24, 2008.
- Galkin, I. A., G. M. Khmyrov, A. V. Kozlov, and B. W. Reinisch**, Intelligent resident archive for RPI Level 2 data, in *Radio Sounding and Plasma Physics, AIP Conf. Proc. 974*, 111-117, 2008.
- Galkin, I. A., B. W. Reinisch, and X. Huang**, A tribute to the ARTIST, in *Radio Sounding and Plasma Physics, AIP Conf. Proc. 974*, 34-38, 2008.
- Galkin, I. A., G. M. Khmyrov, A. V. Kozlov, B. W. Reinisch, X. Huang, and V. V. Paznukhov**, The ARTIST 5, in *Radio Sounding and Plasma Physics, AIP Conf. Proc. 974*, 150-159, 2008.
- Galkin, I. A., G. M. Khmyrov, B. W. Reinisch, and J. McElroy**, The SAOXML 5: New format for ionogram-derived data, in *Radio Sounding and Plasma Physics, AIP Conf. Proc. 974*, 160-166, 2008.
- He, J.-S., C.-Y. Tu, H. Tian, C.-J. Xiao, X.-G. Wang, Z.-Y. Pu, Z.-W. Ma, M. W. Dunlop, H. Zhao, G.-P. Zhou, J.-X. Wang, S.-Y. Fu, Z.-X. Liu, **Q.-G. Zong**, K.-H. Glassmeier, H. Reme, I. Dandouras, and C. P. Escoubet, A magnetic null geometry reconstructed from Cluster spacecraft observations, *J. Geophys. Res.*, *113*(A5), A05205, doi:10.1029/2007JA012609, 2008.
- Khmyrov, G. M., I. A. Galkin, A. V. Kozlov, B. W. Reinisch, J. McElroy, and C. Dozois**, Exploring digisonde ionogram data with SAO-X and DIDBase, in *Radio Sounding and Plasma Physics, AIP Conf. Proc. 974*, 175-185, 2008.
- Kouba, D., J. Boka, **I. A. Galkin**, O. Santolík, and P. Auli (2008), Ionospheric drift measurements: Skymap points selection, *Radio Sci.*, *43*(1), RS1S90, doi:10.1029/2007RS003633, 2008.



- Kozlov, A. and V. V. Paznukhov**, Digisonde drift analysis software, in *Radio Sounding and Plasma Physics, AIP Conf. Proc. 974*, 167-174, 2008.
- Krause, L. H., R. Balthazor, M.G. McHarg, and **B.W. Reinisch**, Development of a campaign to study equatorial ionospheric phenomena over Guam, *Adv. Space Res.*, *42*, 791-796, 2008.
- Lee, C. C. and **B. W. Reinisch**, Quiet-time variations of F2 layer parameters at Jicamarca and comparison with IRI-2001 during solar minimum, *J. Atmos. Solar Terr. Phys.*, *70*, 184–192, 2008.
- Lei, J., W. Wang, A. G. Burns, S. C. Solomon, A. D. Richmond, M. Wiltberger, L. P. Goncharenko, A. Coster, and **B. W. Reinisch**, Observations and simulations of the ionospheric and thermospheric response to the December 2006 geomagnetic storm: Initial phase, *J. Geophys. Res.*, *113*(A1), A01314, doi:10.1029/2007JA012807, 2008.
- McNamara, Leo F., John M. Retterer, M.A. Abdu, Inez S. Batista, and **Bodo W. Reinisch**, F2 Peak parameters, drifts and spread F derived from digisonde ionograms for the COPEX campaign in Brazil, *J. Atmos. and Solar-Terr. Phys.* *70* (2008) 1144–1158.
- Nsumei, P. A., B. W. Reinisch, P. Song, J. Tu, and X. Huang**, Polar cap electron density distribution from IMAGE radio plasma imager measurements: Empirical model with the effects of solar illumination and geomagnetic activity, *J. Geophys. Res.*, *113*(A1), A01217, doi:10.1029/2007JA012566, 2008.
- Nsumei, P. A., P. Song, B. W. Reinisch, J. Tu, and X. Huang**, Ionospheric electron upflow in the polar cap region: Derived from ISIS 2 measurements, *J. Geophys. Res.*, *113*(A3), A03312, doi:10.1029/2007JA012567, 2008.
- Reinisch, B. W., I. A. Galkin, G. M. Khmyrov, A. V. Kozlov, I. A. Lisysyan, K. Bibl, G. Cheney, D. Kitrosser, S. Stelmash, K. Roche, Y. Luo, V. V. Paznukhov, and Ryan Hamel**, Advancing digisonde technology: the DPS-4D, in *Radio Sounding and Plasma Physics, AIP Conf. Proc. 974*, 127-143, 2008.
- Reinisch, B. W., V. V. Paznukhov, I. A. Galkin, D. Altadill, and J. McElroy**, Precise radar range measurements with digisondes, in *Radio Sounding and Plasma Physics, AIP Conf. Proc. 974*, 144-149, 2008.
- Tu, J., P. Song, and B. W. Reinisch**, On the concept of penetration electric field, in *Radio Sounding and Plasma Physics, AIP Conf. Proc. 974*, 81-85, 2008.
- Tu, J., P. Song, and B. W. Reinisch**, Plasma sheath structures around a radio frequency antenna, *J. Geophys. Res.*, doi:10.1029/2008JA013097, in press, 2008.

Zhang, H., **Q.-G. Zong**, T. A. Fritz, S. Y. Fu, S. Schaefer, K. H. Glassmeier, P. W. Daly, H. Rème, and A. Balogh, Cluster observations of collisionless Hall reconnection at high-latitude magnetopause, *J. Geophys. Res.*, *113*(A3), A03204, doi:10.1029/2007JA012769, 2008.

**Zong, Q.-G., B. W. Reinisch, P. Song, I. Galkin**, and X.J. Liu, Ionospheric Response to the Interplanetary Shock, in *Radio Sounding and Plasma Physics, AIP Conf. Proc. 974*, 52-57, 2008.

**Zong, Q.-G.**, H. Zhang, and T. A. Fritz, Multiple cusps during an extended northward IMF period with a significant  $B_y$  component, *J. Geophys. Res.*, *113*(A1), A01210, doi:10.1029/2006JA012188, 2008.

## 2007

Carpenter, D. L., T. F. Bell, D. Chen, D. N. C. Baran, **B. W. Reinisch**, and I. **Galkin**, Proton cyclotron (PC) echoes and a new resonance observed by the RPI instrument on the IMAGE satellite, *J. Geophys. Res.*, *112*(A8), A08208, doi:10.1029/2007JA012139, 2007.

Lee, C. C. and **B. W. Reinisch**, Quiet-condition variations in the scale height at F2-layer peak at Jicamarca during solar minimum and maximum, *Ann. Geophys.*, *25*, 2541–2550, 2007.

Lui, A. T. Y., M. W. Dunlop, H. Rème, L. M. Kistler, G. Gustafsson, **Q.-G. Zong**, Internal structure of a magnetic flux rope from Cluster observations, *Geophys. Res. Lett.*, *34*(7), L07102, doi:10.1029/2007GL029263, 2007.

McNamara, L. F., D. L. Cooke, C. E. Valladares, and **B. W. Reinisch**, Comparison of CHAMP and Digisonde plasma frequencies Jicamarca, Peru, *Radio Sci.*, *42*, RS2005, doi:10.1029/2006RS003491, 2007.

Osherovich, V. A., R. F. Benson, J. Fainberg, J. L. Green, L. Garcia, S. Boardsen, N. Tsyganenko, and **B. W. Reinisch** (2007), Enhanced high-altitude polar-cap plasma and magnetic-field values in response to the interplanetary magnetic cloud that caused the great storm of 31 March 2001: A case study for a new magnetospheric index, *J. Geophys. Res.*, *112*(A6), A06247, doi:10.1029/2006JA012105.

**Paznukhov, V. V., B. W. Reinisch, P. Song, X. Huang**, T. W. Bullett and O. Veliz, Formation of an F3 layer in the equatorial ionosphere: A result from strong IMF changes, *J. Atmos. Solar-Terr. Phys.*, *69*, 10-11, 1292-1304, 2007.

**Reinisch, B.**, D. Bilitza, and D. Altadill (Ed.), New satellite and ground data for IRI and comparison with regional Models, *Adv. Space Res.*, *39*, 5, 639-980 (2007).

**Reinisch, B. W., P. Nsumei, X. Huang,** and D. K. Bilitza, Modeling the F2 topside and plasmasphere for IRI using IMAGE/RPI, and ISIS data, *Adv. Space Res.*, 39, 731-738, 2007.

**Song, P., B. W. Reinisch, V. Paznukhov, G. Sales, D. Cooke, J.-N. Tu, X. Huang, K. Bibl, and I. Galkin,** High-voltage antenna-plasma interaction in whistler wave transmission: Plasma sheath effects, *J. Geophys. Res.*, 112(A3), A03205, doi:10.1029/2006JA011683, 2007.

Triskova, L., **I. Galkin,** V. Truhlik and **B.W. Reinisch,** Application of seamless vertical profiles for use in the topside electron density modeling, *Adv. Space Res.*, 39, 774-778, 2007.

**Tu, J., P. Song, B. W. Reinisch,** and J. L. Green, Smooth electron density transition from plasmasphere to the subauroral region, *J. Geophys. Res.*, 112(A5), A05227, doi:10.1029/2007JA012298, 2007.

**Tu, J.-N., M. Dhar, P. Song, B. W. Reinisch,** J. L. Green, R. F. Benson, and A. J. Coster, Extreme polar cap density enhancements along magnetic field lines during an intense geomagnetic storm, *J. Geophys. Res.*, 112(A5), A05201, doi:10.1029/2006JA012034, 2007.

Wang, J., M. W. Dunlop, Z. Y. Pu, X. Z. Zhou, X. G. Zhang, Y. Wei, S. Y. Fu, C. J. Xiao, A. Fazakerley, H. Laakso, M. G. G. T. Taylor, Y. Bogdanova, F. Pitout, J. Davies, **Q. G. Zong,** C. Shen, Z. X. Liu, C. Carr, C. Perry, H. Rème, I. Dandouras, P. Escoubet, C. J. Owen, TC1 and Cluster observation of an FTE on 4 January 2005: A close conjunction, *Geophys. Res. Lett.*, 34(3), L03106, doi:10.1029/2006GL028241, 2007.

Wang, X., R. Eastes, **B. W. Reinisch,** S. Bailey, C. E. Valladares, T. Woods, Short-term relationship between solar irradiances and equatorial peak electron densities, *J. Geophys. Res.*, 112(A6), A06310, doi:10.1029/2007JA012128, 2007.

Xiao, C. J., Z. Y. Pu, X. G. Wang, Z. W. Ma, S. Y. Fu, T. D. Phan, **Q. G. Zong,** Z. X. Liu, M. W. Dunlop, K.-H. Glassmeier, A. Balogh, H. Rème, I. Dandouras, C. P. Escoubet, A Cluster measurement of fast magnetic reconnection in the magnetotail, *Geophys. Res. Lett.*, 34(1), L01101, doi:10.1029/2006GL028006, 2007

Zhang, H., M. W. Dunlop, **Q.-G. Zong,** T. A. Fritz, A. Balogh, and Y. Wang, Geometry of the high-latitude magnetopause as observed by Cluster, *J. Geophys. Res.*, 112(2), A02204, doi:10.1029/2006JA011774, 2007.

Zhang, H., Z. Y. Pu, X. Cao, S. Y. Fu, Z. X. Liu, Z. W. Ma, M. W. Dunlop, W. Baumjohann, C. J. Xiao, M. H. Hong, J. B. Cao, **Q. G. Zong,** X. G. Wang, C. Carr, H. A. Rème, I. Dandouras, A. Fazakerley, H. U. Frey, C. P. Escoubet, TC-1



observations of flux pileup and dipolarization-associated expansion in the near-Earth magnetotail during substorms, *Geophys. Res. Lett.*, *34*(3), L03104, doi:10.1029/2006GL028326., 2007.

Zhou, X. Y., Z. Y. Pu, **Q.-G. Zong**, and L. Xie, Energy filter effect for solar wind particle entry to the plasma sheet via flank regions during southward IMF, *J. Geophys. Res.*, *112*(A6), A06233, doi:10.1029/2007J6012180, 2007.

**Zong, Q.-G.**, X.-Z. Zhou, X. Li, **P. Song**, S. Y. Fu, D. N. Baker, Z. Y. Pu, T. A. Fritz, P. Daly, A. Balogh, and H. Réme, Correction to Ultralow frequency modulation of energetic particles in the dayside magnetosphere, *Geophys. Res. Lett.*, *34*(17), L17106, doi:10.1029/2007GL031342, 2007.

**Zong, Q.-G.**, S. Y. Fu, D. N. Baker, M. L. Goldstein, P. Song, J. A. Slavin, T. A. Fritz, J. B. Cao, O. Amm, H. Frey, A. Korth, P. W. Daly, H. Reme, and A. Pedersen, Earthward flowing plasmoid: Structure and its related ionospheric signature, *J. Geophys. Res.*, *112*(A7), A07203, doi:10.1029/2006JA012112, 2007.

**Zong, Q. G.**, X.-Z. Zhou, X. Li, P. Song, S. Y. Fu, D. N. Baker, Z. Y. Pu, T. A. Fritz, P. Daly, A. Balogh, and H. Reme, Ultra-low frequency modulation of energetic particles in the dayside magnetosphere, *Geophys. Res. Lett.*, *34*(12), L12105, doi:10.1029/2007GL029915, 2007.



## 9. Conference Presentations

### 2008

#### GEM Workshop – 22-26 June 2008 – Midway, UT

- IMAGE RPI Observations of Plumes on Open Field Lines, J. Tu
- Recovery Phase Plasmasphere: Smooth Transition from Plasmasphere to Subaural Region, J. Tu
- What is the Magnetospheric Driver of the Ionosphere, P. Song

#### AOGS – 16-20 June – Busan, Korea

- Magnetospheric and Ionospheric response to Interplanetary Shock, Q.-Z. Zong
- Oxygen ions dominate BBFs in the magnetotail, Q.-Z. Zong

#### Spring AGU Meeting - 27–30 May 2008 – Ft. Lauderdale, FL

- Energetic electron response to ULF waves in the inner magnetosphere, Q.-G. Zong

#### Ionospheric Effects Symposium – Alexandria, VA – 12-15 May 2008

- Advancing Digisonde Technology: the Digisonde 4D, B. W. Reinisch, I. A. Galkin, and G. Khmyrov
- Uncertainty and Confidence of Ionospheric Specifications with the Digisonde ARTIST-5 Ionogram Autoscaler, Ivan Galkin, Bodo Reinisch, Xueqin Huang, and Vadym Paznukhov
- Far field of linear antennas in an anisotropic plasma, X. Huang, B. W. Reinisch, P. Song, and G. Ginet
- Dayside Ionospheric Response to the Intense Interplanetary Shock with Northward and/or Southward IMF, Q.-G. Zong, B. W. Reinisch, P. Song, I. Galkin and X. Huang

#### Workshop - The Remediation of Enhanced Radiation Belts, Lake Arrowhead, California - March 3 -6, 2008

- Near-field Modeling for VLF Antennas in Space, P. Song
- Far-field Modeling for VLF Antennas in Space, X. Huang
- RPI/IMAGE Radiation Experiment, G. Sales

#### DPG Freiburg CAWSES Symposium – 3-7 March 2008 – Freiburg, Germany

- Precise measurements of E layer heights. A campaign for the COST296/IHY activities, Bodo Reinisch, David Altadill, Vadym Paznukhov

#### Conference on Sun-Earth Connection: Multiscale Coupling in Sun-Earth Processes Event Details - Kona, Hawaii – 9-13 February 2008

- Energetic electrons modulated by ULF waves, Q.-G. Zong



2008 USNC/URSI National Radio Science Meeting – 3-6 January 2008 – University of Colorado at Boulder

- A high-accuracy HF technique to measure E layer heights, B. W. Reinisch and V. Paznukhov

**2007**

Fall AGU Meeting – 10-14 December 2007 – San Francisco, CA

- Comparison of ionospheric profiles derived with radio occultation technique to the Digisonde data, B. W. Reinisch and V. Paznukhov
- Magnetosphere-Ionosphere/thermosphere Coupling: Self-consistent Solutions for a 1-D Stratified Ionosphere in 3-fluid Theory, P. Song, V. M. Vasyliūnas, and X. Zhou
- Response of polar magnetospheric density to high solar wind dynamic pressure, J. Tu, P. Song, B. W. Reinisch
- Observations of Magnetospherically Reflected (MR), Specularly Reflected (SR), and Back Scattered (BS) Whistler Mode (WM) Echoes Observed by Radio Plasma Imager (RPI) on IMAGE: Diagnostics of Electron Density, Density Structure, and Ion Composition, V. S. Sonwalkar, A. Reddy, D. L. Carpenter, R. F. Benson, and B. W. Reinisch
- Occurrence Pattern of WM Echoes Observed by RPI/IMAGE as a Function of Geomagnetic Activity, A. Reddy, V. S. Sonwalkar, D. L. Carpenter, R. F. Benson, and B. W. Reinisch
- Comparison of polar cap electron density enhancement due to solar illumination and geomagnetic activity as measured by IMAGE/RPI, P. A. Nsumei, B. W. Reinisch, P. Song, J. Tu and X. Huang
- An Inner-Magnetospheric Electron Density Database Determined from IMAGE/RPI Passive Dynamic Spectra, Phillip A Webb, Robert F Benson, Richard E Denton, Jerry Goldstein, Leonard N Garcia, Bodo W. Reinisch

Space-based Ionosphere Thermosphere Research, NSF Symposium – 17-19 October 2007 – Manhattan Beach, CA

- Space-based sounders using modern technology, B. W. Reinisch

[Asia Oceania Geosciences Society \(AOGS\) 4th Annual Assembly – 30 July-4 August 2007 - Bangkok](#)

- Unusually Intense Vertical Plasma Drifts of the Evening Equatorial Ionosphere over Brazil during the October 2003 super storm, M. Abdu, I. Batista, J. A. Sobral, B. W. Reinisch

URSI 2007 - 22-26 July 2007 - Ottawa, Canada

- Energetic Particle Modulation by Waves in the Radiation Belt, Q. Zong, B. Reinisch, P. Song, X-Z. Zhou, X. Li
- Simulation Study of Antenna-Plasma Interaction in Space Plasma, J. Tu, P. Song, B. W. Reinisch, and X. Huang



- Radiation patterns of linear antennas in an anisotropic plasma, X. Huang, B. W. Reinisch, Paul Song, and G. Ginot

Spring 2007 Joint Assembly (AGU) - 22-25 May 2007, Acapulco Mexico

- A campaign to study equatorial ionospheric phenomena over Guam, L. Krause, R. Balthazar, M. Dearborn, C. L. Enloe, T. Lawrence, M. G. McHarg, D. Petrash, B. W. Reinisch, and T. Stuart
- Ionospheric electron upflow along open field lines: Derived from ISIS 2 measurements, P. Nsumei, P. Song, B. W. Reinisch, J. Tu, and X. Huang
- TOPLA: A new empirical representation of the F-region topside and plasmasphere for the International Reference Ionosphere, D. Bilitza, B. Reinisch, D. Gallagher, X. Huang, V. Truhlik, and P. Nsumei

EGU 2007 – 15-20 April 2007 - Vienna, Austria

- A global plasmasphere electron density database determined from IMAGE RPI dynamic spectra, P. Webb, R. Benson, R. Denton, J. Goldstein, L. Garcia, and B. W. Reinisch
- Modeling the Polar Cap Topside Ionosphere, B. W. Reinisch, B., P. Nsumei, P. Song, and X. Huang

Sanya, Hainan, China – 17 January 2007

- Smooth Electron Density Transition from the Plasmasphere to the Sub-Auroral Region, J. Tu, P. Song, and B. W. Reinisch

AGU Chapman Conference – 3-6 January 2007 – Yosemite, CA

- Study of mid-latitude geomagnetic storms using Digisonde network data, V. V. Paznukhov, D. Altadill, B. W. Reinisch, and G. S. Sales

10. Collaboration with other Centers/Institutes and/or Departments

11. Regional/Local Outreach (Other Institutes of Higher Education, Industries, Government Agencies, schools, etc.)



## 05. CENTER FOR BIOGRADABLE POLYMER RESEARCH AT UML

### **Mission Statement**

The Biodegradable Polymer Research Center (BPRC) functions to carry out exploratory and fundamental research for the development of new technologies in degradable plastic materials. The goal of this work is to obtain suitable materials, which are inherently degradable in nature as well as being environmentally benign. To realize this objective, the BPRC has been organized to merge expertise in microbial production of polymeric materials, organic transformations, plastics processing, materials characterization, and environmental engineering. The BPRC fosters a broad and active cooperation with industry, which ensures a fast transfer of new methods and technologies. The Center activities are expected to be of great importance to the future economic as well as environmental health of the commonwealth.

The mission and major purpose of the University of Massachusetts Lowell are to provide to students an affordable education of high quality and to focus some of its scholarship and public service on assisting sustainable regional and economic and social development.

### **General Description and Goals**

The NSF Biodegradable Polymer Research Center has been transformed over the past few years to a focus on industrial partnerships. These partnerships have enabled the BPRC to better serve the individual needs of the companies while also protecting the intellectual property that is developed at the BPRC. These partnerships are developed around novel technologies which are either developed or enhanced at the research center. The Center's University personnel presents a review of the research progress to each of the sponsors individually. These review meetings include oral presentations and written reports. Review meetings are held at the University of Massachusetts Lowell and are attended by member companies, student affiliates, and Institute professional staff.

Faculty members recognize the need to assist industry in developing techniques and teaching skills required to keep the American plastics industry competitive in future decades. To meet this challenge the department has been active in soliciting research projects from industry and from the state.

The University of Massachusetts Lowell is uniquely qualified to produce research results and helping member companies gain a competitive edge.

### **Research Focus Areas**

#### *MATERIAL SYNTHESIS*

#### *Microbial Synthesis of Biopolymers*



Identification of new microorganisms and fermentation methods to develop novel materials derived from renewable resources. Microbial nylons, polyesters and polysaccharides are under investigation.

### ***Organic Synthesis***

Synthetic analogues of biopolymers are being synthesized as models to establish relationships between polymer structure, morphology, properties, and degradability. Polysaccharide modification to alter their physical and biological properties. Novel degradable polymers by classical chemical approaches. Interfacial agents for biodegradable blend systems.

## ***PROCESSING AND BLENDING***

### ***Polymer Blends***

The blending of biodegradable components to vary properties and biodegradability. Single screw extrusion, twin screw extrusion, and solvent mixing are being used to vary phase domain size to study the effects on properties and biodegradability. The effect of miscibility and blend morphology on biodegradability.

### ***Processing***

Sheet and blown film extrusion and co-extrusion, extrusion coating, injection molding, compression molding, and solvent casting. Reactive processing of blends and hydrogels. Processing of polysaccharides.

## ***DEGRADATION TESTING AND ENVIRONMENTAL ENGINEERING***

### ***In-Lab Accelerated Simulations***

Controlled aerobic (compost conditions) and anaerobic (optimized landfill conditions) bioreactors are used to evaluate plastics degradation kinetics. The effect of environmental parameters on the biodegradation kinetics. Providing the ASTM with Lowell testing procedures for the development of standard methods. Participation with other ASTM members in the evaluation of present ASTM degradation testing protocols.

### ***Microbial Isolates***

Isolation of microorganisms active in environmental polymer degradation. Purification and characterization of enzymes active in polymer degradation. Determination of polymer degradation kinetics and the products formed using pure cultures and enzymes.

### ***Environmental Engineering***

A program which seeks to integrate current and experimental methods in solid waste management where plastics are viewed as a potentially degradable component of the municipal solid waste system.

## ***CHARACTERIZATION***

## ***AND***

## ***MODELING***

Measurements and effects of crystallinity, orientation, and stress on biodegradation. Sorption, diffusion, and surface analysis and relationships to biodegradability. Control and prediction of molecular weight and effects on biodegradability.

## **Associated Personnel**

### ***DIRECTOR***



Dr. Stephen McCarthy  
Professor, Plastics Engineering, Univ. of Massachusetts Lowell

## ***ASSOCIATE DIRECTORS***

Dr. Steven Goodwin, Professor Microbiology University of Massachusetts Amherst

### ***TECHNICAL COLLABORATORS***

Dr. Carl Lawton, Professor, Chemical Engineering

Dr. Robert Nicolosi, Professor, Clinical Life Sciences, University of Mass. Lowell

### **Students Supported**

#### **Current Graduate Student Researchers**

Ms. Qin Li

Mr. Yanir Shaked

Mr. Abhishek P. Ambekar

Mr. Aditya Bhoite

Ms. Renuka Bhoyar

Mr. Rahul Daga

Mr. Sunny Gupta

Ms. Amruta Kadam

Mr. Pranav P. Kukade

Mr. Hemantkumar Patel

Mr. Jayesh Patel

Mr. Rahul Reddy

Mr. Bhavin Shah

Mr. Dhaval Shah

Mr. Nitin Sood

Mr. Lior Zonder

#### **Research Professor**

Mr. Jinkoo Lee

#### **Current Research**

Metabolix, Development of Novel Blends and Processing Techniques for Polhydroxyalkanoates, 560,433.00

Metabolix, Novel Blends and Processing Techniques (project 2), \$80,000.00

Metabolix, PHA Bioplastic Packaging Films and Foams (project 3), \$45,000.00

Metabolix, Blow Molded PHA Bioproducts (Project 4), \$20,000.00

Advanced Electron Beams, Low Energy Industrial Electron Beams on Polymeric and Plastic Materials, \$20,000.00

Invista, Evaluation of Plasticizers, \$18,000.00

Densified Solutions LLC, Extrusion Testing, \$5,000.00



### **Publications**

- “Derivatization of Polysaccharides Using Microwave Radiation as the Energy Source”, Stephen McCarthy, Balint Koroskenyi, **pending**
- “The effect of polymer surface on the wetting and adhesion of liquid systems”, P.F. Rios, H. Dodiuk, S. Kenig, A. Dotan, *Journal of Adhesion Science and Technology* (2007), 21(3-4), 227-241
- “Transparent ultra-hydrophobic surfaces”, P. F. Rios, H. Dodiuk, S. Kenig, A. Dotan, *Journal of Adhesion Science and Technology* (2007), 21(5-6), 399-408. CODEN: JATEE8 ISSN:0169-4243.
- “Improving the Toughness of Poly(Lactic acid)(PLA) through Co-continuous, Immiscible, Biodegradable Blends” with Jinkoo Lee & Robert Whitehouse, SPE ANTEC, May 2008
- Wenguang MA, “Co-continuous, immiscible and biodegradable polymer blends of polylactic Acid (PLA) and polysuccinate”, 2007 thesis
- Jinkoo Lee, Improving the toughness of poly(Lactic Acid) (PLA) through co-continuous, immiscible, biodegradable blends with PHA, 2007 thesis

### **Conference Presentations**

- SPE ANTEC Structures and Properties, Milwaukee, WI, May 2008
- Society of Plastics Engineers Annual Technical Conference, Cleveland, OH, May 2007.

#### **Collaboration with other Centers/Institutes and/or Departments**

- "Biodegradable Polymers and Blends", Plastics Engineering Industrial Seminars, University of Lowell, Continuing Education
- Nanomanufacturing Center of Excellence
- Robert Nicolosi, Clinical Life Sciences, University of Mass. Lowell
- Thomas Shea, Biology Department, University of Massachusetts
- Edwin Jahngen, Department of Chemistry

### **Regional/Local Outreach**

- Metabolix technology licensing agreement, U S Patent No. 5,883,199

### **Proposals submitted**

- Biodegradable Hollow Nanospheres
- Massachusetts Institute of Technology, Exploring the Application of Functionalized Nanospheres for Pb Removal



## Annual Report 2007-2008

**Georges Grinstein  
Ken Marx  
Co-Directors**

### **Mission Statement of the Center**

The purpose of the **Center for Biomolecular and Medical Informatics** at the University of Massachusetts is to provide a much needed regional and national resource focused on Biomedical Computation, which includes Bioinformatics, Cheminformatics, Medical Informatics, Computational Biology and Computational Chemistry, for companies in the Biotechnology, Genomics, Drug Discovery, Computer Software and Hardware development. This focus will enhance the collaborative development of industrial and government partnerships with the University of Massachusetts.

The Mission of this UMass Lowell Center is to provide a scientifically excellent, enriched, and practical educational experience for undergraduate and graduate students aspiring to work in the area of biomedical computing, computational molecular biology and the new fields of bioinformatics and cheminformatics.

### **General Description and Goals**

The two major activities of the Center are training a future workforce in the above areas at the undergraduate and graduate level and to create and participate in joint industry/university research projects. The training of Bioinformatics and Cheminformatics graduate students and the research undertaken with industry partners will be done in close conjunction and with input from Industrial partners through the Center's Advisory Board. The students will work within the existing UMass Bachelors, Masters and Doctoral programs of Bioinformatics and Cheminformatics in Computer Science as well as the independent department programs in Bioinformatics (Biology Department), Cheminformatics (Chemistry Department), and Computational Sciences (Mathematics Department). The research will harness the current strengths of Center faculty and students as well as draw from the best personnel from other Universities through visiting scholars, post-doctoral students, and external faculty positions. State of the Art equipment and software is available for training and research to participants (students, faculty and researchers).

A number of other activities, including formal and informal training of company personnel in the area of bioinformatics and the identification and implementation of research projects for individual sponsoring companies is also envisioned.



The Center is also involved in outreach to high schools and community colleges to make them aware of the excellent and broad bioinformatics program available at the University.

### **Research Focus Areas**

The Center's focus areas are the integrated applications of the various disciplines of Biology, Chemistry, Computer Science, and Mathematics to Bioinformatics and Cheminformatics (data management, analysis, and exploration) and Computational Molecular Biology and Chemistry. This focus has important implications in two areas: first for mining the increasingly large databases produced by medical, health and drug files; and second for the current and evolving paradigm of drug discovery in the pharmaceutical industry which provides a more fundamental molecular view of how organisms utilize the information contained in their DNA to carry out biological function. The Center's strengths come from its current faculty and its program that currently include the integration of disparate distributed databases, parallel and high performance algorithms, computational geometry, high dimensional visualization, and data mining. These computational techniques are being applied to large datasets, including DNA, gene expression and protein structure databases. The Center provides its researchers and students access to the latest collection of hardware and software systems in use in the biomedical computation areas.

#### *Associated Personnel*

##### Co-Directors

Dr. Georges Grinstein

Dr. Ken Marx

Faculty from the Departments of Biology, Chemistry, Computer Science, and Mathematics, along with external collaborators are involved in research problems at the Center. Our intent is to increase the participating faculty by identifying individuals whose expertise complements our own and who are interested in the various Bioinformatics problems. The Center will invite and have on staff both Distinguished Visiting Faculty and Postdoctoral Fellows whose expertise lies within areas of interest to our industrial partners as expressed through the grants and contracts coming through the Center. Currently, the list includes the following personnel

- Dr. Karen Daniels (computational geometry, data mining)
- Dr. Georges Grinstein (visualization, data mining)
- Dr. Haim Levkowitz (visualization, internet and web, color theory)
- Dr. Gary Livingston (data mining, databases)
- Dr. Lee Jones (mathematical modeling, statistics)
- Dr. Alex Gee (visualization and user interfaces)

##### **Students Supported**

- Jianping Zhou (Sc.D. August 2007) Bioinformatics Visualization and Data Mining (Dr. Zhou has worked with the SensAble project, the UVP platform, and microarray data)



- Mary Beth Smrtic (Ph.D. expected 2009) Web-Based Visual Analysis (Biomedical Engineering Doctoral Program) (Ms. Smrtic has worked with the Umass Medical School, Mass General Hospital, and works with data on the homeless).
- John Sharko (Sc.D. expected 2009) High dimensional visualizations of microarray data (Mr. Sharko has worked with the SensAble project, DARPA's Limb regeneration project, The Pfizer Drug Discovery Project, and the MGH project)
- Amr Elbasiony (Sc.D. expected 2009) Human tissue characterization using imaging, visualization and vision.
- Brian Drohan (Ph.D. expected 2009), Architectures and Visualization for Electronic Health Records. (Mr. Drohan has been working on the MGH project and focused on risk analysis for breast cancer and visualizations for physicians)
- Shawn Konecni (Ph.D. expected 2010), High Dimensional Optimization for Drug Discovery (Mr. Konecni has been working on computational and visual tools).

Several new bioinformatics students have joined the lab (some in the Computer Science Sc.D. program, some in the Biochemistry Ph.D. program and some in the BMET Ph.D. program). Two juniors from CS and one sophomore from Business worked in the lab this summer.

### **Current Research Projects**

#### **MGH (Funded: 7/06-12/08)**

MGH Avon Breast Cancer Center has awarded Dr. Grinstein funds to explore and mine the Avon Breast Cancer patient database, create a new risk model, and develop new pedigree visualizations that support both the family physician as well as clinicians in their diagnosis and determination of how to proceed with different levels of risk.

#### **DARPA (Funded to Ken Marx: 7/06-6/08)**

We are working with Dr. Marx on analyzing initially newt and more recently mice gene expression microarray data to identify genes involved in limb regeneration.

#### **PFIZER (Funded: 01/08-12/09)**

We are working with Dr. Marx on analyzing optimization techniques with high-dimensional visualizations to help select the next leads in the drug discovery process.

### **Publications**

Ozanne, E. M., Sharko J., Drohan B., Grinstein G., and K. S. Hughes, Identification and Management of Women at High Risk through Automated Natural Language Processing (NLP) of Pathology Reports, Submitted to the San Antonio Breast Cancer Symposium, 2008.

Ozanne, E. M., Loberg, A., Hughes S., Lawrence C., Drohan B., Semine A., Jellinek M., Cronin C., Milham F., Dowd D., Block C., Lockhart D., Sharko J., Grinstein G., and K. S.



Hughes, Identification and Management of Women at High Risk for Hereditary Breast/Ovarian Cancer Syndrome, *The Breast Journal* (2008), in press.

Sharko, J., Grinstein G., and K. Marx, Vectorized RadViz and Its Application to Multiple Cluster Datasets, accepted for the IEEE 2008 Visualization Conference.

Drohan B., , Lawrence C., Euhus D., Gadd, M. Grinstein G., Hughes, K., Hughes, S., Javid, S. Sharko S., Kopans, D.; Lee, J., Moore, R., Rafferty, E., Roche, C., Smith, B., and M. Specht, The American Cancer Society Guidelines for Breast Screening with MRI: An Argument for Genetic Testing, Submitted to the *Journal of Cancer* (2008)

Tagne, J.B. Kakumanu S., Konecni S., Workman C., Gupta S., Love J., Ortiz D., Grinstein G., Shea T., Volkert T., Young R. A., and R. J. Nicolosi<sup>1</sup> (2008), Molecular Mechanisms of the Chemopreventive Effect of the Nano-emulsion Anti-Cancer Drug Tamoxifen on Human HTB-20 Breast Cancer Cells, submitted to *Cancer Research*.

Marx, K., Sharko, J., Grinstein, G., Odelberg, S., Simon, H. (2007), Evidence for Proximal to Distal Appendage Amputation Site Effects from Global Gene Expression Correlations Found in Newt Microarrays, *Proceedings of the IEEE 7th International Symposium on Bioinformatics and BioEngineering*, Harvard Medical School, Boston MA, pp 456-463, October 14-17, 2007

Sharko, J., Grinstein, G., Marx, K. A., Zhou, J., Cheng, C., Odelberg, S., and H. Simon (2007), Heat Map Visualizations Allow Comparison of Multiple Clustering Results and Evaluation of Dataset Quality: Application to Microarray Data, *Proceedings of the 11th international Conference Information Visualization (July 04 - 06, 2007)*. IV. IEEE Computer Society, Washington, DC

M.L. Ujwal, ML, Hoffman, P and Marx, KA, (2007) A Machine Learning Approach to Pharmacological Profiling of the Quinone Scaffold in the NCI Database: Effective Against Melanoma and Leukemia Cell Lines, *Proceedings of the IEEE 7th International Symposium on Bioinformatics and BioEngineering*, Harvard Medical School, Boston MA, pp 131-136, October 14-17, 2007.

For other CS related publications see the IVPR 2007-2008 report

### **Conference Presentations**

Numerous presentations at meetings of the IEEE, CBSE, ICDE, CHI, IBC, DDT, BioIT, and at Universities and Labs, including a keynote talk at the Pfizer Global Summit in the UK

### **Tutorials and Workshops:**

Numerous presentations, both tutorials and workshops, at many conferences



## **Collaborations**

Institute for Visualization and Perception Research  
Department of Biological Sciences  
Department of Chemistry  
Mass General Hospital  
Newton-Wesley Hospital  
Pfizer Drug Discovery

## **Regional/Local Outreach**

BioIT and are the two groups we have focused on joint presentations through tutorials and workshops. These have been fruitful in establishing contacts. The current MGH collaboration came from one of these presentations. Several presentations were done jointly with Dr. Peter Henstock, Pfizer and Dr. Liebman, Director Windber Research Institute..

We made numerous presentations to high schools and community colleges on the bioinformatics program to help increase the number of students and minorities joining the program.

## **Proposals Submitted/Awarded**

### **Awarded**

MGH, 07/07 – 07/09, additional funding  
PI: Dr. Georges Grinstein  
Continued research in breast cancer risk assessment

Pfizer, 01/08 – 01/10. \$150,000  
PI: Dr. Georges Grinstein  
High-dimensional visualization of drug discovery data

DARPA, 07/08 -08/08, \$75,000  
PI: Dr. Ken Marx  
Microarray Analysis of Limb Regeneration Systems



## 07. THE CENTER FOR CELLULAR NEUROBIOLOGY AND NEURODEGENERATION RESEARCH

### 1. Mission Statement

The Center for Cellular Neurobiology and Neurodegeneration Research seeks to understand the basic mechanisms that maintain neuronal health, and how errors in these processes lead to neuronal degeneration, with particular attention towards delaying or preventing the progression of Alzheimer's disease and motor neuron disease. In addition to testing of pharmacological agents effective against Alzheimer's disease, our efforts include the development of inexpensive, vitamin- and nutraceutical-based, consumable formulations that can delay the progression of neurodegeneration.

### 2. General Description

The Center consists of laboratories in Olsen and Weed Hall, with its primary location in 605 Olsen.

### 3. Research Groups and Activities Focus Areas

Our research, along with that of other laboratories, suggests that chronic neurodegenerative conditions such as Alzheimer's disease are the result of several factors, including environmental, nutritional and genetic predispositions (and perhaps more than one of each category). This renders analyses and developments of treatments particularly difficult. We utilize several model systems in efforts to identify various enzymes and genes that may contribute to neurodegeneration, including:

- transgenic mice whose genomic profile mimics that of individuals at risk for Alzheimer's or Parkinson's disease
- neurons maintained outside of the brain in culture interfaced with computers for stimulation and recording
- identified neurons within the brain

We subject these models to defined treatments and/or deficient diets that provoke neurodegeneration, and attempt to intervene with this neurodegeneration by vitamin or drug supplements.

Our more recent University- and CFCI-supported studies have involved clinical trials with early- to mid-stage Alzheimer's disease and normal adults/seniors.

Affiliated Faculty of the Center each direct their own research programs. As a result of our respect diverse expertise and interests, our collaborations bring unique approaches to neuroscience. Undergraduate and graduate students are involved in all Center research projects, and this is considered a key mission of the Center.

### 4. Associated Personnel

#### Director

Thomas B. Shea, Ph.D. (Neurobiology and Neurodegeneration)

#### Associate Directors

Garth Hall, Ph.D. (Neurobiology and Neurodegeneration)  
Robert Nicolosi, Ph.D. (Chronic Diseases, Cardiovascular Disorders, Nutrition)  
Eugene Rogers, Ph.D. (Antioxidants, Toxicology, Nutrition)  
Ruth Remington (Nursing, Clinical Trials)  
Michael Graves, Ph.D. (Genomics, recomb DNA)  
Deane Falcone, Ph.D. (Genetic Engineering of Plants to produce Nutraceuticals)

#### Affiliated Faculty



Aurea Pimenta (Univ of Vanderbilt Medical School)  
Chris Miller (Institute of Psychiatry, London)  
Harish Pant (NIH)  
Nancy Lombardo (Boston University; Bedford VA Hospital)  
Mike McGee (St. Joseph's Senior Center)

## 5. New and Temporary Faculty Affiliations

James Paskevitz, M.D. UMass Worcester James directs the largest Alzheimer's clinic in the Northeast; Medical Advisor for clinical trials with our "SmartPill"

## 6. Student Research Support 2007-2008

CFCI funds were utilized to support doctoral candidate Patti Stadler (in Associate Director Falcone's laboratory); if funds are forthcoming from CFCI, we will continue to fund her as she is making excellent progress.

Shea supported doctoral students Mike Serra and James Suchy and undergraduate James Kushkulney.

## 7. Current Research Projects

- Determination of intermediates in methionine metabolism and their role in health and disease
- Pharmacological intervention in cytoskeletal abnormalities in Alzheimer's disease
- Clinical trials of the SmartPill, a vitamin/nutraceutical formulations which we have shown to delay progression of Alzheimer's disease and to improve cognitive performance in normal aging.
- Production of S-adenosyl methionine in genetically-engineered plants
- The interplay of cytoskeletal elements in outgrowth and regeneration of axons.
- Development of a computer-neuronal interface/biosensor.
- Efficacy of S-adenosyl methionine in motor neuron disease/ALS

Our research, along with that of other laboratories, suggests that chronic neurodegenerative conditions such as Alzheimer's disease are the result of several factors, including environmental, nutritional and genetic predispositions (and perhaps more than one of each category). This renders analyses and developments of treatments particularly difficult. We utilize several model systems in efforts to identify various enzymes and genes that may contribute to neurodegeneration, including:

- transgenic mice whose genomic profile mimics that of individuals at risk for Alzheimer's or motor neuron disease (ALS)
- neurons maintained outside of the brain in culture
- identified neurons within the brain

We subject these models to defined treatments and/or deficient diets that provoke neurodegeneration, and attempt to intervene with this neurodegeneration by vitamin or drug supplements.

We completed a number of one-year clinical trials with our neuroprotective formulation, termed the "SmartPill," with early-stage Alzheimer patients, with funding from Chancellor Hogan. We have just been awarded funding for a phase-II, 3 year clinical trial. One company has licensed this formulation for direct sales, we are in final negotiations with a second company for over-the-counter distribution. We wish to stress that this formulation was developed due to support from the CFCI, which made possible the collaborations among Shea, Nicolosi and



Rogers that led to its development, and with Ruth Remington, who has participated in running the trials.

In collaboration with Falcone, we have developed genetically-modified plants that express elevated levels of S-adenosylmethionine, which our studies have shown to delay cognitive decline in Alzheimer's disease and normal aging. We have discussed the development of a "SmartSalad" with companies and submitted a proposal to NIH.

In collaboration with Miller and Pant, we are designing point mutations of cytoskeletal proteins that will help define key aspects of development of the nervous system; a proposal to the NIH is planned for Oct submission.

Affiliated Faculty of the Center each direct their own research programs. As a result of our respect diverse expertise and interests, our collaborations bring unique approaches to neuroscience. Undergraduate and graduate students are involved in all Center research projects.

We continue our studies of dietary supplementation with apple juice

## **8. Representative Peer-Reviewed Full-Length Publications NOT previously reported to the CFCI (2007-2008 only)**

- 1) Dubey M, Chaudhury P, Kabiru H and Shea TB (2007) Tau inhibits anterograde axonal transport and perturbs stability in growing axonal neurites in part by displacing kinesin cargo: neurofilaments attenuate tau-mediated neurite stability. *Cell Motil Cytoskel* 65: 89-99.
- 2) Tagne JB, Kakumanu S, Oritz D, Shea TB, Nicolosi RJ (2008) A nanoemulsion formulation of tamoxifen increases its efficacy in a breast cancer cell line. *Mol Pharm* 5:280-286.
- 3) Shea TB and Chan A (2008) S-adenosyl methionine: a natural therapeutic agent effective against multiple hallmarks and risk factors associated with Alzheimer's disease. *J Alz disease* 13:67-70.
- 4) Chan A, Remington R and Shea TB (2008) The Clock-drawing test: Time for a change? *Am J Alz Dis Other Dementias*: in press.
- 5) Chan A, Alsaraby and Shea TB (2008) Folate deprivation increases tau phosphorylation by homocystein-induced calcium influx and by inhibition of phosphatase activity: alleviation by S-adenosyl methionine. *Brain Res* 1199: 133-137.
- 6) Chan A, Tchantchou F, Graves V, Rozen R and Shea TB (2008) Dietary and genetic compromise in folate availability reduces acetylcholine and cognitive performance: critical role of S-adenosylmethionine. *J Health Nutr Aging* 12:252-261.
- 7) Tchantchou F, Graves M and Shea TB. S-adenosylmethionine mediates glutathione efficacy by increasing glutathione s-transferase activity: Implications for S-adenosyl methionine as a neuroprotective dietary supplement. *J Alz Dis*; in press



- 8) Chan A, Paskavitz J, Remington R and Shea TB. Efficacy of a vitamin/nutriceutical formulation for early-stage Alzheimer's disease: A one-year open-label pilot study with an 11-month extension. *Am J Alz Dis Other Dementias*: in press
- 9) Serra M, Dubey M, Chan A, Gilman V and Shea TB. A low-cost data acquisition interface for multi-electrode array culture systems. *Biotechniques*: in press
- 10) Lee S, Chu B, Yao J, Shea TB and Hall GF. The glutamate-rich region of the larger lamprey neurofilament sidearm is essential for proper neurofilament architecture. *Brain Res*: in press
- 11) Remington R, Chan A and Shea TB. Efficacy of a vitamin/nutriceutical formulation for moderate to late-stage Alzheimer's disease: A placebo-controlled pilot study. *Am J Alz Dis Other Dementias*: in press
- 12) Chan and Shea. Dietary supplementation with apple juice decreases production of endogenous beta-amyloid in murine brain.

**Review article:**

Shea TB and Chan W K-H. Regulation of neurofilament dynamics by phosphorylation. *Euro J Neurosci*: *in press*

**Manuscripts under consideration for publication**

Serra M, Chan A, Dubey M and Shea TB. S-adenosymethionine stimulates neurotransmission in cultured cortical neurons: Impaired response in transgenic mice lacking apolipoprotein E.

**9. Conferences NOT previously reported (includes only those where a presentation was made)**

Shea et al., A vitamin/nutriceutical formulation that delays cognitive decline and improves behavioral symptoms in Alzheimer's disease: International Conference on Alzheimer's disease Chicago, Ill

Shea et al., Neurofilament dynamics and axonal transport: Gordon Conference, Oxford, UK.

Suchy et al., S-adenosyl methionine delays motor neuron decline in a mouse model of ALS. *Am Soc Neurosci*, Wash DC

**10. Intra-University Collaboration**

We have ongoing collaborations with investigators from the National Institute of Health (Harish Pant), UMass•Worcester (James Paskevitz), Boston University (Nancy Lombardo), St. Joseph's Senior Center (Mike McGee) and the University of Pittsburg Medical School (Aurea Pimenta).

**11. Regional/Local Community Technical Outreach**

Shea and associates give annual presentations at the Massachusetts Alzheimer's Association as well as multiple regional presentations to families and caregivers, and regional schools. In addition to highlighting the ongoing studies at the Center, the purpose of these presentations is to



provide an interface between scientists and the community, in order to allow the community to understand current developments and research areas in neurodegeneration. Our studies on apple juice were featured in over 60 news articles and two television and two radio appearances.

Center faculty and graduate students serve as the Judges' Panel for the annual Science Fair at St. Michael's School (grades 5-8) in Dracut, MA

Shea once again present a workshop in the Map Thru the Maze (Malboro, MA, 2008)

## 12. New Grant Awards for 2008

2008 Principal Investigator, US Army STIR

*"Optimization of a neuronal biosensor"*

Total Direct Cost: \$46,700

2008-2001 Principal Investigator, National Institute on Aging

*"A phase II clinical trial of a vitamin/nutriceutical formulation for Alzheimer's disease?"*

Total Direct Cost: \$237,009

2007 Principal Investigator, National Institute of Health

*"Gordon Conference on Intermediate Filaments"*

Total Direct Cost: \$5,000

## Proposals Submitted

- Neurofilament dynamics and axonal outgrowth (resubmitted)
- Can S-adenosyl methionine delay motor neuron decline in ALS?
- Expression of anti-Alzheimer nutriceuticals in plants (Falcone ; resubmitted)



## 08. ANNUAL REPORT FOR THE CENTER FOR COMPLEX ENVIRONMENTAL SYSTEMS

2007-2008

**Director: Juliette N. Rooney-Varga**

**Associate Director: Jackie Zhang**

### Mission Statement

The mission of the Center for Complex Environmental Systems (CCES) is to conduct multi-disciplinary research, technical assistance, and training in environmental sciences and technologies. CCES' mission extends to local, regional, and global environmental processes and includes both basic and applied environmental science.

### General Description

The Center for Complex Environmental Systems (CCES) at UMass Lowell is a multi-disciplinary research, technical assistance, and training organization that focuses on environmental science and technologies.

Areas of research include air pollution modeling and analysis; analytical tools for atmospheric, aquatic, and soil chemistry; soil remediation technologies; environmental microbiology and microbial ecology; biogeochemistry; and environmental policy and impact analysis.

The Center has several associated laboratories, including analytical and wet chemistry laboratories; a biochemistry laboratory; an environmental microbiology laboratory; a site remediation laboratory; and a biogeochemistry laboratory. The Center and associated faculty are engaged in several research efforts funded by Federal and State agencies and private institutions. The Center also provides a forum for exchange of information in the form of colloquia and occasional symposia on specific subjects.

### Research Focus Areas

Several Research Groups representing diverse disciplines are members of the CCES. These include:

<i>Research Group</i>	<i>Faculty Leadership</i>	<i>Focus Area</i>
Analytical and Environmental Chemistry	David K. Ryan and Eugene Barry	Development of new methods to analyze metal ions, synthetic organic compounds, and humic and fulvic acids in environmental samples.
Atmospheric Chemistry	Robert Gamache	Modeling of tropospheric pollutant gases.

---

Biogeochemistry	Mark Hines	Analysis of anaerobic biogeochemical processes in wetlands and sediments.
Environmental Engineering	Clifford Bruell	Development of remediation technologies for soils contaminated with hazardous pollutants.
Meteorology	Frank Colby	Modeling of regional wind patterns.
Microbial Ecology	Juliette Rooney-Varga	Molecular and cultivation-based analysis of bacteria in marine, wetland, and wastewater treatment microbial communities.
Modeling	Stephen Pennell	Mathematical modeling of hydrological and other environmental processes.
Wastewater Treatment	Jackie Zhang	Analysis of bioreactor-based wastewater treatment processes.

---

### Associated Personnel

Faculty and Staff Associated with the CCES:

<i>Name</i>	<i>Title</i>	<i>Research Area</i>
Barry, Eugene	Professor	Analytical Chemistry
Bruell, Clifford	Professor	Remediation Technologies
Colby, Frank	Professor	Meteorology
Eby, Nelson	Professor	Geochemistry
Gamache, Robert	Professor	Atmospheric Chemistry
Hines, Mark	Professor	Biogeochemistry
Jahngen, Edwin	Professor	Biochemistry
O'Brien, Arnold	Professor	Groundwater Quality
Pennell, Stephen	Professor	Modeling
Rooney-Varga, Juliette	Center Director,	Microbial Ecology

---

	Associate Professor	
Ryan, David	Professor	Analytical and Environmental Chemistry
Zhang, Xiaoqi Jackie	Associate Director, Associate Professor	Biological Wastewater Treatment

### Student Research Support

CCES faculty members have mentored undergraduate, graduate, and post-doctoral students

<i>Name</i>	<i>Mentor</i>	<i>Degree</i>
Adatto, I.	Hines	M.S.
Antony, Bobby	Gamache	Post-Doctoral Associate
Dancoe, A.	Hines	M.S.
Elenbaas, P.	Rooney-Varga	M.S.
Goyal, Deepankar	Rooney-Varga	Ph.D.
Graham, Joseph	Zhang	B.S.
Humphrey, Caitlin	Gamache	B.S.
Hussain, Mack	Rooney-Varga	High School
Kilsdonk, Sam	Gamache	B.S.
Laraia, A.	Gamache	B.S.
Luongo, Lauren	Zhang	M.S.
Lynch, A.	Hines	M.S.
Manmode, Rahul	Ryan	Ph.D.
Mohanty, N.	Bruell	Ph.D.
Musgrave, A.	Bruell	B.S.
Pande, Nilesh	Rooney-Varga	M.S.
Patel, Sunali	Rooney-Varga	B.S.
Poitras, E.	Hines	B.S.
Shedeler, C.	Bruell	B.S.
So, Dary	Zhang	B.S.
Swett, P.	Golomb and Ryan	M.S.
Wadden, A.	Bruell	M.S.
Yin, Yexin	Zhang	M.S.

### Current and Recent Research Projects

<i>PI</i>	<i>Project Title</i>	<i>Sponsor</i>	<i>Amount</i>
Eby	Characterization of trace metals in nanotech materials.		
Eby	Correlation of volcanic ash from the eruption of Thera. Establishing a time line for artifacts associated with the eruption of the volcano and the collapse of Minoan civilization.		



Eby	Characterization of the source of materials used in Colonial era pottery.		
Eby	Geochemistry of alkaline rocks and carbonatite from the Western Branch of the East African rift system.		
Eby	Geochemistry of Argentine granites and associated ore deposits.		
Eby	Mineral chemistry of Moroccan carbonatites.		
Eby	Geochemistry of Neoproterozoic granites, Kola Peninsula, Russia.		
Gamache	Line shape parameters for water vapor and other atmospheric asymmetric rotor molecules	National Science Foundation	
Gamache	Theory in support of laboratory spectroscopy for AIRS, TES and HIRDLS	National Aeronautics & Space Administration	
Golomb and Ryan	CO <sub>2</sub> Sequestration	Department of Energy	
Hines	Mercury transformations in the Idrija River System, Slovenia	National Science Foundation	\$68,877
Hines	Mercury, Methylmercury, and Mercury (II) Analysis, Salmon Creek Reservoir, Idaho	U.S. Geological Survey	\$13,279
Hines	Mercury, Methylmercury, and Mercury (II) Analysis, Narraguinnep Reservoir, Colorado	U.S. Geological Survey	\$24,020
Hines	MIRACLE - Mercury Interdisciplinary Research for Appropriate Clams farming in Lagoon Environment.	Dipartimento di Scienze Geologiche Ambientali e Marine of Trieste's University, Italy	\$30,150
Hines (co-I)	Atmospheric Deposition, Transport, Transformations and Bioavailability of Mercury across a Northern Forest Landscape	National Science Foundation	\$1,800,000
Rooney-Varga	Microeukaryote diversity in the Gulf of Maine: Under-explored microbial diversity in a well-studied coastal marine ecosystem	Keck Foundation	\$30,000 in-kind
Rooney-Varga (co-PI)	Characterization of the microbial community in the particle-rich, marine benthic nepheloid layer (BNL)	UMass School of Marine Sciences	\$10,000
Rooney-Varga and Zhang	The impact of nanomaterials on microbial processes and community dynamics in wastewater treatment reactors	UML	\$6,440
Ryan		Mass Technology Transfer Center	\$25,000
Ryan		Bausch & Lomb	\$50,000
Zhang	Kinetics and extent of Fe(III) reduction-dependent phosphorus removal using anaerobic sequencing batch reactors	CICEET/University of Illinois-Urbana Champion	\$113,196



Zhang, Bruell, and Hines	NUE: Laboratory Modules on Environmental Impacts of Nanotechnology	National Science Foundation	\$200,000
Mohanty, Bruell	EPA Graduate Fellowship	Environmental Protection Agency	\$101,069
Bruell (Planning Committee Member)	Science, Technology, Engineering and Math (STEM) Pilot Program for accelerated High School Students	Massachusetts Department of Education	\$150,000

### **Publications by members of the CCES during the last Academic Year**

- Antony, B. K., Danielle L. Niles, Sarah B. Wroblewski, Caitlin M. Humphrey, Tony Gabard and Robert R. Gamache, "N<sub>2</sub>-, O<sub>2</sub>- and air-broadened half-widths and line shifts for transitions in the n<sub>3</sub> band of methane in the 2726-3200 cm<sup>-1</sup> spectral region," In press *J. Mol. Spectrosc.*, May, 2008.
- Antony, B.K., and Robert Gamache, "Self-broadened half-widths and self-induced line shifts for water vapor transitions in the 3.2-17.76 mm spectral region via complex Robert-Bonamy theory," *J. Mol. Spectrosc.* 243, 113-123, 2007.
- Brown, L. R., C. M. Humphrey and R. R. Gamache, "CO<sub>2</sub>-broadened water in the pure rotation and n<sub>2</sub> fundamental regions," *J. Mol. Spectrosc.* 246, 1-21, 2007.
- Chanton, J.P., P.H. Glaser, L.S. Chasar, D.J. Burdige, M.E. Hines, D.I. Siegel, L.B. Tremblay, W.T. Cooper. Submitted. Radiocarbon Content of Fermentation and Respiration Products and Molecular Composition of Dissolved Organic Carbon in Boreal Peatlands in Relation to the Solid-Phase Peat. *Global Biogeochem. Cycles*.
- Cooper, A. F., Adam, L. J., Coulter, R. F., Eby, G. N., and McIntosh, W. C. (2007) Geology, geochronology and geochemistry of a basaltic volcano, White Island, Ross Sea, Antarctica. *Journal of Volcanology and Geothermal Research* 165, 189-216.
- Gméling, K., Németh, K., Martin, U., Eby, N., and Varga, Z. (2007) Boron concentrations of volcanic fields in different geotectonic settings. *Journal of Volcanology and Geothermal Research* 159, 70-84.
- Golomb, D., Pennell, S., Ryan, D., Barry, E., and Swett, P. (2007) Ocean Sequestration of Carbon Dioxide: Modeling the Deep Ocean Release of a Dense Emulsion of Liquid CO<sub>2</sub> in Water Stabilized by Pulverized Limestone Particles. Submitted for publication *Environ. Sci. Technol*
- Gomez, L. H. Tran, A. Perrin, R. R. Gamache, A. Laraia, J. Orphal, P. Chelin, C. E. Fellows, J.-M. Hartmann, "Some improvements of the HNO<sub>3</sub> spectroscopic parameters in the spectral region from 600 to 950 cm<sup>-1</sup>," In press, *J. Quant. Spectrosc. Radiat. Transfer*, 2008.



- Gordon, I. I. , Laurence S. Rothman, Robert R. Gamache, David Jacquemart, C. Boone , P. F. Bernath, M. Shephard, J. S. Delamere, S. A. Clough, “Current updates of water vapor linelist in HITRAN2004: A new “Diet” for air-broadened half-widths,” *J. Quant. Spectrosc. Radiat. Transfer* 108, 389–402, 2007.
- Gray, J.E. and M.E. Hines. Submitted. Biogeochemical mercury methylation influenced by reservoir eutrophication, Salmon Falls Creek Reservoir, Idaho, USA. *Sci. Tot. Environ.*
- Hasegawa, Y., J. L. Martin, M. W. Giewat, and J. N. Rooney-Varga. 2007. Microbial community diversity in the phycosphere of natural populations of the toxic alga, *Alexandrium fundyense*. *Environ. Microbiol.* 9:3108-3121.
- Hines, M. E., K. N. Duddlestone, J. N. Rooney-Varga, D. Fields, and J. P. Chanton. 2008. Uncoupling of acetate degradation from methane formation in Alaskan wetlands: Connections to vegetation distribution. *Global Biogeochem. Cycles*, 22, GB2017, doi:10.1029/2006GB002903
- Hines, M.E., P.T. Visscher, A. Teske and R. Devereux. 2007. Sulfur cycling. p. 497-510. In: C.J. Hurst, R.L.Crawford, J.L. Garland, D.A. Lipson, A.L. Mills, L.D. Stetzenbach (eds.) . *Manual for Environmental Microbiology*, 3rd Edition, American Society for Microbiology Press.
- Killian, P.F., C.J. Bruell, C. Laing and M.C. Marley, 2007, “Iron (II) Activated Persulfate Oxidation of MGP Contaminated Soil”, *Soil and Sediment Contamination, An International Journal*, 16(6): 523-537.
- Liang, C. , C.J. Bruell, 2008, “Thermally Activated Persulfate Oxidation of TCE: Preliminary Experimental Investigation of Reaction Orders”, *Industrial & Engineering Chemistry Research*, 47(9): 2912-2918.
- Liang, C., Bruell, C.J., Albert, M.F., Cross, P.E. and Ryan, D.K. (2007) Evaluation of Reverse Osmosis and Nanofiltration for In Situ Persulfate Remediated Groundwater. *Desalination*, 208, 238-259.
- Liang, C., C.J. Bruell, M.F. Albert, C. Paul, 2008, “Evaluation of Reverse Osmosis and Nanofiltration for Removal of Excess Persulfate Resulting From In Situ Chemical Oxidation Treatment of Groundwater”, *Desalination*, 208: 238-259.
- Liang, C., Z-S Wang, C.J. Bruell, 2007, “Influence of pH on Persulfate Oxidation of TCE at Ambient Temperatures”, *Chemosphere*, 66:106-113.
- Long, D.T, W. B Lyons, M.E. Hines. In press. Influence of hydrogeology, microbiology, and landscape history on the geochemistry of acid hypersaline waters, southern Australia. *Appl. Geochem.*
- Payne, V. H., J. S. Delamere, K. E. Cady-Pereira, R. R. Gamache, J-L. Moncet, E. Mlawer, S. A. Clough, “Air-broadened half-widths of the 22 GHz and 183 GHz water vapor lines,” in press *IEEE Transactions in Geoscience and Remote Sensing*, 2007.
- Rinsland, C. P.V. Malathy Devi, D. Chris Benner, T. A. Blake, R. L. Sams, L. R. Brown, I. Kleiner, A. Dehayem-Kamadjeu, H.S.P. Müller, R. R. Gamache, D. L. Niles, T. Masielloh, Multispectrum analysis of the  $n_4$  band of  $\text{CH}_3\text{CN}$ : Positions, intensities, self



and N<sub>2</sub> broadening and pressure-induced shifts, *J. Quant. Spectrosc. Radiat. Transfer* 109, 974-994, 2008.

Sharma, K., McSwain, B., Zhang, X., Lin, W. and Yu, T. (2007) Biological Fixed Film Systems – Review. *Water Environment Research*.

Sharma, S.K., Tyagi, R., Kumar, S., Kumar, R., Barry, E.F., Kumar, J., Watterson, A.C., Ryan, D.K., Parmar, V. (2007) Selective Recognition of Ca<sup>2+</sup> Ions Using Polymeric Phenols. in press *Microchem. J*.

Tran, H., D. Bermejo, J.-L. Domenech, P. Joubert, R. R. Gamache, and J.-M. Hartmann, “Collisional parameters of H<sub>2</sub>O lines: velocity effects on the line-shape,” *J. Quant. Spectrosc. Radiat. Transfer* 108, 126-145, 2007.

Yu., R.-Q., I. Adatto, J.K. Schaefer, T. Barkay and M.E. Hines. Submitted. Bacterial diversity in an acidic freshwater wetland: Potential links to mercury methylation. *J. Geophys. Res. Biogeochem*.

Yu., R.-Q., T. Barkay, J.K. Schaefer, C. DiPasquale, I. Adatto, M.E. Hines. Submitted. Molecular Characterization of Microbial Communities in a Methylmercury-producing Adirondack Lake Wetland. *Appl. Environ. Microbiol.*

Zhang, X., C. Bruell, Y. Yin, P. Jayaradu and A. Watterson, “Introducing Nanotechnology into the Environmental Engineering Curriculum” (Book Chapter) Submitted to ACS, 2007

Zhang, X., Gartner, N., Gunes, O. and Ting, J. (2007) Integrating Service-Learning Projects into Engineering Courses. *The International Journal for Service-Learning in Engineering*. 2(1), 44-63.

### **Conferences**

Center PIs and graduate students attended and gave presentations at several national and regional conferences. These included:

Brown, L., B. Drouin, C. Miller, J. Pearson, G. Orton, R. Toth, C. Benner, M. Devi, T. Blake, T. Masiello, R. Sams, R. Butler, J. Champion, P. Chelin, A. Dehayem, I. Kleiner, J. Orphal, L. Sagui, R. Gamache, C. Humphrey, W. Liu, A. Predoi-Cross, A. Unnikrishnan, H. Muller, A. Nikitin, C. Rinsland, M. Smith, “Laboratory Spectroscopy of Planetary Molecules,” European Planetary Science Congress 2007, Potsdam, Germany, 20 – 24 August 2007.

Brown, L., B. Drouin, C. Miller, J. Pearson, G. Orton, R. Toth, C. Benner, M. Devi, T. Blake, T. Masiello, R. Sams, R. Butler, J. Champion, P. Chelin, A. Dehayem, I. Kleiner, J. Orphal, L. Sagui, R. Gamache, C. Humphrey, W. Liu, A. Predoi-Cross, A. Unnikrishnan, H. Muller, A. Nikitin, C. Rinsland, M. Smith, “Laboratory Spectroscopy of Planetary Molecules,” Workshop on Planetary Atmospheres, Greenbelt, MD, Nov. 6-7, 2007.

Buchsbaum, R, M. Hines and G. Brace. 2007. The effects if salt marsh haying on the ecology of Plum Island Sound, MA marshes. 17th Biennial Estuarine Research Federation Conference, Providence, RI.



- Delamere, J., Vivienne H. Payne, Eli J. Mlawer, Shepard. A. Clough, David Turner, Robert R. Gamache, Improved Understanding of Far-Infrared Radiative Processes Using Measurements from the ARM North Slope of Alaska Climate Research Facility”, The 10th Biennial HITRAN Database Conference, Harvard-Smithsonian enter for Astrophysics, June 22-24, 2008.
- Duffy, J. Ting, J., Zhang, X., Kazmer, D., Clark, D. and Barry, C. (2007) Service-learning Integrated into Existing Core Courses Throughout a College of Engineering. ASEE Annual Conference, Honolulu, HI.
- Eby, G. N. (2007) Forensic Geology as a Vehicle for Inquiry-Driven Learning: The Case of the Sandy Body. Geological Society of America Abstracts with Programs 39, 6, p. 458.
- Fonseca, C., G.W. Brace, R.N. Buchsbaum, and M.E. Hines. 2008. Effects of haying on nitrogen acquisition and sediment biogeochemistry in *Spartina patens*. New England Estuarine Research Society Spring Meeting, Portsmouth, N.H. (Awarded best undergraduate student poster).
- Gamache, P. R., B. K. Antony, and R. R. Gamache, “Adjusting the Intermolecular Potential Parameters for the  $\text{H}_2^{16}\text{O}-\text{N}_2$  System for Line Shape Calculations,” The Twentieth Colloquium on High-Resolution Molecular Spectroscopy, Dijon, France, September 3-7, 2007.
- Gamache, R. R., Anne Laraia, “ $\text{N}_2$ -Broadening of  $n_5$  and Transitions of  $\text{HNO}_3$  in the Region from  $841-931\text{ cm}^{-1}$ ,” The 10th Biennial HITRAN Database Conference, Harvard-Smithsonian Center for Astrophysics, June 22-24, 008.
- Gamache, R. R., Bobby Antony, Danielle L. Niles, Sarah B. Wroblewski, Caitlin M. Humphrey, Tony Gabard “Half-widths and Line Shifts for Transitions in the  $n_3$  and of Methane in the  $2726-3200\text{ cm}^{-1}$  Spectral Region or Atmospheric Applications,” The 10th Biennial HITRAN Database Conference, Harvard-Smithsonian Center for Astrophysics, June 22-24, 2008.
- Gamache, R. R., Bobby Antony, Danielle L. Niles, Sarah B. Wroblewski, Caitlin M. Humphrey, Tony Gabard, Line Shape Parameters for  $n_3$  Transitions of  $^{12}\text{CH}_4$ ,” the 9th International Conference on Spectral Line Shapes, Valladolid, Spain, June 15-20, 2008.
- Gamache, R.R., Linda R. Brown, Caittlin M. Humphrey, “Line shape of  $\text{H}_2\text{O}$  in  $\text{CO}_2$ -rich atmospheres for remote sensing of Mars and Venus”, UML Research: Creating the Future of the Commonwealth, Inauguration of Martin T. Meehan, April 2, 2008.
- Gomez, L., H. Tran, A. Perrin, J.-M. Hartmann, J. Orphal, P. Chelin. G. Brizzi, R. R. Gamache, A. Laraia,  $\text{HNO}_3$  Spectroscopic Parameters in the  $600-950\text{ cm}^{-1}$  and  $300-1360\text{ cm}^{-1}$  Spectral Regions,” The 10th Biennial HITRAN Database Conference, Harvard-Smithsonian enter for Astrophysics, June 22-24, 2008.
- Gordon, I. E., L. S. Rothman, V. I. Perevalov, S. A. Tashkun, R. R. Gamache, R. J. Barber, J. Tennyson, P. F. Bernath, A. Goldman, H. Dothe, “The HITEMP Reloaded,” The Twentieth Colloquium on High-Resolution Molecular Spectroscopy, Dijon, France, September 3-7, 2007.
- Goyal, D., X. J. Zhang, Y. Yin, L. Luongo, and J. N. Rooney-Varga. Impact of Single-Walled Carbon Nanotubes on the Structure of Microbial Communities in Activated Sludge



- Bioreactors. American Society for Microbiology General Meeting, Boston, MA. , June 2008.
- Hines, M., K. Duddleston, J. Rooney-Varga and J. Chanton. Connections between the pathway and rate of methanogenesis and vegetation in peatlands: Implications for a changing climate. Carbon in Peatlands Symposium. Wageningen, the Netherlands.
- Hines. M.E. 2008. Decoupling of methanogenesis from decomposition in bogs and fens: Relationship with trophic status and implications for C and other elements. Amer. Soc. Microbiol. General Meeting, Boston.
- Humphrey, C. H., Robert R. Gamache, Bobby Antony, Danielle L. Niles, Sarah B. Wroblewski, Tony Gabard, N<sub>2</sub>-, O<sub>2</sub>- and Air-broadened Half-widths and Line Shifts or Transitions in the n<sub>3</sub> Band of Methane in the 2726-3200 cm<sup>-1</sup> Spectral Region,” the 11th Annual Student Research Symposium, The University of Massachusetts Lowell, April 29, 2008.
- Humphrey, C. M., R. R. Gamache, L. R. Brown, “Line Shape of H<sub>2</sub>O Broadened by CO<sub>2</sub> for Applications to the Atmospheres of Mars and Venus,” The Twentieth Colloquium on High-Resolution Molecular Spectroscopy, Dijon, France, September 3-7, 2007.
- Inyang, H. I., Rossi, L., Graham-Eagle, J., Pennell, S., and Menezes, G. B. 2007, "Modelling smectite illitization in earthen barriers of buried radioactive wastes," *Geomechanics and Geoengineering: An International Journal* 2 (2), 87 - 95.
- Laraia, A., Robert R. Gamache, , “Pressure Broadening Parameters for Nitric Acid in the n<sub>5</sub> Band,” the 11th Annual Student Research Symposium, The University of Massachusetts Lowell, April 29, 2008.
- Liang, C., I.-L. Lee, N. Mohanty, C.J. Bruell, Persulfate Oxidation of Trichloroethylene- A Column Study. The 5<sup>th</sup> International Conference on Oxidation and Reduction Technologies for In-Situ Treatment of Soil and Groundwater (ORTs-5), Niagara Falls, New York, USA, September 24-27, 2007.
- Mitchell, E. E. Samaritani, and M. Hines. 2008. Carbon cycling in northern peatlands: effects of site history, vegetation and climate. Mountain soils under a Changing Climate and Land-Use Conference and Workshop. Birmensdorf, Switzerland.
- Müller, H. S. P., B. J. Drouin, J. C. Pearson, L. R. Brown, I. Kleiner, A. De-Hayem, J. Orphal, P. Chelin, C. P. Rinsland, V. M. Devi, D. C. Benner, T. A. Blake, T. Masiello, R. L. Sams, R. R. Gamache, D. L. Niles, “Laboratory Spectroscopy of Low-Lying Vibrational States of Methyl Cyanide, CH<sub>3</sub>CN,” The Twentieth Colloquium on High-Resolution Molecular Spectroscopy, Dijon, France, September 3-7, 2007.
- Payne, V. H., Jennifer S. Delamere, Karen E. Cady-ereira, Robert R. Gamache, Eli J. Mlawer, Jean-Luc Moncet, Shepard. A. Clough, “Air-broadened half-widths of the 22 GHz and 183 GHz water vapor lines”, ARM Science Team Meeting. Norfolk, Virginia, March 10-14, 008.
- Payne, V. H., Jennifer S. Delamere, Karen E. Cady-ereira, Eli J. Mlawer, Jean-Luc Moncet, Robert R. Gamache, Shepard. A. Clough, “Air-Broadened Half-widths of the 22 GHz and 183 GHz Water Vapor Lines,” The 10th Biennial HITRAN Database Conference, Harvard-Smithsonian Center for Astrophysics, June 22-24, 2008.



- Perrin, A., D. Jacquemart, F. Kwabia Tchana,, N. Lacombe, R. R. Gamache, A. Laraia, “Absolute Line Intensities and Accurate Line Broadening Parameters for the 5.7 mm and 3.6 mm Bands of Formaldehyde,” The 10th Biennial HITRAN Database Conference, Harvard-Smithsonian Center for Astrophysics, June 22-24, 2008.
- Rooney-Varga, J. N., 2008. Exploring the phycosphere: Links between bacteria and toxic algae in the Gulf of Maine. Invited seminar, UMass Amherst.
- Tennyson, J., Peter F. Bernath, Linda R. Brown, Alain Campargue, Michel R. Carleer, Attila G. Császár, Robert R. Gamache, Joseph T. Hodges, Alain Jenouvrier, Olga V. Naumenko, Oleg L. Polyansky, Laurence S. Rothman, Robert A. Toth, Ann C. Vandaele, Nikolai F. Zobov, Ludovic Daumont, Alexander Z. Fazliev, Tibor Furtenbacher, Iouli E. Gordon, Semen N. Mikhailenko, Sergei V. Shirin, Boris A. Voronin, “The IUPAC Critical Evaluation of the Rotational-Vibrational Spectra of Water Vapor. Part I. Energy Levels and Transition Wavenumbers for the Singly-Substituted Isotopologues H<sub>2</sub><sup>17</sup>O, H<sub>2</sub><sup>18</sup>O, and HD<sup>16</sup>O”, 22nd Austin Symposium on Molecular Structure, March 1-4, 2008.
- Turner, D., Eli Mlawer, Jennifer Delamere, Vivienne Pane, Shepard Clough, and Robert Gamache, “Radiative Closure in the Far-infrared: Results from RHUBC-I”, ARM Science Team Meeting. Norfolk, Virginia, March 10-14, 2008.
- Yin, Y. and Zhang, X. (2007) Assessment of Carbon Nanotubes on Activated Sludge Wastewater Treatment Process. Water Environment Federation Annual Conference. San Diego, CA.
- Zhang, X., Bruell, C., Hines, M., Watterson, A. and Barry, C. (2007) Laboratory Modules on Environmental Impacts of Nanotechnology, 2007 Spring ACS National Meeting, Chicago, IL.
- Zhang, X., Bruell, C., Yin, Y. and Jayaradu, P. (2007) Introducing Nanotechnology into Environmental Engineering Curriculum. ASEE Annual Conference, Honolulu, HI.
- Zhang, X., C.Bruell, Y.Yin,P.Jayaradu, M.Hines,” Introducing Nanotechnology into the Environmental Engineering Curriculum, Presented at the ASEE Annual Conference & Exposition, Hilton Hawaiian Village and Hawaii Convention Center, Honolulu, HI, June 24-27, 2007.
- Zozulya, D.R. and Eby, G.N. (2008) The anorthosite – A–type peralkaline granite connection: a case study from the Keivy Terrane, Baltic Shield. Geological Association of Canada – Mineralogical Association of Canada, Joint Annual Meeting, Quebec City 2008, Abstracts 33, 190–191.

### **Intra-University Collaboration**

Center PIs are engaged in a wide range of collaborations with members of other departments and centers. These include:

- CCES members Zhang, Hines, and Bruell are collaborating with the Chemistry and Plastics Engineering Departments in their NSF-funded “Laboratory Modules on Environmental Impacts of Nanotechnology” project.



- CCES Associate Director Zhang has ongoing funded collaborations with John Duffy (Mechanical), Donn Clark (Electrical) and Arthur Watterson (Institute for Nano Science and Engineering Technology).
- CCES Director Rooney-Varga has co-advised graduate students with Michael Graves and has joint project with him funded by the International Census of Marine Microbes (Biological Sciences).
- CCES Director Rooney-Varga and CMINDS Director Megherbi are collaborating to develop new bioinformatics approaches for analyzing microbial community composition data.
- Eby is collaborating with the Work Environment Department to characterize trace metals in nanotechnology materials.

## Regional/Local Community Technical Outreach

Center PIs have been involved in a diverse range of outreach activities, including:

Zhang gave an invited talk at the 4th Annual K-12 Nanotechnology Teacher Conference, *University of New Hampshire*.

Gamache serves as an advisor to the Weather Club, Lawrence High School.

CCES members Pennell and Bruell are serving on the Vertical Teaming Task Force (collaboration with Middlesex CC, Lowell HS, and Lowell middle schools to align math curricula).

Bruell served as Conference Co-Director and Session Moderator, *The 23<sup>rd</sup> Annual International Conference on Contaminated Soils, Sediments and Water*, Amherst, MA., October 2007. (Approximately 800 attendees).

Colby provided precipitation data to the Lowell Wastewater Treatment Plant.

## Proposals Submitted

---

<i>PI</i>	<i>Project Title</i>	<i>Sponsor</i>	<i>Amount Requested</i>
Hines (PI), Rooney-Varga (co-PI)	Controls on the pathway of carbon flow and effects on CH <sub>4</sub> production in northern wetlands	National Science Foundation	\$469,785



## Proposals Awarded

<i>PI</i>	<i>Project Title</i>	<i>Sponsor</i>	<i>Awarded</i>
Zhang	Toxicity of carbon nanotubes to the activated sludge process: protective ability of extracellular polymeric substances.	Massachusetts Water Resources Research Center	\$5,000
Gamache	Line Shape Parameters and Their Temperature Dependence for Molecules of Importance in Earth's Atmosphere	National Science Foundation.	\$356,063
Hines	Mercury, Methylmercury, and Mercury (II) Analysis, Narraguinnep Reservoir, Colorado	US Geological Survey	\$24,020
Hines	MIRACLE - Mercury Interdisciplinary Research for Appropriate Clams farming in Lagoon Environment.	Dipartimento di Scienze Geologiche Ambientali e Marine of Trieste's University, Italy	\$30,150



09. CENTER FOR COMPUTER MACHINE/HUMAN INTELLIGENCE, NETWORKING & DISTRIBUTED  
SYSTEMS  
(CMINDS)

**Annual Report: 2007- 2008**

## **I. Mission Statement**

The aim of the multi-disciplinary CMINDS research Center, in partnership with some leading corporations in the computer fields and the 128 High tech industries, is to advance the analytical, experimental, and operational aspect of Computer Engineering and Information Technologies that have potential influence on the Acquisition, Management, Processing and Storage of Knowledge and Data Engineering and Services (AMPSKDES). In particular, within the CMINDS research Center four equipped research laboratories have been established, namely:

- a. The Networking & Distributed Networks and Applications Laboratory;
- b. The Machine Vision and Multi-Media Signal & Image Processing and Applications Laboratory;
- c. The Artificial & Machine Intelligence, Knowledge & Data Engineering and Applications Laboratory;
- d. The Embedded Real-Time Systems & Architectures, HDL/VLSI and Applications Laboratory.

The ultimate goal of the CMINDS activities is to develop the enabling technologies that lead to new products and methodologies that have potential impact on the AMPSKDES. Using advances in the four main areas mentioned above makes this possible. The mission of the Center is also to undertake undergraduate and graduate basic research training in the above mentioned areas.

## **II. 1 General Description**

The Center was founded in May 2001 with far-reaching and cutting edge interdisciplinary research activities to attract high-quality graduate students and researchers, and to advance Computer Engineering technologies to support the new Computer Engineering programs at UML. It is currently comprised of more than 40 faculty, research & industry affiliates, one senior personnel, one engineer, and graduate and undergraduate students. It includes faculty from Mathematics, Mechanical, and Electrical and Computer Engineering as well as corporate representatives in computer and high-tech areas. The Center is located in Ball 434 on One University Avenue. The Center is equipped, among other things, with hardware and software equipment, embedded systems, and a state-of-the-art High Performance Distributed Computing Engine (HDPC) consisting of a cluster of several 64-bit-Ultra-Sparc-III-Processor dual SUN Blade 1000 advanced workstations, a powerful multiprocessor SUN 450 server, and several high



end Intel-based advanced workstations, all connected by a 4 gigabits per second switch (fiber). The system is scalable to up to 128 computer nodes.

## II-2. Current Strategic Goals

1. Development of strong and sustainable funding/technology ties with industry, local, and federal agencies, consistent with the UML mission.
2. Performing and promoting basic and applied research in key areas in Computer Engineering mentioned above, and facilitating Technology Transfer to industry in key strategic technical areas supported by the Center.
3. Support innovative curriculum development by incorporating the research aspects supported by the Center into the Computer Engineering curriculum in order to (a) facilitate research/research training, (b) continually improve the evolving and fast changing Computer Engineering program, (c) to attract quality undergraduate and graduate students and (d) support a strong new doctoral program in Computer Engineering at UML.
4. Active support and involvement of undergraduate and graduate students in the Center.

## III. Research Groups and Activities Focus Areas

There are four research groups within the Center associated within the four research laboratories mentioned in section I above. The Center associated personnel and its affiliation to the respective four research groups is further depicted in section IV. The specific key research areas and topics include but are not limited to:

### **Networking & Distributed Systems and Applications(G1)**

Parallel, Distributed Processing Networks.  
High-speed Networks/Networking.  
Switching/Routing  
Mobile Internet  
Storage Area Networks and Algorithms for Data and Knowledge Management;  
Network Security  
Integrity, Security and Fault-Tolerant Systems  
Real-Time Systems and Distributed Systems  
High Performance and Distributed Computing and applications

### **Artificial Intelligence & Machine Intelligence, Knowledge and data Engineering and Applications (G2)**

Artificial Intelligence Algorithms  
Knowledge-based Systems  
Knowledge and Data Engineering Tools and Techniques  
Advanced Robotics  
Machine Vision  
Bio-Engineering and Informatics.

### **Machine Vision & Multi-Media Digital Signal Processing and Applications(G3)**

Computer and Machine Vision  
Multi-Media DSP



Image Processing  
Medical Imaging

#### **Embedded Systems Architectures, and VLSI and Applications(G4)**

Real-Time Embedded Systems  
Advanced System Architecture  
Cache Design, Pipelining  
VLSI  
HDL (Hardware Descriptive Languages)

#### **IV. Associated Personnel**

##### **Center Director**

**Professor Dalila B. Megherbi, Department of Electrical and Computer Engineering (G1,G2,G3,G4)**

##### **Associate Directors**

Professor Kanti Prasad, Department of Electrical and Computer Engineering (G4)

Dr. Dennis Martinez, Director of Research and Development, M/A-COM, Inc (G1, G3)

Professor Michael Fiddy, Director, Optoelectronics and optical Communications Center, the University of North Carolina at Charlotte (G1, G2, G3)

##### **Associated Faculty/Members and External Collaborators**

Professor George Cheney, Electrical and Computer Engineering (G4)

Professor Anh Tran, Electrical and Computer Engineering (G4)

Professor Jay Weitzen, Electrical and Computer Engineering (G1)

Professor Dick Kalluri, Electrical and Computer Engineering (G1)

Professor Julie Chen, Mechanical Engineering (G1)

Professor James Sherwood, Mechanical Engineering (G1)

Professor John McKelliget, Mechanical Engineering (G1)

Dr. Jon Arvik, Chief Scientist, NASA Remote Sensing Technologies Center, Mississippi (G1, G2, G3)

Mr. Norbet Kaula, Chief Scientist and Research Professor, Colorado Health Sciences Center (G2, G3, G4)

Mr. Chris Gantz, Lead Corporate Engineer, Storage Area Networks and IO performance, SUN Microsystems (G1, G2, G4)

Mr. Thomas V. McNamura, Draper Laboratory. (G1, G2, G3)

Mr. David Killelea, SUN Microsystems (G1, G4)

Professor Adam Elbirt, Computer Science (G1, G4)

Professor Alkim Akyurtlu, Electrical and Computer Engineering (G1)

Dr. P. Deb, Raytheon Co.(G1, G2, G3)

Professor Oliver Ibe Prof., Associate Professor of Electrical and Computer Engineering (G1, G3)

Professor Joel Therrien, Assistant Professor of Electrical and Computer Engineering (G1, G3)

Professor. Yan Luo, Assistant Professor of Electrical and Computer Engineering (G1, G4)

Professor Young-Kyun Kwon, Assistant Professor of Physics and Applied Physics (G1)



Professor Judith E. Gold, Assistant Professor, Department of Public Health, Temple University. (G2, G3).

Dr. N. Nagel, Grid Institute

## V. New Faculty/External Affiliation and Personnel

Prof. Juliette Rooney Verga, Department of Biology

Sandip Sengupta, Senior Personnel

Prof. Judith E. Gold, Assistant Professor, Department of Public Health, Temple University

Dr. N. Nagel, Grid Institute.

## VI. Student Research Support

Doctoral Students supported in 2007-2008

Helal Saghir

Suzan El-Shoura

Manuel Madera

Paul Beaulieux

## **Master's and Undergraduate Students supported in 2007-2008**

Dana Pyburn

Manuel Madera

Illiana Vonichka

Ian Sebanja

## **Earned Doctoral Degrees in 2007-2008.**

Carlos Bejar, Ph.D in Computer Engineering, June 2007, Advisor, D.B. Megherbi.

## **Earned Graduate (MS) and Undergraduate (BS) Degrees in 2007-2008**

Long Dong, MS in Computer Engineering, June 2007, Advisor D. B. Megherbi.

Tony Sivarit\_sultornsanee, MS in Computer Engineering, June 2007, Advisor D. B. Megherbi.

Manual Madera, BS in Computer Engineering, June 2007, Advisor D. B. Megherbi

Illiana Voynichka, BS in Computer Engineering, June 2007, Advisor D. B. Megherbi

Ian Sebanja, BS in Electrical Engineering, June 2007, Advisor D. B. Megherbi

## VII. Current and Recent Research Projects



Non-uniform link weights with or without Time-Delay Stability and Convergence Analysis for Interconnected Dynamical Systems and Complex Systems

A Novel Computational Method For Mutation Detection and Characterizing for the HIV and SARS viruses.

A Study and Analysis of of the Application of Machine Vision for the Automatic Detection of Road Traffic Signs.

Digital Image Watermarking and High Security Image Tampering Detection with Application to Homeland Security

**A Distributed machine Learning Technique for Multi-agent Autonomous Path Planning**

A Distributed Architecture-Based Self Learning System for Object Representation, Recognition and Authentication

A Client-Server based Methodology for Medical Imaging Retrieval in a Distributed Computing Environment Based on Combinational Image Primitives

**SOPC Solution for 3D Imaging**

An Embedded Multi-processor FPGA Applications technique for System Integration and verification in Image Retrieval

A Middleware Architecture and Protocol Design For Geographically Distributed Battlefield

A Novel Technique for Index and Shape Based Image Data Retrieval and Knowledge Representation from Large Data sets in Distributed Networks

A Distributed Behavioral-Based Technique For Multi-Agent Event-Driven Autonomous Navigation

Distributed Real-Time Autonomous Agent Path Planning for Synthetic Environment and Battlefield

Computational Methods For Characterizing Genomic Sequences, and Proteins

Biometrics and Fingerprint Representation & Recognition Systems

An Extended Correlation Method of Content Based Image Retrieval within a Distributed System

Distributed FPGA-based Systems for 3-D multi-sensors and multi-spectral imaging

3-D Registration Algorithms for Ladar Imaging

FPGA-Based Embedded system for Ladar x-scanning real-time image correction and enhancement



Ladar Image Range and Intensity Data Fusion at the FPGA Hardware level

Facial Recognition with varying pose and expression

Biometrics for home land security

## VIII. Refereed Publications Generated During Year 2007-2008

1. B. Megherbi, Manual Madera, L. Dang, "On Interconnected Multi-Agent Dynamical Systems with Non-Uniform Heterogeneous Coupling Link Weights", *Proceedings of the IEEE International Conference on Computational Intelligence, Turkey, July 2008*
2. Suzan Al-Shoura, D.B. Megherbi, "Comparative of Zernike and Tchebichef Moments For Image tampering Detection Sensitivity and Watermark Recovery", *Proceedings of the IEEE International Conference on Homeland Security, MA, June 2008.*
3. Suzan Al-Shoura, D.B. Megherbi, "Analysis of Noise Sensitivity and Reconstruction Accuracy for Tchebichef Moments," *Proceedings of IEEE Southeast Conference, Alabama, April 2008.*"
4. D. B. Megherbi, H. Aldaya , D. B. Megherbi, "A Lyapunov-Stability-Based System Hardware Architecture for a Real-Time Multiple-Look-Ahead-Levels Reinforcement Learning", *Proceedings of The International Conference on Machine Learning; Models, Technologies & Applications , Las Vegas, June 2007.*
5. D. B. Megherbi, Vikram Malayia, "An Autonomous Hybrid Cognitive/Reactive Agent Path Planning Technique in a Networked Distributed Unstructured Environment for Reinforcement Learning. " *Proceedings of The International Conference on Parallel and Distributed Processing Techniques and Applications, Las Vegas, June 2007.*
6. Suzan Al-Shoura, D. B. Megherbi, "Higher Transparency Digital Image Watermarking By Tchebichef Moments", *Proceedings of the International Conference on Computer Vision, Pattern Recognition & Image Processing, (CVPRIP), Salt lake City, July 2007.*
7. P. Pingle, J. Sherwood and L. Gorbatikh *Properties of rigid-line inclusions as building blocks of naturally occurring composites*, *Composites Science and Technology*, Vol. 68, pp. 2267-2272, 2008.
8. P. Pingle, L. Gorbatikh and J. Sherwood *Analysis of Multiple Rigid-Line Inclusions for Application to Biomaterials* *Proceedings of the ASME International Mechanical Engineering Congress and Exposition November 11-15, Seattle, Washington, USA IMECE, 2007*
9. A. G. Kussow and A. Akyurtlu, "Optically Isotropic Negative Index of Refraction Metamaterial," submitted to *Phys. Rev. B*, July, 2007.
10. A. G. Kussow, A. Akyurtlu, A. Semichaevsky, and N. Angkawattissipan, "MgB<sub>2</sub>-based negative refraction index metamaterial at visible frequencies," *Physical Review B*, 76, 195123. This article was selected for the December 1, 2007 issue of Virtual Journal of Applications of Superconductivity.
11. N. Wongkasem, A. Akyurtlu, K. A. Marx, Q. Dong, J. Li, and W. D. Goodhue, "Development of Negative Refractive Index Chiral Metamaterials in the Optical Frequency Regime," Special Issue on Optical and THz Antenna Technology, *IEEE Transactions on Antennas and Propagation*, accepted, to appear November 2007.
12. Nantakan Wongkasem, Alkim Akyurtlu, Kenneth A. Marx, William D. Goodhue, Jin Li, Qi Dong, and Earl T. Ada, "Fabrication of a Novel Micron Scale Y-structure-Based Chiral Metamaterial: Simulation and Experimental Analysis of its Chiral and Negative Index Properties in the Terahertz and Microwave Regimes," Special Issue on Nanomanufacturing, *Microscopy Research and Technique*, January 2007.
13. A. G. Kussow and A. Akyurtlu, "Isotropic optical negative index of refraction metamaterials composed of randomly arranged nanoparticles," accepted for *2007 APS March Meeting*, Denver, CO, March 5- 9, 2007, Invited Paper.

14. A. G. Kussow, A. Akyurtlu, and A. Semichaevsky, "First-principle studies of the optical properties of MgB2 and its applications in optics," *North American Radio Science Meeting, URSI 2007*, Ottawa, ON, Canada, July 23-27, 2007.
15. A. G. Kussow, A. Akyurtlu, A. Semichaevsky, and N. Angkawatissipan, "Novel optically isotropic negative refraction index metamaterial at visible frequencies based on superconductors (MgB2)," *North American Radio Science Meeting, URSI 2007*, Ottawa, ON, Canada, July 23-27, 2007.
16. N. Wongkasem, A. Akyurtlu, and K. Marx, "Identification and Classification of Chiral and Bi-anisotropic Metamaterials," *North American Radio Science Meeting, URSI 2007*, Ottawa, ON, Canada, July 23-27, 2007.
17. N. Wongkasem, A. Akyurtlu, and K. Marx, "Gammadion Structures with Negative Refractive Index: Analysis and Experiment," *North American Radio Science Meeting, URSI 2007*, Ottawa, ON, Canada, July 23-27, 2007.
18. N. Limberopoulos, G.S. Banks, A. Akyurtlu, A.S. Karakashian, W.D. Goodhue, V. Limberopoulos "Surface Plasmon Resonance Test Bench Device for the Validation of Optical Metamaterials," *North American Radio Science Meeting, URSI 2007*, Ottawa, ON, Canada, July 23-27, 2007.
19. N. Wongkasem, A. Akyurtlu, J. Li, A. Tibolt, Z. Kang, W. D. Goodhue, "Novel Broadband THz Negative Refractive Index Metamaterials: Analysis and Experiment," accepted, will appear in *Progress in Electromagnetics Research (PIER)*.
20. N. Wongkasem, A. Akyurtlu, and K. A. Marx, "Group Theory Based Design of Isotropic Negative Refractive index Metamaterials," accepted, will appear in *Progress in Electromagnetics Research (PIER)*.
21. Gorczyca, J., Sherwood, J. and Chen, J., 2007, "Development of a Friction Model for Use in the Thermoforming of Commingled Glass-Polypropylene Woven Fabrics," *Composites Part A*, Vol. 38, p. 393-406.
22. A. G. Kussow and A. Akyurtlu, "Optically Isotropic Negative Index of Refraction Metamaterial," accepted, *Physica Status Solidi B*, Vol. 245/5/2008, page 992-997.
23. N. Wongkasem, A. Akyurtlu, K. A. Marx, Q. Dong, J. Li, and W. D. Goodhue, "Development of Negative Refractive Index Chiral Metamaterials in the Optical Frequency Regime," *Special Issue on Optical and THz Antenna Technology, IEEE Transactions on Antennas and Propagation*, Vol. 55, No. 11, pp. 3052-3062.
24. A. G. Kussow, A. Akyurtlu, A. Semichaevsky, and N. Angkawatissipan, "Superconductor-based optically isotropic negative refraction index metamaterial at visible wavelengths," *Proceedings of Metamaterials 2007*, Rome, Italy, pp. 525-528, October 2007.
25. N. Angkawatissipan and A. Akyurtlu, "Conformable Wireless Sensors for Strain/Crack Detection," *2008 IEEE AP-S International Symposium and USNC/URSI National Radio Science Meeting*, San Diego, CA, July 5-12 2008.
26. N. Wongkasem, A. Akyurtlu, K. A. Marx, Q. Dong, J. Li, and W. D. Goodhue, "Development of Negative Refractive Index Chiral Metamaterials in the Optical Frequency Regime," *Special Issue on Optical and THz Antenna Technology, IEEE Transactions on Antennas and Propagation*, Vol. 55, No. 11, pp. 3052-3062.
27. A. Akyurtlu and A. G. Kussow and, "Homogenous Negative Index of Refraction Metamaterials in the THz Regime," *2008 IEEE AP-S International Symposium and USNC/URSI National Radio Science Meeting*, San Diego, CA, July 5-12 2008.
28. A. Akyurtlu and A. G. Kussow and, "Homogenous Negative Index of Refraction Metamaterials in the THz Regime," *2008 IEEE AP-S International Symposium and USNC/UR*
29. N. Limberopoulos, A. Akyurtlu, A. S. Karakashian, and W. D. Goodhue, "Design, Fabrication, and Validation of Optical Metamaterials," *2008 IEEE AP-S International Symposium and USNC/URSI National Radio Science Meeting*, San Diego, CA, July 5-12 2008.
30. Bandremer, J. Therrien, and A. Akyurtlu, "Novel Fabrication Methods for Isotropic Optical Negative Index Metamaterials", Invited, Special Session on "Nanoelectromagnetics," *2008 IEEE AP-S International Symposium and USNC/URSI National Radio Science Meeting*, San Diego, CA, July 2008, submitted.
31. AJ Elbirt, *Understanding and Applying Cryptography and Data Security*, Auerbach Publications, in print.
32. S O'Melia and AJ Elbirt, "Enhancing the Performance of Symmetric-Key Cryptography via Instruction Set Extensions", Submitted to *IEEE Transactions on Very Large Scale Integration (VLSI) Systems*.



33. AJ Elbirt, "Accelerated AES Implementations Via Generalized Instruction Set Extensions", *Journal of Computer Security*, 16(3), pp. 265-288, 2008.
34. P Gamache, A Galante, G Seben, and AJ Elbirt, "Validating Baseball Bat Compliance", *Sports Engineering*, 10(3), pp. 157-164, 2007.
35. S O'Melia and AJ Elbirt, "Instruction Set Extensions for Enhancing the Performance of Symmetric-Key Cryptography", Submitted to the 24th Annual Computer Security Applications Conference – ACSAC 2008.
36. A. J. Elbirt, L. Abdallah, K. Fisher, A. Koren, and P. Scollin, "Tablets At the Bedside: Accuracy Testing of Secure Wireless-Based Data Entry in a Nursing Education Laboratory", 2007 University of Massachusetts Instructional Technology Conference, April 5 2007, Springfield, Massachusetts USA.
37. . A. J. Elbirt, "Fast and Efficient Implementation of AES Via Instruction Set Extensions", IEEE 21st International Conference on Advanced Information Networking and Applications (AINA-07), Third IEEE International Symposium on Security in Networks and Distributed Systems, May 21-23 2007, Niagara Falls, Canada.
38. P. Scollin, A. J. Elbirt, A. Koren, and K. Fisher, "Tablets At the Bedside: Accuracy Testing of Secure Wireless-Based Data Entry in a Nursing Education Laboratory", the Twenty-Fifth International Nursing Computer and Technology Conference, June 14-17 2007, San Francisco, California, USA.
39. Kanti Prasad "Motivating Students through Industrial leaders By Providing State-Of-The-Art Technology and Successfully Spreading the Mission of the ASEE at UMASS Lowell", ASEE National Conference, May 2007.
40. Kanti Prasad, "Imparting Consummate Instructions in Microelectronics Engineering and VLSI Technology at the University of Massachusetts Lowell " ASEE national conference at Pittsburgh on June 23, 2008.
41. Alex Raj and Oliver C. Ibe, "A Survey of IP and Multiprotocol Label Switching Fast Reroute Schemes," *Computer Networks*, volume 51, 2007, pp. 1882-1907.
42. Oliver C. Ibe, "Analysis and Optimization of M/G/1 Vacation Queueing Systems with Server Timeout," *Electronic Modeling*, volume 29, 2007.
43. O.C. Ibe, *Markov Processes for Stochastic Modeling*, Elsevier Academic Press, 2008.

## **XI. Conferences**

### **Dalila B. Megherbi**

(Conference International Program Technical Committee and Organizer)

*Visualization, Imaging and Image Processing International Conference (VIIP 2008)*, Marbella, Spain

*International Conference on Robotics & Automation*, Tampa (Florida); November 2008

Conference International Technical Program Committee and Organizer

*Computer Graphics and Imaging , IASTED Conference, Hawaii*, August 2008

Attendance:

*IEEE International Conference on Homeland Security, Waltham, May 2008 IEEE Southeast Conference*, Alabama, April 2008.

### **Kanti Prasad**

Annual ASEE Regional Conference, May 2008.

Received in zone 1 best paper award at ASEE national conference at Pittsburgh on June 23, 2008.



**Alkim Akyurtlu**

*North American Radio Science Meeting, Ottawa July 2007.*

IEEE Antennas and Propagation Magazine, Editor

*N. Angkawasittpan and A. Akyurtlu, "Flexible Negative Index Metamaterials," Nypro Conference, UML, November 2007.*

**A. Akyurtlu**, "Metamaterials in the Visible Range," *AFOSR Scientific Advisory Board Review Poster Session*, Arlington, VA, August 2007.

**A. J. Elbirt**

*"Instruction Set Extensions for Enhancing the Performance of Symmetric-Key Cryptographic Algorithms"*.  
Invited talk, presented at Worcester Polytechnic Institute, Worcester, Massachusetts, December 2007

**X. Intra-and inter- University Collaboration**

Dr. Dennis Martinez, Director of Research and Development, M/A-COM, Inc  
Professor Michael Fiddy, Director, Optoelectronics and optical Communications Center, the University of North Carolina at Charlotte  
Prof. Juliette Rooney Verga, Department of Biology, UML  
Food and Drug Administration, Agency (NCR)  
Professor Julie Chen, Mechanical Engineering  
**Professor James Sherwood, Mechanical Engineering**  
Dr. Jon Arvik, Chief Scientist, NASA Remote Sensing Technologies Center, Mississippi  
Mr. Norbet Kaula, Chief Scientist and Research Professor, Colorado Health Sciences Center  
Mr. Chris Gantz, Senior Engineer, Storage Area Networks and IO performance, SUN Microsystems  
Mr. Thomas V. McNamara, Draper Laboratory.  
Mr. David Killelea, SUN Microsystems  
Dr. P. Deb, Raytheon Co.  
Professor Jody Gold, Department of Public Health, Temple University,  
Professor. Bannister, Chemistry Department (UML).  
Professor Young-Kyun Kwon, Assistant Professor of Physics and Applied Physics

**XI. Regional/Local Community Technical Outreach**

Through the Center, which is part of a public university, we have been rigorously working in creating collaboration/partnership with local/national Industry, research labs, and government agencies in basic research, applied research, and technology transfer, to strengthen the local and national economy. Those include MA-COM Co, Raytheon Air and Missiles Defense Systems, Altera, Xilinx, Draper Laboratory, TRW Joint Synthetic Battle-space, SDRC Inc, Cisco Inc, Lucent Technologies, Nortel Networks, SUN Microsystems, NASA Remote Sensing Center, Colorado Health Sciences, Altova Inc, and the Grid Computing consortium, the Food and Drug Administration (FDA) (NCR), UMass medical School.



The Center supports the newly developed Computer Engineering programs at UML stimulating researchers to place renewed value on quality education, research training, and curriculum innovation in the context that education and research are of equal value and complementary parts of an integral whole.

## XII. FUNDING

There are 10 research grants and contracts awarded/active during this reporting period in the respective amounts of: one from Analog Devices **(\$60,000)**, one from Skyworks Solutions Inc, **(\$60,000)**, one from Intel corporation **(\$10,000)**, one from Army Research lab (ARL) **(\$150,000)**, one from NSF **(\$300,000)**, one from AFSOR **\$450,000**, one from NSF **(\$366,000)**, one from UMASS Strategic Initiative **(\$24,064)**, one from Sky-computers Inc **(\$144,800)**, one from HP Higher Technology **(\$68,000)**

Submitted proposals during academic year 2007-2008:

- *“Knowledge Representation and Extraction for Characterization and Analysis of Arbitrarily Sized Genomic Sequences and Data”*, NSF. **(\$448,900)**.
- *“: University of Massachusetts Lowell Undergraduate Research and Training in Computer Engineering and Related Fields”*, NSF, **\$479,600**.
- AJ Elbirt, *“Enabling the Use of Any Computer - Secure, Virus-Immune, Without-A-Trace”*, **Massachusetts State Police, \$70,183**
- AJ Elbirt, *“Bulk Data Encryption Targeting Systems with Limited Hardware Resources”*, DARPA - **Strategic Technologies, \$290,128**,
- Oliver Ibe, "Project IMPACT: Increasing Math Proficiency in Algebra with College Tutors." With Graduate School of Education, **e Commonwealth Corps, \$73,920**.

Snap Shots of Some Recent Research Results at CMINDS:

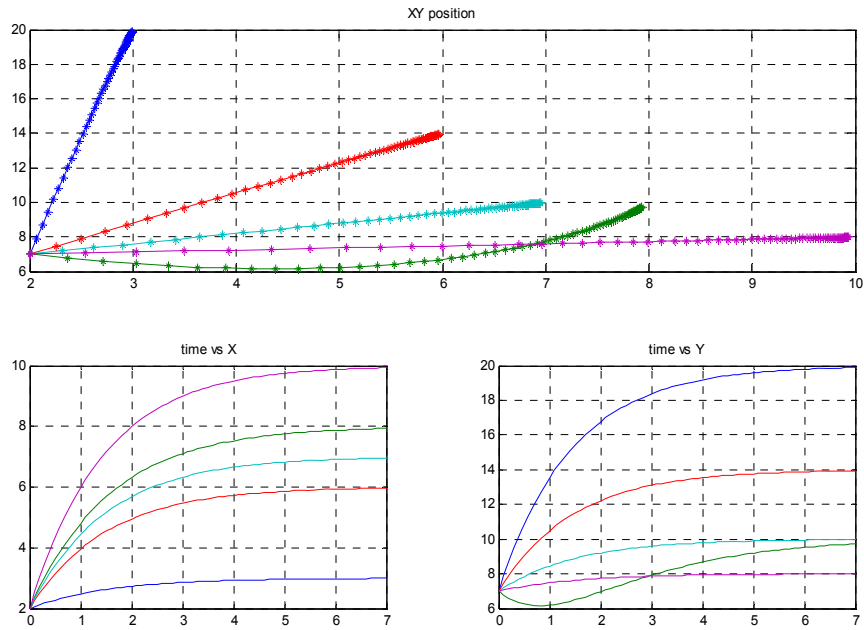
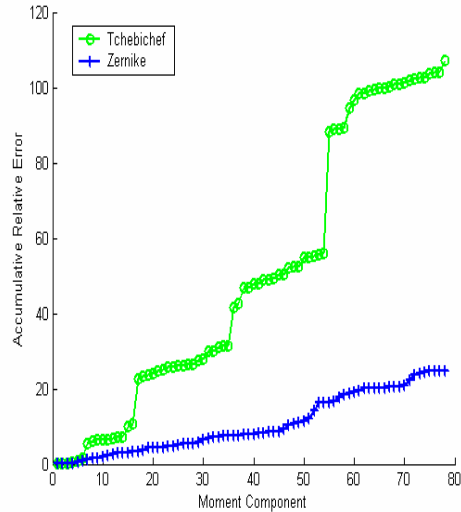
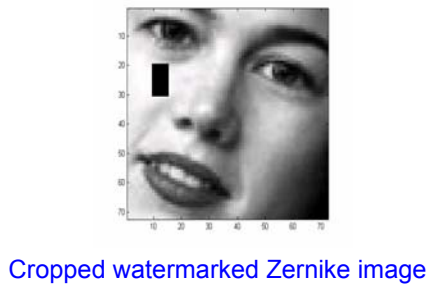


Figure-1 Examples of Results from the work going on at CMINDS in the field of Complex Interconnected Dynamical Systems (IDS). This figure shows the change in the Interconnected Dynamical System (IDS) Convergence Time, in 5 constrained agents' (dynamical systems) Y components (vertical component in the graph), as the different link weights of the interconnected system vary (horizontal component in the graph), with and/or without time-delay. The 5 agent starts from a known starting state and progresses to a desired but only *approximately known destination state*. There are many applications to the proposed techniques. One of them, is battlefield terrains, distributed interconnected structures, and distributed networks to name a few. These distributed techniques show potential results in fast learning and optimal-result finding processes.

# Tampering Detection Sensitivity Based on Proposed Metrics



The Accumulative Relative Error of the cropped images moments and the non-tampered image moments vs. moment component.

**Figure-2:** Example of Results from the work going on in CMINDS in the field of information securing, watermarking and recovery against non-authorized tampering. This figure shows the accumulative error and sensitivity of the proposed method for some tampering detection including image cropping. The proposed method shows its superiority over existing popular methods (method-1 and method-2) in the literature, in terms of watermark transparency, and image high security and tampering detection in the transmission.



## 10. CENTER FOR ELECTRIC CAR AND ENERGY CONVERSION (EC&EC)

### I Mission Statement

To promote a clean environment and less dependent on foreign oil the EC&EC center is dedicated to the promotion of the use of electric cars as a mean for transportation and the use of alternative energy resources as a mean of generating electricity. To do that the center is doing the following:

1. Carry out basic and applied research with a goal of achieving national and international recognition for excellence. This goal will be implemented by external grant funding to evaluate emerging technologies and to develop the most promising electric-vehicle (EV) technology and the supporting technology including batteries, battery chargers and battery-charging stations using renewable energy sources.
2. Transfer the most promising technologies to industry, initially targeting local high-tech/electric-vehicle companies and energy-conversion companies
3. Providing state-of-the-art resources to local high-tech/electric-vehicle companies and energy-conversion companies that make electric cars and hybrid cars and to power-supply companies. This center will encourage and promote Industry/UMass-Lowell Collaboration.
4. Constructing prototypes projects of alternative energy sources (AES), such as; wind-turbines, Photovoltaic and fuel cells to generate electricity, solve the problems associated with the use of AES, show the public the prototypes of AES in action to encourage their use and finally through courses and education contribute to the understanding of the importance of these sources to the economy.
  1. Train graduate and undergraduate students in electric-car and energy-conversion technologies for the local and national workforces.

### II General Description

The center has the following advanced research laboratories:

#### **Renewable Energy Laboratory.**

This lab consists of three wind mills (1.5KW, 300 Watts, 500 Watts) , two Photovoltaic systems (three arrays of Photovoltaic panels totaling of 2500 Watts, four arrays of Photovoltaic panels totaling of 10,500 Watts) and 1.2 kw Ballard PEM Fuel cell). These renewable sources of power feed two huge banks of batteries (24 Volts battery bank consists of 24 batteries 305 AH each, and 48 volts battery bank consists of 16 batteries 305 Ah each).



In Addition research is done on super capacitors evaluation and applications to fast charging batteries and as energy storage units. The lab has four super capacitor modules each consists of 18 super capacitors cells and a 48 v output. A new 1.8kw wind turbine (Skystream) will be installed on the roof.

### **Battery Evaluation Lab Ball 308**

The Battery Evaluation Lab at the University of Massachusetts Lowell (UML) has three complete battery test systems. The systems are computer controlled and are designed to test batteries ranging from 0.1mV to 20 volts at 1mA to 320 amps. The current regulators are capable of current sinking or sourcing and can change from charge to discharge mode instantaneously . The data acquisition and control systems provide current control and data acquisition including voltage, current, time, and temperature. Each tester is controlled via A/D and D/A interfaces.

### **Power Electronics Lab Ball 310**

The lab has all kinds of equipment that allows a researcher to build, test, and evaluate the inverters and choppers.

### **Electric Car Evaluation Lab Pinanski 100 and 102**

The Lab has a fleet of eleven Solectria electric cars, and six level 2 battery charging stations (208 volts).

The cars are equipped with data acquisition systems and different types of batteries, with different ranges.

### **Advanced Composite Materials and Kitson 104 Textile research Lab**

## **III Research Groups and Activities Focus Areas**

There are four research groups:

### **1. Electric Vehicle Group**

This group is engaged in the following activities:

- a) Evaluate the suitability of a battery for electric vehicle application. The heating and cooling demands, the road evaluation test.
- b) Evaluating electric vehicles battery chargers and designing new generation of battery chargers, modular type of battery chargers.
- c) Evaluating Electric vehicle batteries charging algorithms
- d) Doing research on heating and cooling electric vehicles
- e) Doing research on battery management systems in the electric vehicles
- f) Fast battery charging using super capacitors

### **2. Renewable Energy Group**

- a) Evaluating and solving problems of Wind Energy Conversion Systems
- b)Evaluating and solving the problems of Photovoltaic Systems



- c) Evaluating and solving problems of Fuel Cells
  - d) Evaluating the distributed generation system operation that consists of Wind/Photovoltaic/Fuel cells
  - e) Evaluating super capacitors
3. **Modeling and Characterization of Baseball Bats group**
4. **Composite Materials group**

#### **IV-Associate Personnel:**

### **Primary**

Dr. Ziyad Salameh, Center Co-director / Electrical Engineering

Dr. James Sherwood, Center Co-director / Mechanical Engineering

Dr. Julie Chen, Center Co-director / Mechanical Engineering

### **Secondary**

Dr. Robert Parkin / Mechanical Engineering

Dr. Gene Niemi / Mechanical Engineering

Dr. Mufeed Mah'd, Electrical Engineering

Dr. Fahad Wakim / Electrical Engineering

Mr. Alan Rux / Electrical Engineering



## V-Student Research Support

### Funding 07/08

Title	Funding Source	PIs	Period	Amount
<b>10.6 kw Photovoltaic Design and evaluation</b>	<b>MTC</b>	Ziyad Salameh	06/08	<b>\$50,000</b>
Distributed Energy Neural Network Integration System	DOE/Orion	Ziyad Salameh	06/08	<b>\$157,000</b>
Evaluation of super capacitors and advanced lithium batteries for EV application	National Grid	Ziyad Salameh	07/08	<b>\$26,000</b>
Modeling and Characterization of Baseball Bats	Major League Baseball & Rawlings	Jim Sherwood	06/08	\$93,000
<b>Linking Process-Induce Properties to Thermoplastic-Matrix Woven Fabric</b>	NSF	Jim Sherwood Julie Chen Larissa Gorbatiikh	08	\$360,000
Evaluation of 1.8 Sky stream wind turbine,	National Grid	Ziyad Salameh	08	<b>\$26,000</b>
Electric Drive Train System Study	Insular Technologies	Ziyad Salameh	08	<b>\$4,000</b>
Evaluation of Lithium Ion Batteries	International Battery Inc	Ziyad Salameh	07/08	<b>\$27,612</b>

### **Students Interaction:**

#### **Current Doctoral Students**

<u>Student</u>	<u>Disertation</u>
1. Frank Tredeau/ ECE	Lithium ion batteries evaluation for EV
3. Bong Fon Kim /ECE	Evaluation of lithium Polymer Batteries for EV
4. Butch Cultura / ECE	Distributed generation performance Evaluation



- 5 Jennifer Gorczyca/ ME
- 6. Xiang Li /ME

A Constitutive Model for Woven Composite  
Finite element analysis of woven composites and the stamping process: modeling, prediction and optimization

### Current Master Students:

<u>Student</u>	<u>Thesis</u>
3. Macancela Jhonny / ECE	Energy Storage in Fly-wheels
4. Adam Crowell	PV powered Street Light
5. Nathan P. Gravelle /ME	Using the Finite Element Method to Investigate the Potential Replacement of a Steel Side-Impact Beam with a Composite
6.Ching-Pei Liang/ME	Determination of Material Constants for Viscoplastic Constitutive Theories
7.Kari White /ME	Composite Ply Shear Test and Model

### Recent graduates

- 2006 . Buasri Panhatha, DE. Distributed Generation Using Wind/Photovoltaic/fuel Cell

### VI Current and Recent Research Projects

- 1) Evaluation of Lithium ion batteries for the use in electric vehicles.
- 2) Modular EV battery charger and management system
- 3) Evaluation of Lithium polymer batteries for the use in electric vehicles
- 4) Evaluation of sky stream 1.8 kw wind turbines
- 5) EV Battery Charging Station Using Super Capacitor
- 6) *Linking Process-Induce Properties to Thermoplastic-Matrix Woven-Fabric Composites Performance*

### VII Most Recent Publications 07/08

- Alaoui Z. Salameh, "Electric Vehicle Diagnostic and Rejuvenation System (EVDRS)", International Journal of Power & Energy Systems, Vol. 27, No 2, pp. 151-156, 2007.
- F. Giraud and Z. Salameh , "Combined Effects of Passing Clouds and Wind Gusts on an Interactive Wind-PV System With Battery Storage Using Neural networks,"

- Electric Power Components and Systems Journal, Vol. , 35, No. 7, pp. 823-836, July 2007.
- F. Giraud and Z. Salameh, "Harmonics Generated by a Grid-Linked Residential Wind/Photovoltaic Hybrid System With Battery Storage," *Electric Power Components and Systems Journal*, Vol. , 35, No. 7, pp. 757-768, July, 2007.
- A. Davis and Z. Salameh, "Compatibility of Small-Scale Wind and Photovoltaic Systems Used as Distributed Generation", IASTED Asia PES, Phuket, Thailand April ,2007,
- F. Tradeau and Z. Salameh, "Characterization of the M100–12 NiZn Battery" IASTED, Jan. Orlando, Fl. 2007.
- P. Buasri and Z. Salameh," Harmonics generated by a distributed generation system using Wind/Photovoltaic/Fuel cell with battery storage", IASTED Asia\_PES07,Phuket ,Thailand, April ,2007 .
- A. Cultura and Z. Salameh," Design and installation of 10.56KW Photovoltaic power system at UML," *Power Gen. Renewable and Fuels*, Las Vegas. NV, March 2007.
- P. Buasri and Z. Salameh," Modeling of a Distributed Generation System using Adaptive Neuro Fuzzy Inference Approach, "Annual IEEE\_PES , PP. NO, 07GM0715, FI ,2007.
- W. Lynch and Z. Salameh," Taper Charge Method for a Nickel-Cadmium Electric Vehicle Traction Battery," Annual IEEE\_PES , PP. NO, 07GM1503, FI ,2007.
- Gorczyca, J. A " Study of the Frictional Behavior of a Plain-Weave Fabric during the Thermo stamping Process, Doctoral Dissertation, Department of Mechanical Engineering, University of Massachusetts Lowell. In Press.
- Gorczyca-Cole, J., Sherwood, J. and Chen, J., 2006, "Development of a Friction Model for Use in the Thermo stamping of Commingled Glass-Polypropylene Woven Fabrics," *Composites Part A*, (in press).**
- Gorczyca, J., Sherwood, J. and Chen, J., 2005, "A Friction Model for use with a Commingled Fiberglass-Polypropylene Plain-Weave Fabric and the Metal Tool during Thermo stamping", *European Finite Element Revue*, Vol. 14, No. 6-7, p. 729-751.**
- 16 A. Cultura and Z. Salameh,"Economic Analysis of 10.56kw Grid connected Photovoltaic system at UMass-Lowell, PVSEC-17, Dec. 2-7, 2007, Fukuaka, Japan.
- W. Lynch and Z. Salameh," An Electrical Component Model for Lithium Ion Cells". Accepted for publication in the Proceeding of " Solar 2008 Conference, May 2008, Santiago, CA.
- Kim Bong, F.Tredeau and Ziyad Salameh," Realistic Electric Vehicle Lithium Polymer Battery Evaluation". Accepted for Publication in the Proceedings of the Annual IEEE\_PES Meeting, PP. NO, 08GM0861.
- A. Cultura and Z. Salameh," Performance Evaluation of a Super Capacitor Module for Energy Storage Applications" .Accepted for Publication in the Proceedings of the Annual IEEE\_PES Meeting , PP. NO, 08GM0686.
- Kim Bong, F. Tradeau and Ziyad Salameh," Fast Chargeability of Lithium Polymer Batteries". Accepted for publication in the Annual IEEE\_PES Meeting , PP. NO, 08GM0857.
- A. Cultura and Z. Salameh," Performance Evaluation of a 1.2 KW PEM Fuel Cell Connected to Wind/PV Distributed Generation System " Solar 2008 Conference, May 2008, Santiago,CA



Kim Bong, F. Tredeau and Ziyad Salameh, "Performance Evaluation of Lithium Polymer batteries for use in the Electric vehicles", VPPC 2008 Harbin, Sep 3-7, 2008, China.

F. Tredeau, Kim Bong and Ziyad Salameh, "Performance Evaluation of Lithium Ion batteries for use in the Electric vehicles", VPPC 2008 Harbin, Sep 3-7, 2008, China.

### **VIII Conferences:**

Members of the EC&EC center attended the following conferences:

1. IASTED Asia\_PES 07, Phuket, Thailand
2. Power Gen. Renewable and Fuels, Las Vegas. NV, March 2007
3. Annual IEEE\_PES, Florida , 2007
4. Annual IEEE\_PES, Pittsburgh, PA , 2008
5. VPPC 2008, China
6. Solar 2008, Santiago, CA
7. PVSEC-17, Dec. 2-7, 2007, Fukuoka, Japan.
8. 13<sup>th</sup> IEEE- SA, April 19-30, 2008, Dhahran. Saudi Arabia
9. **19th Annual American Society for Composites Conference.**
10. **7th ESA Form Conference**
11. **8th ESA Form Conference**

### **IX Journal Editorial Boards:**

Professor Salameh is an associate editor of the following two International Journals:

1. International Journal of Power & Energy Systems  
ISSN-1078-3466

### **X Intra University Colaboration**

- Generating electricity for the University for the facility department, installed capacity of 15.4 kw.

### **XI Regional/Local Community Technical Outreach**

The primary focus of the center is industrial extension work. The center is aiming at solving problems facing the electric-car industry as well as developing new methods of efficiently utilizing energy-conversion devices and improving the power quality. EC&EC has developed good working relations with the following Massachusetts based companies and agencies:



New England Power Service/NEES , National Grid  
Division of Energy Resources/DOER  
Boston Edison Company  
Cambridge Electric Light Company  
E-Vermont  
Nstar  
Commonwealth Electric Company/COM-EL of 3D  
Productibility Fixture Composite  
Solectria Corp./ electric-car manufacturer  
DOE  
Evercell  
Specialty Material  
MTC  
Ford Motor Co.  
I-TEK  
Major League Baseball  
Electrastor  
Eagle Picher  
Plug Power  
Ballard  
International Battery Inc.  
Solar One  
Arc Energy  
Harbor Planning Group

### **Community Outreach**

**The center has a cooperative agreement with Lowell Historic National Park (LHNP),and through DOE acquired three grants to help the LHNP.**

### **XII Strategic Goals of the Center**

Promote clean environment and reduce dependent on foreign oil. This is done by Solving the problems facing the electric-car commuters as they arise, and solving the problems of the use of alternative energy sources.  
Expand the activities of the center to other cars like the hybrid and the fuel cell cars.  
Educate the public about the use of renewable energy sources  
and help transferring the renewable energy technologies to the public in Massachusetts  
and help Massachusetts companies exporting it.



## 11. CENTER FOR ELECTROMAGNETIC MATERIALS AND OPTICAL SYSTEMS (CEMOS)

### **Mission Statement**

The mission of the Center for Electromagnetic Materials and Optical Systems (CEMOS) is to support government research, regional industries, and train undergraduate and graduate students. The center is committed to remain a resource in photonics, electromagnetics, and the study of electromagnetic materials. Applying this expertise and expanding collaboration with industry is a primary element of the center's mission via materials and system analysis and design.

### **General Description**

The research underway in CEMOS comprises a number of different scientific disciplines and involves projects at the overlap of these different disciplines. These disciplines (1) electromagnetic wave propagation studies, and novel metamaterial investigations; (2) optical systems and component design and 3) nanotechnology and 4) biophotonics. In the first discipline, rigorous computational electromagnetics codes are developed to study electromagnetic wave interactions with complex media, wave propagation, and device design. The second disciplines involves research on the design, fabrication and characterization of photonic devices such as long wavelength Avalanche Photodiodes (APDs) and quantum dot structures as well as optical subsystems such as tunable fiber lasers. The third discipline is directed at the development of nanomaterials, such as carbon nanotubes (CNT), and their use in optical and electronic devices. The fourth discipline involves research on the design and development of biosensors such as miniature in-cell sensing probes and simultaneous multianalyte sensing systems with high resolution and sensitivity.

### **Research Focus Areas**

The following is a short summary of the research of the four faculty members currently active in CEMOS. There are also projects that involve two or more faculty working on a common project, often working at the overlap of two or more disciplines.

Professor Akyurtlu's research involves the investigations of electromagnetic waves with novel metamaterials, which possess material properties not found in naturally occurring materials. Specifically, the work involves the design of novel metamaterials at GHz and THz regimes, development of material property extraction methodologies, and novel designs including patch antennas using these metamaterials are studied. Prof. Akyurtlu's research group has collaborated with researchers at NASA Langley Research Center and at AFRL Antennas Technology Branch at Hanscom Air Force Base. Fabrication of these materials at the GHz frequency regime has been accomplished at AFRL. A novel metamaterial design constructed to perform at the THz frequency regime will be fabricated in collaboration with Prof. Goodhue from the Photonics Center. Furthermore, collaborations are ongoing with the Plastics Engineering Department for nanomanufacturing of nano-scale metamaterials, as well as deformable metamaterials based on novel fabrication techniques.



Professor Armiento's primary activities involve development of optoelectronic components and optical networks based on Wavelength Division Multiplexing (DWDM). He has been working with Prof. Goodhue (UML Physics Dept) on two AFRL grants involving the development of long wavelength (2-4 micron) InGaAsSb/InGaAsSb avalanche photodiodes (APDs) and an integrated photodetector/deformable mirror array for wavefront correction.

Professor Lu's work includes developing quantum dot infrared photodetectors, wavelength tunable fiber-lasers, and flexible nano-transistors. Prof. Lu has been collaborating with industry, including Crystal research Inc. and Polaronyx Inc. in investigations of optical interconnects and optical filters. Professor Lu is also working with Raytheon in high-performance infrared photodetectors, and Brewer science in carbon nanotube based flexible transistors.

Prof Joel Therrien's work includes fabrication of SiC nanowire transistors and Micro-Electro-Mechanical devices for applications in sensors. He is also working on methods for high speed Atomic Force Microscopy including the design of novel cantilevers for faster readout. This effort is geared towards measuring nanoscale components in manufacturing lines. He is also working on self assembly of metamaterials (with Prof. Akyurtlu). He is also working on Chemical vapor Deposition growth of graphene. He is also collaborating on various biology projects (with Prof. Susan Braunhut) on instrumentation and sensor development.

Prof Xingwei Wang's work includes developing versatile sensing system for detection of chemical and biological interactions, miniature in-cell sensing probes, blood pressure sensor, sensors with nanostructure for surface enhanced Raman scattering (SERS), and some sensors for harsh environments, such as acoustic sensors. She is collaborating with the Chemistry Department, the Plastics Engineering Department, and the Mechanical Engineering Department on sensor fabrication and testing.

## **Personnel**

### Active Faculty Members

Prof. Craig Armiento, Director  
Prof. Alkim Akyurtlu, Deputy Director  
Prof. Xuejun Lu  
Prof Joel Therrien  
Prof. Xingwei Wang

### Affiliated Faculty

Professor William Goodhue (Physics Department)  
Prof. Dikshitulu Kalluri (ECE)

## **New and Temporary Faculty Affiliations**

none



## Students Currently Supported

### Funded RAs:

Nantakan Wongkasem, Andrey Semichaevsky, Nicholaos Limberopoulos, Niwat Angkwattisipan., Ravi Bhatia, Rohit Samarth, Jared Vallancourt, Amir Dindar, Samba Siva Karthik Bollam, Jarrod Vallancourt, Haitao Xia, Hanyan Zhang, Puminun Vasinajindakaw; Xiaodong Ma; Tao Jiang, Malavika Vashist, Aaron Bandremer, Meg Noah (Physics)

### Doctoral Students:

Nicholaos Limberopoulos, Niwat Angkwattisipan, Aaron Bandremer (Bioengineering), Jarrod Vallancourt; Xiaodong Ma (Bioengineering); Tao Jiang (Physics), Aaron Bandremer Ph.D. Student (Bioengineering); Meg Noah (Physics)

### Post Doctoral Fellow

Wenhui Wang

### Degrees Granted

Nantakan Wongkasem, D.Eng. in Electrical Engineering  
Andrey Semichaevsky, D.Eng. in Electrical Engineering  
Jarrod Vaillancourt, M.S. in Electrical Engineering  
Lei Zheng, M.S. in Electrical Engineering  
Amir Dindar, M.S. in Electrical Engineering

## Current and Recent Research Projects

There are a number of current research projects in metamaterials, electromagnetic modeling and photonic devices and nanomaterials that have been described in Section 3.

### **1. Publications (Most Recent/ School Year of this report)**

A. G. Kussow and A. Akyurtlu, "Optically Isotropic Negative Index of Refraction Metamaterial," accepted, *Physica Status Solidi B*, Vol. 245/5/2008, page 992-997.

A.G. Kussow, A. Akyurtlu, A. Semichaevsky, and N. Angkawatissipan, "MgB<sub>2</sub>-based negative refraction index metamaterial at visible frequencies," *Physical Review B*, 76, 195123. [This article was selected for the December 1, 2007 issue of Virtual Journal of Applications of Superconductivity.](#)

N. Wongkasem, A. Akyurtlu, K. A. Marx, Q. Dong, J. Li, and W. D. Goodhue, "Development of Negative Refractive Index Chiral Metamaterials in the Optical Frequency Regime," *Special Issue on Optical and THz Antenna Technology, IEEE Transactions on Antennas and Propagation*, Vol. 55, No. 11, pp. 3052-3062.

A. Akyurtlu, D. H. Werner, V. Veremey, D. J. Steich, and K. Aydin, "Staircasing Errors in FDTD at an Air/Dielectric Interface," *IEEE Microwave and Guided Wave Letters*, Vol. 9, No. 11, pp. 444-446.



“Molecular behavior in the vibronic and excitonic properties of hydrogenated silicon nanoparticles” Rao S., Mantey K., Therrien J., Smith A., and Nayfeh M., *Phys. Rev. B* (76), 155316 (2007)

“Voltage-tunable dual-band InAs quantum-dot infrared photodetectors based on InAs quantum dots with different capping layers,” Mark J. Meisner, Jarrod Vaillancourt, and Xuejun Lu, Accepted for publication, *Semiconductor Science and Technology*, (2008)

“Temperature-dependent photoresponsivity and high-temperature (190 K) operation of a quantum dot infrared photodetector,” Xuejun Lu, Jarrod Vaillancourt and Mark J. Meisner, *Applied Physics Letters*, Vol. 91, No. 5, pp. 051115 (2007).

“A modulation-doped longwave infrared quantum dot photodetector with high photoresponsivity,” Xuejun Lu, Jarrod Vaillancourt, and Mark J. Meisner, *Semiconductor Science and Technology*, vol. 22, pp. 993-996 (2007)

Longwave-infrared InAs-InGaAs quantum-dot infrared photodetector with high operating temperature over 170 K”, Xuejun Lu, Jarrod Vaillancourt, Mark J. Meisner, and Andreas Stintz “*Journal of Physics D: Applied Physics*, vol. 40, pp. 5878-5882 (2007).

“Modulation-doped InAs-InGaAs quantum dot longwave infrared photodetector with high quantum efficiency,” Xuejun Lu, Mark J. Meisner, Jarrod Vaillancourt, Jin Li, Xifeng Qian, and William D. Goodhue, *IEE Electronics Letters*, Vol. 43, Issue 10, p. 589-590 (2007).

“An Electro-optic Tunable Band-pass Filter Based on Long –period-grating Assisted Asymmetric Waveguide Coupling,” Xuejun Lu, Miao Li, Rohit Samarth and Lei Zheng, *Optical Engineering Letters*, Vol. 46, No. 4, p. 040508 (2007).

“Printable High-Speed Thin-Film Transistor on Flexible Substrate Using Carbon Nanotube Solution,” Xuliang; Janzen, Daniel; Vaillancourt, Jarrod; and Lu, Xuejun; *Micro & Nano Letters*, Vol. 2, pp. 96 (2007).

“AFM studies of nanoparticle deposition via electrospray ionization” Therrien, J, Dindar, A, and Smith, D, *MICROSC RES TECHNIQ*, 70(6), 530 (2007)

## 2. Conference Presentations

A.G. Kussow, A. Akyurtlu, A. Semichaevsky, and N. Angkawatissipan, “Superconductor-based optically isotropic negative refraction index metamaterial at visible wavelengths,” *Proceedings of Metamaterials 2007*, Rome, Italy, pp. 525-528, October 2007.

A. G. Kussow and A. Akyurtlu, “Negative index of refraction metamaterial in the optical regime with randomly distributed nanoparticles,” *Proceedings of Metamaterials 2007*, Rome, Italy, pp. 723-726, October 2007.

A. G. Kussow and A. Akyurtlu, “Negative Refraction Index in Magnetic Semiconductors,” *2008 American Physical Society March Meeting*, New Orleans, Louisiana, March 10–14 2008.



N. Angkawisittpan and A. Akyurtlu, “Conformable Wireless Sensors for Strain/Crack Detection,” *2008 IEEE AP-S International Symposium and USNC/URSI National Radio Science Meeting*, San Diego, CA, July 5-12 2008.

A. Akyurtlu and A. G. Kussow and, “Homogenous Negative Index of Refraction Metamaterials in the THz Regime,” *2008 IEEE AP-S International Symposium and USNC/URSI National Radio Science Meeting*, San Diego, CA, July 5-12 2008.

N. Limberopoulos, A. Akyurtlu, A. S. Karakashian, and W. D. Goodhue, “Design, Fabrication, and Validation of Optical Metamaterials,” *2008 IEEE AP-S International Symposium and USNC/URSI National Radio Science Meeting*, San Diego, CA, July 5-12 2008.

A. Bandremer, J. Therrien, and A. Akyurtlu, “Novel Fabrication Methods for Isotropic Optical Negative Index Metamaterials”, Invited, Special Session on “Nanoelectromagnetics,” *2008 IEEE AP-S International Symposium and USNC/URSI National Radio Science Meeting*, San Diego, CA, July 2008.

“A CdSe quantum dot photodetector for hyperspectral imaging in the visible region,” Jiang T., Dindar A., and Therrien J., *Proc. SPIE*, vol. 6829 (2008), Beijing, China

“A Novel Technique for the Production of MHz Frequency AFM Tips,” Therrien J. and Schmidt D., *MRS Fall Meeting*, Boston, MA, Nov. 2007

“A versatile technique for fabrication of SiC SPM probes,” Therrien J., Schmidt D., Barrot S., and Patel B., *APS March Meeting*, New Orleans, LA, March 2008

“A voltage-tunable multiband quantum dot infrared focal plane array with high photodetectivity,” Xuejun Lu; Jarrod Vaillancourt; Mark J. Meisner, *Proc. SPIE*, vol. 6940 (2008).

“Waveguide polarization decoding module for free-space quantum key distribution,” Xuejun Lu; Xuping Zhang, *Proc. SPIE*, vol. 6838 (2008).

“High-speed transparent flexible electronics,” Jarrod Vaillancourt; Xuejun Lu; Xuliang Han; Daniel C. Janzen; Wu-Sheng Shih, *Proc. SPIE*, vol. 6940 (2008).

“A miniature electro-optic switch array,” Xuejun Lu and Miao Li, *Proc. SPIE* 6469, 64691A (2007).

“An all-optical nonlinear threshold gate based on high-order weakly coupled microring resonators with a low switching threshold,” Xuejun Lu, Miao Li, Lei Zheng, and Jarrod Vaillancourt *Proc. SPIE* **6478**, 64780S (2007).

“A two-photon sequential absorption photocurrent generation process in modulation doped InAs/GaAs quantum dots,” Xuejun Lu and Mark Meisner, *Proc. SPIE* **6481**, 64810K (2007).



“A resonant tunneling CdSe quantum dot photodetector for spectral resolution in the visible region,” Therrien, J, and Dindar, A, SPIE Quantum Sensing and Nanophotonic Devices IV conference proceedings, Paper Number: 6479-29 (2007)

### **Other Presentations**

N. Angkawisittpan and A. Akyurtlu, “Flexible Negative Index Metamaterials,” *Nypro Conference*, UML, November 2007.

A. Akyurtlu, “Metamaterials in the Visible Range,” *AFOSR Scientific Advisory Board Review Poster Session*, Arlington, VA, August 2007.

Prof Therrien gave an invited lecture on nanoelectronics for the college of engineering at Nanjing University, China in Nov 2008.

Prof Therrien gave an invited seminar for the materials science department at the University of New Hampshire in Nov. 2008.

### **3. Collaboration with Other Centers**

**Our research activities continue to overlap with, and benefit from, close ties with Prof William Goodhue in the Photonics Center. Our interactions include topics such as: nanoscale metamaterials, long wavelength APDs in Sb-based materials, integrated MEMS devices and applications of quantum dots. The long term goal remains that of increasing collaboration between these Centers and expanding our interaction with the personnel at the Air Force Research Laboratories at Hanscom Air Force Base and NASA Langley. We also anticipate increased activity in collaborations on new electromagnetic materials, in particular with the Plastics Engineering and Physics departments.**

### **4. Regional/Local Outreach**

We have opened our facility to local schools through the U Mass Design Camp that is conducted in the summer months. We have had groups of junior high and high schools in the local community. Students have been exposed to concepts such as fiber optics and laser physics.

**We have been able to maintain and establish new contacts with industry partners through our research activities. The reorganization of the CEMOS labs, which we have been continuing throughout the last years, will help to make our facilities increasingly attractive for short term as well as long term industry collaborations.**

**CEMOS has a long standing history of supporting local industry by conducting exploratory studies which can be carried out at the center at relatively low cost and with the support and expertise of center personnel CEMOS is committed to continue these collaborations. We believe that we can meet our responsibilities in supporting local industry with higher efficiency by maintaining a high level of federal funding. Given the constraint of an academic research institution, this can be better addressed in terms of resources and personnel if these projects can be embedded and complemented by long term**



research. To maintain a healthy blend of external funding is a major emphasis of the center strategy.

## 5. Proposals Submitted/Awarded

### New Awards

A Quantum Approach to Optical Negative Index Metamaterials (NIMs): Homogeneous NIMs in the Solid State; AFOSR, May 2008- April 2011, \$450,000, Akyurtlu PI

UBAD: *Antibody Bioagent Detection*, Army Sensor Nanomanufacturing program, 8/08 – 12/09, year II funding (\$ still pending), Wang, co-PI.

*Acoustic-optical Sensors*, Army Sensor Nanomanufacturing program, Year II funding (\$ still pending), 8/08 – 12/09, Wang, PI.

*Novel Automated Nutrient Incorporation (NANI)*, CVIP, \$36,000, 06/08 -12/08, Wang co-PI.

Massachusetts Life Sciences Center (MLSC) Board of Directors: the New Investigator Grant: ~ \$600K (2008 – 2011). Wang, PI.

*Patterned graphene for template based nanomanufacturing*, Center for High Rate Nanomanufacturing Seed Grant, \$40,000, Therrien PI

*SiC Nanowire Field Effect Transistors using Preceramic Polymers*, National Science Foundation (NSF), \$60,000, Therrien, PI

*"Developing Infrared (IR) Transparent Conductive Electrode Technology,"* Sponsor: AFOSR, \$299,453. Xuejun Lu (PI). 2008-2011.

*"Developing MIR and LWIR Quantum Dot Infrared Detectors and Focal Plane Array,"* Sponsor: Raytheon, \$120,000. Xuejun Lu (PI) and William Goodhue (Co-PI). 01/2008-12/31/2008.

*Nanostructured Sensing Elements for Structural Health Surveillance*, Army Research Laboratory (ARL), \$150,000, 5/07 – 12/07, Akyurtlu PI.

*Novel Homogenous, Low-loss, and Tunable Magnetic Semiconductor-based Metamaterials*, National Science Foundation (NSF), \$300,000, 4/07-3 Akyurtlu PI

*LWIR and FIR Infrared Focal Plane Array*, Raytheon, 04/2007-03/2008, \$208,540, Xuejun Lu, PI

*LWIR and FIR Infrared Quantum Dot Photodetector with High Sensitivity and Large Field-of-View*, Air Force, SBIR Phase II, 04/2007-12/2008, \$184,950, Xuejun Lu, PI

*Development of High-Speed Infrared-Transparent Flexible Electronics based on Carbon Nanotube Solutions*, NSF STTR Phase I, 08/2007-07/2008, \$83,000, Xuejun Lu, PI

*Investigation of Optical Transparent Electrodes*, Crystal Research, 07/2007-12/2007, \$15,555, Xuejun Lu, PI.



## **Existing Contracts**

*Fluorescence/ Optical Detection, Army Sensor Nanomanufacturing program, 8/07 – 12/08, \$ 78,500, Wang PI*

*UBAD: Antibody Bioagent Detection, Army Sensor Nanomanufacturing program, 8/07 – 12/08, \$112,420, Wang, co-PI.*

*Acoustic-optical Sensors, Army Sensor Nanomanufacturing program, 8/07 – 12/08, \$46,200, Wang, PI.*

*Novel Automated Nutrient Incorporation (NANI), NCOE, \$36,000, 02/07 -05/07, Wang co-PI.*

*Nanostructured Sensing Elements for Structural Health Surveillance, Army Research Laboratory (ARL), \$150,000, 5/07 – 12/07, Akyurtlu PI.*

*Novel Homogenous, Low-loss, and Tunable Magnetic Semiconductor-based Metamaterials, National Science Foundation (NSF), \$300,000, 4/07-3 Akyurtlu PI*

*Novel Optical Metamaterials and approached for Fabrication, Air Force Research Laboratory (AFRL), \$100,459, 9/1/07 – 11/30/08, Akyurtlu (PI) and Therrien (Co-PI).*

*Investigation and Applications of Metamaterials in the Visible Regime, Air Force Office of Scientific Research (AFOSR), \$374,756, 5/05 - 4/08, Akyurtlu PI.*

*Electromagnetic Metamaterials for Advanced Antenna Applications, AFOSR, \$49,855.00, 6/05 - 8/06, Akyurtlu (PI).*

*Investigation of Chiral Metamaterials for Drug Characterization, Intellectual Property Advancement Grant, UML, \$132,800, 10/1/04 – 10/1/05, Akyurtlu (Co-PI).*

*Development of Long Wavelength Technologies and Devices, AFRL/SNHC, \$487,000, 7/04-7/07. Craig Armiento (Co-PI) with Prof Goodhue*

*NSEC: New England Nanomanufacturing Center for Enabling Tools, National Science Foundation, \$ 5,030,017, 8/1/04 – 7/31/09, Akyurtlu (Senior Personnel).*

*Research Training in Numerical Electromagnetics for Microwave Applications, Technical Training Trust, \$ 220,032, Kalluri(PI)*

## **Submitted Proposals**

*Low Cost Nano-Patterned Biosensor Substrate by High Rate Nanomanufacturing, CHN, \$30,000, 9/1/08 – 9/1/09, Wang, PI.*

*Collaborative Research: Fundamental Research on Titanium Drilling with Rotary Ultrasonic Machining, NSF, \$ 277,085, Wang, co-PI.*

*Rapid Laser Heating for Mold Wall Temperature Control in Polymer Processing, NSF, \$ 379,630, Wang, co-PI.*



RET Site: Manufacturing a Nano Future, NSF, \$479,979, Wang, co-PI

**Service**

Prof. Akyurtlu ; Editor, IEEE Antennas and Propagation Magazine, Reviewer: IEEE Transactions on Antennas and Propagation , IEEE Transactions of Microwave Theory and Techniques, IEEE Antennas and Wireless Propagation Letters, IEEE Antennas and Propagation Magazine, IEEE Microwave and Wireless Components Letters, Journal of Physics D: Applied Physics, Journal of Nanophotonics, Optics Communications

Prof. Wang; Reviewer, Applied Physics Letters, Sensors & Actuators: B. Chemical

Prof. Therrien ; Reviewer J. Phys. D and Nanotechnology



## 12. CENTER FOR FAMILY, WORK, AND COMMUNITY

Annual Report  
2007-2008

### 1. Mission

The Center is an interdisciplinary program of community-focused activities and research that emphasize sustainable economic and social development, leadership development, family enrichment, capacity building, and empowerment in areas such as environmental quality, community-based economic development, and the connection between work and family life. The Center places particular emphasis on expanding the capacity of organizations and community groups to address cultural diversity and changing family and community leadership roles. All activities of the Center are based on a multicultural approach to human problems. In all of its efforts, the Center for Family, Work and Community strives to:

- Demonstrate innovative ways that faculty can carry out collaborative projects with the community
- Demonstrate ways that social science research can contribute to regional economic development
- Build application capacity among faculty, staff, graduate, and undergraduate students throughout the University

### 2. General Description

During the 2007-2008 academic year, the Center for Family, Work, and Community continued to develop programs that bring university faculty, staff, and students together with external partners to address long-standing regional issues in economic and social development. All of the initiatives of the Center are intended to:

- Assist UML in achieving its mission of regional economic and social development
- Strengthen UML's commitment to working in collaboration with multiple partners
- Create opportunities for undergraduate and graduate students to work in interdisciplinary teams to address community problems
- Develop research programs that have strong application potential
- Develop and test innovative interdisciplinary approaches to problem solving
- Draw on the strengths of the diverse leaders in the region

### 3. Research Focus Area

CFWC's research focuses on "translational" research: that is, on ways that basic research can be carried out so as to lead directly to application. The topic areas of our translational research include environmental sustainability, healthy homes, affordable housing, health care for immigrant groups, educational inclusion, the built environment, environmental justice, and health and environmental impacts of urban living. During the 2007-2008 academic year, CFWC has involved faculty, staff, and students in research in each of the above areas.



#### 4. Associated Personnel (Faculty and Staff)

*Dr. Linda Silka*- Director

*Robin Toof*- Assistant Director, evaluation projects

*Bowa George Tucker*- Program Manager, GEARUP Educational Partnership

*David Turcotte*- Senior Program Manager, Strengthening the Capacity of Health Professionals, US Housing and Urban Development Fellows Program, Non-Profit Alliance, Sustainable Urban Redevelopment Program’s Lowell Green Building Initiative.

***Dan Toomey*- Program Manager, Community Outreach Partnership Center, Community Connections Information Clearinghouse (through March 2008)**

***Melissa Wall*- Program Evaluator, MAPA, Strengthening Couples. AMIGOS mentoring**

*Julie Villareal*- Program Manager – River Ambassador Program (RAP); Protecting Children’s Health from Environmental Risks, Collaborative Problem-Solving, Sustainable Urban Redevelopment Program’s Lowell Green Building Initiative

*Leticia Porter*- Associate Program Manager, Gear-Up Educational Partnership

*Leonor Daley*- Associate Program Manager, Gear-Up Educational Partnership,

*Shawn Barry*- Associate Program Manager, Gear-Up Educational Partnership, Program Manager, Science of Small Things

*Lauren Butler*- Associate Program Manager, Gear-Up Educational Partnership

*Elaine Donnelly*- Program Manager, Lowell High School-UMass Lowell Partnership

*Jason Carter*- Program Associate, Lowell High School-UMass Lowell Partnership

*Andrea Lee*- MA Campus Compact Americorps VISTA Volunteer  
Various tutors placed at local schools

#### 5. New and Temporary Faculty Affiliations (within last 3 years)

CFWC continues to support the development of faculty involvement in community outreach that links teaching and research. Dr. Silka, as CFWC Director, has continued to work with faculty to develop their skills in community outreach and research. The faculty involved at CFWC during the current academic year include Dr. Lenore Azaroff (Work Environment Research Faculty), Dr. Stephanie Chalupka (Nursing), Dr. Michaela Colombo (Education), Dr. Judith Davidson (Education), Dr. Khanh Dinh (Psychology), Dr. Mignon Duffy (Sociology), Dr. Robert Forrant (Regional Economic and Social Development), and Dr. Fred Martin (Computer Science), Dr. Deirdra Murphy (Physical Therapy), Dr. Susan Reece (Nursing), Dr. Marina Ruths (Chemistry), Dr. Charlotte Ryan (Sociology), Dr. Mansoureh Tajik (Health Education), Dr. Holly Yanco (Computer Science), Paula Haines (English), Dr. Marina Ruths (chem), Dr. Joyce Gibson (GSOE), Dr. Valeri Barsegov (chem), Dr. Melissa Pennell (English).

There have also been numerous faculty and staff members that have participated on a short term basis in several of CFWC’s projects.

#### 6. Students Supported-last year

*Graduate*

Shaun McCarthy- RESD

John Fraser- RESD

Karishma Shetty- CSP

*Undergraduate*

Saoran Roeth- Business

Christopher Geary- Business

Jennifer Clark- English



Ramona Bryan- CSP  
Kris Tuttle- CSP  
Lei Shuwen- RESD  
Madoka Asaka- RESD  
Amy Provencal- RESD  
Guiyuan Zeng- RESD  
Shuwen Liu- RESD  
Sreedevi Menon- Engineering  
Prashant Shah- Engineering

Esther Tetteh- Biology  
Diana Perez- Psychology  
Sade Jean-Jacques Pascale- Undeclared Health/Nursing  
Merrytime Ebhohon- Engineering  
Lucy Wafo- Biology  
Justin Harris- Mgnmnt  
Amber Zapatka- Engineering  
Robert Walters- undeclared  
Chanthu Phauk- undeclared  
Evan Chan Aldebol- Sociology  
Bianca Ramirez- CJ  
Chantal Joseph  
Lillian Nalubwama  
Ivonne Acholonu  
Hung Phan- Engineering  
Kenneth Kham- Computer Science

## 7. Current Research and Outreach Projects

### **Environmental and Health Outreach**

#### ***Sustainable Urban Redevelopment Program: Lowell Green Building Initiative***

As a result of interest from the city of Lowell's Division of Planning and Development and several stakeholders to establish programs and incentives to encourage more sustainable and greener construction and redevelopment practices, the UMass Lowell's Sustainable Urban Redevelopment Program identified 21 municipalities in the U.S. that have established sustainable building and development programs. We initially conducted an internet analysis of sustainable building programs websites of these municipalities. We then conducted follow-up telephone interviews with the managers of these sustainable building programs to ascertain pertinent information that was missing from the websites, but was necessary to our analysis and evaluation. The programs were selected to represent a cross-section of existing programs around the country. In order to determine which program components and economic incentives would be most useful in Lowell, we also conducted surveys of homeowners and building professionals. Based on the findings of this research, we developed recommendations on what kind of programs and incentives should be offered by the City of Lowell to encourage more sustainable and greener construction and redevelopment practices in the city. We presented a report with these recommendations "The Benefits of Building Green: Recommendations for Green Programs and Incentives for the City of Lowell" at a community forum in December, 2006. Subsequently, the City of Lowell's Environmental Subcommittee has reviewed these recommendations, leading to the City of Lowell to pass a resolution supporting US Mayors Climate Protection Agreement, which includes a focus on green buildings. In addition, the city joined the U.S. EPA's England's Community Energy Challenge, committing to become an EPA ENERGY STAR partner and reducing municipal emissions by 10%. We worked with the City of Lowell's Division of Planning and Development and City Council Environmental Subcommittee to identify prospective members for a proposed green building commission, which was established in November 2007 to help develop and promote the city's green building program. We continue to



work with the City of Lowell's Green Building Commission, providing research, technical assistance, and facilitation support.

### *Sustainable Outreach Partnership Initiative (SOPI): Creating Green Buildings and Healthy Communities*

**Project Description and Justification:** The goals of this project are to:

1. Adapt the generalizable local governmental level model of best practices (developed through the Lowell Green Building Initiative) for source reduction of green gas emissions, toxic materials and resource conservation using sustainable/green construction and redevelopment practices to other Merrimack Valley communities
2. Identify and develop effective programs and incentives that communities can use to promote environmentally friendly building design, construction and redevelopment processes in the private sector and local governmental level
3. Facilitate the creation and implementation of local sustainable/green building development programs statewide by promulgating this model of best practices to other cities in Massachusetts

During the course of the year, we worked with several cities, a regional planning entity, and other stakeholders within the Merrimack Valley, including the Cities of Lowell, Lawrence, Haverhill, Methuen and the Merrimack Valley Planning Commission by providing ongoing research support, technical assistance, and facilitation. In addition, we attended the Massachusetts Smart Growth/ Smart Energy Conference in Worcester on December 7, 2007 as exhibitors, distributed over 150 copies of our report, *The Benefits of Building Green* and discussed the Lowell Green Building Model with several attendees of the conference. David Turcotte also served as a panelist at the *Green, Clean and Sustainable – Economic Development for the 21<sup>st</sup> Century Summit* on May 19<sup>th</sup>, sponsored by the Merrimack Valley Economic Development Council and Congresswoman Niki Tsongas Office, presenting information on the Lowell Green Building Model and national research on how to establish programs and incentives at local level to encourage green construction and development while creating demand for green products and services that lead to new job creation. We also distributed copies of the *The Benefits of Building Green* report at the summit. Furthermore, we conducted case study research on four higher educational institutions that are leaders in the area of green and sustainable buildings.

### ***Technical Assistance and Research Center for Housing Sustainability (TARCHS)***

The Theodore Edson Parker Foundation recently awarded a \$25,000 seed grant to establish the Technical Assistance and Research Center for Housing Sustainability (TARCHS), which will enable UML to respond to the rapidly increasing community requests for housing technical assistance and research support. The four main goals of the TARCHS are the following:

1. Provide technical assistance on affordable housing to stakeholders and the city during the Hamilton Canal District “charrette” process and initial action plan activities identified in the City of Lowell’s 10-Year Plan to End Homelessness
2. Involve UML students in providing technical assistance to the City of Lowell and housing stakeholders, including in assessing the most effective ways to involve students in addressing housing needs



3. Build our internal capacity to identify in-kind contributions, resources, and volunteers so we can respond more effectively to the array of community housing needs
4. Conduct external fundraising activities to identify and obtain funding from private foundations, federal and state governmental agencies to support summer student research projects, efforts to develop “employer assisted housing” strategies, implementation of the City of Lowell’s 10-Year Plan to End Homelessness, and efforts to create a formal housing consortium and other housing issues, such as foreclosures.

We created a Community Steering Committee to help guide our research. The priority research project identified by the steering committee was to examine the impact of Hamilton Canal District on existing affordable housing, particularly in regards to Single Room Occupancy (SRO) units within the area. Engaging UML students, we assessed all properties within the area, gathering information about number of units, number of tenants, rental rates and key landlords. We also compiled statistics from the City assessor’s office and other key groups, combining all the information into a briefing paper presented to city officials. We also have begun to gather data on the foreclosure problem in the region to support effort of the Lowell Foreclosure prevention taskforce to address this burgeoning crisis. Moreover, we participated in the Merrimack Valley Regional Housing Consortium and co-sponsored a forum with them and the Northern Middlesex Council of Government on 40-B for regional governmental officials.

### ***Strengthening the Capacity of Health Professionals (EPA funded)***

This project was a partnership between the Nursing Department, Lowell Center for Sustainable Production and the Center for Family, Work, and Community to prevent environmental health risks facing children. To accomplish this, we focused on health professionals who serve low-income, immigrant/refugee and minority children in small cities and rural areas in New England, a population that is generally underserved by children’s environmental health capacity building efforts although it suffers disproportionately from the impacts of environmental contaminants.

Our objectives were to: 1) work closely, and increase knowledge through training and education, with the primary health care providers for such communities, including Community Health Centers, School Nurses, Public Health Nurses, Emergency Department Nurses, and Nurse Educators in order to build health professional capacity to address children’s environmental health in low-income and minority populations to understand, diagnose, and conduct prevention activities for a full spectrum of environmental health issues encountered by children in a culturally relevant manner; 2) create positive change in the practices of healthcare professionals, parents and children that contribute to the minimizing and/or eliminating environmental health hazards for children; 3) establish a training and evaluation model to build health professional capacity to address children’s environmental health that can be replicated; and 4) promote that model and continued networking of regional health professionals working on children’s environmental health through websites, professional listserves, conference presentations, and the publication of articles. By the time we concluded the project in January, 2008, we conducted eight workshops in all the New England states (New Hampshire, Connecticut, Rhode Island, Vermont, Maine, and three in Massachusetts) training over 500 healthcare professionals in prevention of environmental health risks facing children.

### **Initiatives with Schools and Youth**



### ***UML –LHS Partnership for College Success***

The University of Massachusetts Lowell (UML) and Lowell High School (LHS) are collaborating through a ‘Partnership for College Success’ grant. This project focuses on *increasing the number of Lowell High School students who enroll and earn post-secondary degrees at UMass Lowell and other four-year institutions*. Now beginning its fifth year, *Partnership for College Success* is funded by the Nellie Mae Education Foundation and receives technical assistance from the Woodrow Wilson National Fellowship Foundation. The regional grant program is aimed at strengthening collaborations between universities and high schools to improve college preparation and success for all students.

PCS is building on existing resources at LHS and UML, creating new collaborative opportunities, and working to align systems within the two institutions to draw on corresponding strengths and assets. This includes the following actions:

1. *Develop a transition process for LHS seniors into their first-year at UML:*
  - The second annual Early Introduction and Lunch:  
In May, 25 UML faculty, staff and administrators spent the afternoon with over 60 LHS seniors at the high school to discuss college expectations, answer questions about classes and majors, and to initiate a relationship between incoming students and UML professors and classmates. Furthermore, these UML personnel had the opportunity to talk with more than 30 of their Lowell High colleagues, including department heads and guidance counselors.
  - Alumni Society:  
During 2007-08, the Alumni Society elected officers, ratified a constitution and became a bona fide UML Student Activities club on campus. Spearheaded by current UML students who are LHS grads, this group has guided tours for Lowell High students, spoken on panels and cable television about college-going issues, and held a UML event in May 2008 to recruit more members. They also helped facilitate focus groups with current UML students about the college experience. Currently, several members are designing summer workshops as part of the PCS summer program.
  - Fall 2008 events:  
PCS and its stakeholders will host events during 2008 to help bridge the high school-to-university transition for Lowell youth. These include a LHS reception at UML, modeled on the first PCS reception on September 4, 2007, and regular assistive communications.
  - Launch Pad 2008:  
PCS is developing a summer program for Lowell High graduates who will be entering UML as first-year students. The curriculum includes self-management skills and academic supports such as reading for comprehension, note taking, and research skills. This program will be implemented in August 2008.
  - PASS Network:  
PCS developed and implemented a pilot peer-mentoring program for UML students who are alumni of Lowell High School. Student pairs met throughout the year (UML first-year students matched with second/third year peers) and a UML graduate student facilitated three large group meetings, a career workshop, and a fall orientation.



2. *Enhance college information resources at LHS:*

- **Collaboration with the LHS College and Career Center:**  
The College and Career Center (CCC) has been very involved with the PCS project since the center's inception in 2005. For example, the two guidance counselors who staff the CCC are active members of the PCS team, including participation in the tri-annual PCS cluster meetings. During 2007-08, PCS supported the efforts of the CCC to (a) develop a comprehensive professional development series for LHS faculty on college advising, (b) establish an annual College Week at the high school that includes a college fair, speakers, and promotes a college going culture, and (c) support school-wide administration of the PSAT to all 10<sup>th</sup> and 11<sup>th</sup> grade students (October 2007).
- **Co Teach:**  
Working with the College and Career Center, PCS has developed a series of "CoTeach" opportunities where faculty from the high school and the university are paired according to academic disciplines to deliver lessons to high school students. So far, more than 35 faculty members from UML and 40 faculty members from LHS have participated, reaching more than 900 students.
- **Campus visits:**  
PCS is developing a campus visit strategy that is tailored for LHS students. This involves no (or low-cost) transportation and UML student guides who are themselves LHS alums. In 2007-08, PCS piloted this with three classes at LHS.
- **Enhanced college communications within the school:**  
Over the past year, PCS utilized six LED screens, located in strategic points within Lowell High School buildings, to communicate priority college messages such as deadlines for scholarships and updated information for college representative visits.
- **You Too! TV:**  
In 2007-08, faculty and students at both institutions worked together on a new television series dedicated to promoting college awareness within the Lowell community. This program is a magazine style show that is co-produced by mixed teams of LHS and UML students. It has run as an afterschool program during its initial year. Currently, plans are in development to offer it as a dual enrollment course for high school and university students to study broadcast journalism in January 2009.

3. *Expand connections between LHS and UML:*

- **Guidance and Admissions:**  
PCS facilitated several large group meetings between guidance and admissions offices in the 2007-08 school year. These workshops were opportunities for mutual learning around admissions, Lowell student concerns, and similar topics. Two were held at the high school and one was held in the UML Admissions office and included personnel from Middlesex Community College.
- **Chemistry vertical teaming:**  
During 2007-08, faculty and administrators from LHS and UML partnered around the chemistry coursework and departments at both institutions. Several key issues surfaced, notably the gaps in student learning, the overlap of curricula, and the similarity of challenges in classrooms across the levels. The final vertical team meeting in May included discussion with the math vertical team around problem solving and math-related struggles that students encounter in their science courses.



4. *Build access to college information resources within the community and for families of LHS students:*
  - You Too TV: This project has produced several 30-minute television shows which air in the Lowell community and during high school advisory periods. The content focuses on the college experience and pre-college preparation.
  - Website:

PCS is looking to potentially use the front page of the LHS website (which is the default home page for every computer at LHS) to link to college information at UML and other locations. This will build upon the 50 pages already developed and will incorporate a campaign that utilizes other communication vehicles at LHS, UML and PCS disposal to spread the message about this resource.
  
5. *Enhanced data collection and assessment to connect both institutions and inform decision making:*
  - Nellie Mae database:

With technical assistance from Woodrow Wilson, PCS has been building a database that tracks information about 500 LHS and 150 UML students to assess their academic performance, course taking patterns, college status and graduation rates.
  - Student data:

PCS has been tracking data from current students to better inform access and retention practices and to make available college resources more effective. This includes discussion groups, enhancing the high school senior survey vehicle for improved data quality, and interviews with faculty. In 2007-08, PCS worked with UML Professor Duffy and her students to develop a new online survey, submit its related IRB proposal, and pilot its implementation with first-year UML students. Simultaneously, the sociology class helped develop a survey instrument for high school 11<sup>th</sup> grade students that tracks their college-going intentions and use of high school resources.
  - Student Tracker:

PCS has supported a LHS subscription to Student Tracker, a nationwide clearinghouse that follows student progress at universities throughout the US and monitors who is still enrolled, their current status, and graduation rates.

### *GEAR UP Opportunity Lowell*

GEAR UP (Gaining Early Awareness and Readiness for Undergraduate Programs) is a national college preparatory program funded by the U.S. Department of Education. The mission of the GEAR UP Opportunity Lowell program is to significantly increase the number of low-income students who are prepared to enter and succeed in postsecondary education. The program is focused on increasing math literacy among families and raising the level of mathematical understanding and performance among students, and has well established partnerships among schools, colleges, local arts and youth-serving organizations, and coordinated activities with adult education and other programs to support parents in the schools and the community. The partnership includes the University of Massachusetts Lowell, the Lowell School Department, Middlesex Community College, the Revolving Museum, the Greater Lowell Boys & Girls Club, Lowell Telecommunications Corporation, and the Merrimack Valley Housing Partnership.



The 2007-2008 reporting period of the program has supported the cohort in the **transition from middle school to high school**. For both GEAR UP staff and the students, transition has been aided by Lowell High School's Freshman Academy, which groups students and teachers in small, cross-disciplinary, ability-grouped ("College" and "Honors") clusters. A few program elements stood out for their effectiveness in engaging students in GEAR UP and in increasing their perceived and actual likelihood of attending college. The Academy as an administrative structure helped to focus and facilitate our outreach to students and to faculty as we entered the high school. Several initiatives helped us to establish relationships with students and families which we can be nurtured throughout the coming years, and which will serve as our base for engaging more students, families, and faculty.

As we followed students in the transition to high school, we became heavily engaged with 20 incoming Lowell High School freshmen who were enrolled in our **2007 summer program**. Consequently, we recruited college and university faculty in various departments from institutions in Greater Lowell to engage students in interactive and stimulating learning experiences. This intensive summer program exposed students to the rich resources and opportunities in science, technology, engineering and mathematics at UMass Lowell and surrounding colleges. The goals of the program were to improve academic performance for high school students in the area of math and science; to expose students to various careers within health, information technology and engineering areas; and to encourage students to seek post secondary educational opportunities. At the end of the program, the students were asked to write a letter to themselves in 10 years from now and describe what their life would be like. Many of them included attending college in their visions. They were also asked to reflect on their experiences during the summer program. One student wrote, "Instead of wasting my time with being on the computer or watching TV, I was having a fun, education summer". Another student wrote, "I thought it was going to be boring, but it was really fun. The colleges that I went to opened doors for me and it widened my college experience".

Out of our summer program, we created a **GEAR UP Club**, which enables us to maintain connection with students. We meet with the students once a month over the entire school year, and the students in essence became ambassadors for GEAR UP to the larger high school population. They helped to recruit more of their classmates to take part in many of the GEAR UP activities designed to improve their academic performance in the areas of math and science, and to encourage students to seek post secondary educational opportunities. The students were involved in planning most of their own activities.

During the school year, every GEAR UP student had access **tutoring** during school as well as after-school. Professional tutors were assigned to work closely with students, developing stable and supportive relationships through consistent meetings. Tutoring, focused on mathematics, English Language Arts, and physics, was provided through several strategies to reach many groups of students, as students built stable, supportive relationships with professional tutors and volunteer mentors. Tutors were also available during a weekly first-year seminar for students identified by teachers as in need of additional support. Tutors also worked directly with classroom teachers to provide in-class support in mathematics. In addition, after school tutoring was available on a drop-in basis for all students and was offered in the after-school detention program, an especially important resource for reaching students at high risk of disengaging from



school. Teachers reported to our staff on substantial grade improvements in individual students served by GEAR UP tutors and mentors.

Our work was also focused around our continued efforts to build our parent advocacy group and engage **parents** and students in campus tours so that they can understand the college experience and associated cost in more direct ways. The Parent Advocacy group, “GEAR UP for Active Parents,” or GAP was formed. The group met monthly. Parents chose the focus of meetings and had an overall goal of helping parents to advocate for and support their children in high school. Just over 100 students and parents alike attended college tours and information sessions. The college trips were popular GEAR UP events where many of our students and parents gained considerable knowledge about the accessibility and value of a college education.

Quarterly **project nights** for students and parents were also sponsored by GEAR UP at the Freshmen Academy. These sessions were open to all ninth grade students and their parents to attend evening workshops in order to work on quarterly assessment assignments worth 25% of students’ grade in each class. GEAR UP provided tangible materials and academic support to help students to complete major projects at the end of the quarter.

National data shows that poor academic performance and students from low-income families among others are more likely to drop out of high school. In light of these facts, GEAR UP developed an **intervention program** for students at risk of failing two or more courses. GEAR UP worked very closely with teachers and guidance counselors to develop a comprehensive strategy to increase educational expectations for all students. Collaboration with teachers and guidance counselors led to additional targeted support to students at risk of failure, including individual meetings with each student. These students were identified each quarter prior to the due dates for final project assignments. In order to ensure that these students were provided with the necessary support to prevent failure, a letter was mailed to their parents informing them of tutoring opportunities. Parents were then encouraged to enroll their child in the after school tutoring support with transportation provided to drop students at home. Through the support of these efforts, daily attendance increased, and students at risk of failing two or more classes declined by the end of the academic year.

At the same time that GEAR UP was working to increase students’ academic success, we are providing students and their families with opportunities to see college as an accessible and desirable opportunity. GEAR UP brought over 500 students to **visit areas colleges** and universities, including MIT, Framingham State Emerson College, UMass Lowell and Middlesex Community College among others. In addition, GEAR UP provided “PINPOINT” **career counseling** for grade 9 students which involved completing an interest survey and personal profile which students will continue to draw upon with their parents and guidance counselors as they move through high school.

As a part of our collaboration with the **Revolving Museum**, a community based museum focused on participatory public art projects, an educational program for GEAR UP students was designed to enhance students’ understanding of postsecondary education and financing. *Rules of Engagement* was the result - a giant board game and associated life-sized playing pieces which focused upon the theme of traversing the high school experience, with the ultimate goal of



college admission representing the winning phase of the game. The game identified the challenges and rewards of high school life, from the perspective of the students themselves. Raised platforms at intervals throughout the board game represented themes of peer pressure, study, knowledge, personal growth, identity and ambition. This interactive public art work was introduced to the public by the students themselves during this spring, at a game playing event hosts invited family members, Lowell High School faculty and students, Gear-Up Lowell representatives and City dignitaries.

Particularly important to the academic focus of this project, Math and English teachers across institutions were involved in the program's "**vertical team.**" This team includes UMass Lowell faculty, Middlesex Community College faculty, GU staff, and Lowell High School faculty. The groups met on a monthly basis to consider the path to assessment, placement, and performance in higher education. These activities began in mathematics early in the GEAR UP program and due to their visible success have now been replicated in the sciences and language arts. The relationships formed among faculty, have had a lasting impact on GU students through curriculum adaptations, and through the greater understanding teachers have gained through the process.

### *Science of Small Things*

Science of Small Things (SOST) is a multi-year nanotechnology after school project for 7<sup>th</sup>, 8<sup>th</sup>, and 9<sup>th</sup> grade students in Lowell public schools. SOST is a partnership between Citizen Schools (CS), the Center for Family, Work and Community, Raytheon and Nypro and is funded by the National Science Foundation's ITEST program.

CS is a national, volunteer driven after school program. Raytheon and Nypro are worldwide leaders in advanced technology and contribute to the project in a number of ways, including providing facility tours, exposing SOST participants to careers in STEM (Science, technology, engineering and math) industries. Other key collaborators include faculty in the UML Center for High-rate Nanomanufacturing, and the American textile History Museum.

SOST provided students with after school programming through Citizen Schools and a summer program independent of CS. The students were engaged and are now excited about the possibilities of Nanotechnology and have been on site tours of UML's Center for High-Rate Nanomanufacturing (CHN), including plastics and chemistry labs, as well as attend field trips to our industry partner sites, Raytheon and Nypro.

Examples: Students learned about nano-Textiles through a lotus-effect activity that introduced them to the concept of bio-mimicry. Due to the limited availability of lotus leaves in the area, students worked with cabbage, which has similar properties (self-cleaning and hydrophobic). Students experimented with lotus leaves, lettuce leaves, and ivy, and they compared the results. Students then discussed the possible applications of hydrophobic self-cleaning materials, including Textiles, medical gauze, and windshield film. Participants also conducted an experiment designed to simulate nano-medical research that uses nano-particles of gold to cure breast cancer.



As an end-of-year celebration, students prepared for and led demonstrations at their schools and at the American Textile History Museum in Lowell, Massachusetts. Students were able to lead demonstrations on several activities that they participated in. These events were designed for families, and students were able to demonstrate their knowledge of several nanotechnology activities, including nano-medicine, scanning-probing microscopy, the lotus effect and biomimicry, and the lego-mitten challenge.

### ***The River Ambassador Program***

The River Ambassador Program (RAP) is a volunteer youth program supported by the Center for Family, Work and Community. It is now in its tenth year of bringing youth together with the University and community groups to address environmental health concerns in Lowell. Over 250 high school students have participated throughout the years. The program not only provides project-based hands-on activities on environmental justice, but also gives students opportunities to develop and create their own environmental activities. In addition, the students participate in local community events to promote and exchange ideas about the environment.

Our mission is to learn more about environmental issues in our region, educate others in our community about those issues, and to take action wherever possible to improve our environment. We believe that we can make a difference in Lowell and abroad, by drawing on the positive energy of youth to serve the community and by providing worthwhile activities for teens. RAP strives to build a strong relationship to the community through interactions that increase the community's recognition of, and respect for youth as role models. Our goals are to study environmental topics impacting our health and well being; to share what we learn with fellow RAP members, other teens, and the community; to develop an understanding of and a relationship to the political process by which environmental decisions are made; to plan and perform community service that improves our environment; to plan and carry out environmental events with immigrant & refugee communities of Lowell; to establish RAP's image and mission in the public mind; and to seek funding for on going group activities and for special projects and programs. <http://www.lowellrap.org>

This past year RAP focused on environmentally friendly clothing including clothes made out of recycled materials and vintage clothes. They also coordinated the Youth Environmental Expo which highlighted organic agriculture, an eco-friendly fashion show and healthy lifestyle tips.

One of the integral components of the program is to be involved with **community events**. By supporting and volunteering in various events, the program and its members are recognized in the community as an important resource. The teens also feel a sense of pride and accomplishment in participating in these civic activities.

RAP students continue their involvement with the **Lowell National Historical Park (LNHP)**. One of the LNHP rangers attends the weekly RAP meetings. The RAP students also continue their experience as summer interns in the Interpretation and Education Division of LNHP. The internship will give them the opportunity to build leadership and interpersonal skills. They will continue to give park tours, operate the exhibits and interpret the industrial and environmental history of the Merrimack River Watershed.



### ***Health Curriculum Evaluation***

We continue to work with Lowell Public Schools to evaluate the health curriculum being implemented in some elementary and middle schools. This pre-test post-test model provides information to program coordinators and teachers on the effectiveness of the program.

## **Capacity Building with Refugee and Immigrant Groups**

### ***Family Service, Inc. Lawrence MA***

We are currently the evaluators on the Family Service, Inc. project, *Mujeres en Accion Protegiendose Ahora* (MAPA) an HIV/AIDS prevention curriculum specifically designed for the Latina community, *Strengthening Families* program for Lawrence couples and the AMIGOS Mentoring Program for middle schoolers. The evaluations provide program coordinators feedback on the effectiveness of the programs' implementation and outcomes.

***Building Ethical Research Partnerships: The Lawrence Research Initiative:*** CFWC continued to participate and help to facilitate the development of the Lawrence Research Initiative, an academic-community collaborative project. The project aims to build a research infrastructure to assure that research conducted in Lawrence will provide a clear benefit to the community by including community members in all research phases. Established in the fall of 2006, the Initiative was created by individuals from Lawrence organizations and is being led by a working group from the Lawrence Mayor's Health Task Force. It includes representatives from the City of Lawrence, UML and other universities, and community organizations. Many local community organizations have been approached over the years and asked to facilitate research in Lawrence. However, the researchers making these requests have had varying levels of sensitivity to community concerns and varying abilities to form collaborative relationships with community groups. The Initiative has developed a set of core principles for research partnerships, a list of criteria for agreements between partners, and a model to help guide researchers and community members toward an equitable and mutually-beneficial research process and result.

***Award:*** Linda Silka received an outstanding partnership award from the Lawrence Mayor's Health Task Force for her work on the Executive Committee and the Research Initiative described above.

## **Other Outreach**

### **Community University Advisory Board**

The Community/University Advisory Board brings together an active group of more than twenty community and university members who meet monthly. In the past year the COPC Advisory Board has developed plans to evolve into two teams made up of Greater Lawrence and Greater Lowell community and UML partners. These groups will work with the newly formed UML Council on Outreach and Engagement to develop goals and objectives with coming year.

### ***Community Engagement throughout the University of Massachusetts System***



Silka and Toof are part of a leadership team for the University of Massachusetts System to develop a unified plan for community engagement throughout the University of Massachusetts System. The team developed and implemented a spring workshop for 125 New England colleges and universities on tips and tools for applying to the Carnegie Foundation for the community engaged institution designation. In addition, members representing four of the five campuses attended an intensely focused multi-day charette to design innovative, competency-based, campus-wide approaches to developing community-engaged faculty members. Our team was one of 20 colleges and universities across the United States – selected from among over 100 applications. The aims are “to strengthen community-engaged career paths in the academy by developing innovative competency-based models of faculty development, facilitating peer review and dissemination of products of community-engaged scholarship, and supporting community-engaged faculty through the promotion and tenure process. The three-year effort is supported in part by a grant from the Fund for the Improvement of Postsecondary Education (FIPSE) in the U.S. Department of Education.” Craig Slatin represented UMass Lowell at the workshop.

### ***Community Connections Information Clearinghouse***

Many in the Merrimack Valley continue to report that UML is still a “black box” to them. People struggle to identify who they can contact within UML in order to build partnerships with students, staff, and faculty. The UML Community Connections Clearinghouse serves as a “gateway” through which groups and individuals outside of UML can learn of partnership opportunities with UML students, staff, and faculty, while at the same time UML students, staff and faculty can learn from the community of partnerships in which they may wish to participate.

The Focus of the Clearinghouse is:

- To assist outside partners in identifying which UML courses have projects, service learning, practicum, or internship possibilities.
- To assist UML students, staff, and faculty in identifying community partners who have projects that provide interesting growth opportunities for our students, staff, and faculty.

The site, [www.clearinghouse.uml.edu](http://www.clearinghouse.uml.edu), is designed to be used by community partners, faculty and staff, and students as a classified message board to list opportunities for service learning, practicum, internship and work study opportunities.

The clearinghouse has already helped place students and volunteers in nearly twenty community organizations over the past two years including: The Lowell Housing Authority, Casey Family Services, Girls Incorporated, the Revolving Museum, Merrimack River Watershed Council, WUML, Junior Achievement, International Institute, Community Software Lab, Caleb Foundation, Work Opportunities, Lowell Canalwaters Cleaners, National Park Service, Lawrence Community Works, Lawrence YWCA, GEAR UP, and others.

### ***Nonprofit Alliance of Greater Lowell***

In the past many of the over 70 nonprofit organizations in Lowell have struggled to maintain their infrastructures and build programs. The CFWC facilitates the Nonprofit Alliance in order



to expand the capacity and resources of groups and organizations. We lead monthly meetings, facilitate retreats, and carry out training to strengthen programs in the area.

### ***MA Campus Compact Americorps VISTA Volunteer***

For a second year, CFWC supervised an Americorps VISTA Volunteer placed through Massachusetts Campus Compact. Andre Lee, a graduate of Springfield College, has filled this role. Main accomplishments include: (1) visited community based organizations to establish new relationships and build on existing ones, (2) documented current UML partnerships with the City of Lawrence, (3) facilitated the UML and Lawrence Mayor's Health Task Force community research review and infrastructure process (4) facilitated the Mayor's Health Task Force Youth Initiative strategic planning sessions, and (5) aided the UML team with the Carnegie community engaged institution designation application.

### ***Thinking Out Loud***

Thinking Out Loud is a public affairs radio show that airs from 10 a.m., until noon, every Monday through Friday on WJUL 91.5 FM, the university's radio station. The focus of the show is the community, the workplace and the environment. The show brings community news, live interviews and commentary with segments in five language segments: English, Spanish, Khmer (Cambodian), Portuguese (Brazilian) and Laotian, to a potential audience of over two million listeners in the Merrimack Valley of Massachusetts and New Hampshire. The show currently provides ten hours of programming, utilizing 25 regular volunteer hosts each week and their guests. Nationwide public affairs features such as "Between the Lines", "Workers Independent News Service", the Maryknoll's "Voices of Our World", and Democracy Now's Spanish Language news segment are aired as part of the shows varied format. Locally produced weekly segments include Julie Villareal's "Environmental Corner" Isa Cann's "Long View on Sustainability" and Grace Ross' Commonwealth Report.

## **8. Publications (Most Recent 2007-2008)**

### **Books**

Geigis, P., Hamin, E., & Silka, L. (Eds.). (2007). *Preserving and enhancing communities: A guide for citizens, planners and policymakers*. Amherst, MA: University of Massachusetts Press.

### **Articles and Book Chapters**

Pending and 2008

Silka, L. Partnership Ethics. (under review). In P. Ginsberg & D. Merten (Eds.). *Handbook of Social Science Research Ethics*. Sage Publications.

Silka, L. (in press). Roles for Higher Education in Driving Economic Development: What Can We Learn from Australian Models of the Engaged University? *Journal of the New England Board of Higher Education*.



**Silka, L., Farrant, R., Bond, B., Coffey, P., Toof, R., Toomey, D., Turcotte, D., & West, C.** (in press). Achieving Continuity in the Face of Change in Community-University Partnerships. *Gateways Journal*.

**Silka, L., Toof, R., Turcotte, D., Villareal, J., Buxbaum, L., & Renault-Caragianes, P.,** (in press). Community University Partnerships: Achieving the Promise in the Face of Changing Goals, Changing Funding Patterns, and Competing Priorities. *New Solutions: A Journal of Environmental and Occupational Health Policy*.

**Turcotte, D.** (in press) Waste Sites. In RA, Etzel, (Ed), *Pediatrics Environmental Health*. 3<sup>rd</sup> ed. Elk Grove Village, IL: American Academy of Pediatrics.

**Turcotte, D.** (under review) A Framework for Sustainable Housing Development: Moving Beyond Green. In R. Auffrey & M. Romanos (Eds), *Creating Sustainable Communities: Theories, Methods, and Practice*.

**Silka, L. (2008). Transforming Experiences: When Host Communities Become Home Communities. In L. Pho & J. Gerson (Eds), Learning from Diverse Voices: Southeast Asian Refugees in the Mill City: Changing Families, Communities, Institutions (pp. 192-206).. Durham: The University Press of New England.**

**Silka, L., Cleghorn, G. D., Grullon, M., & Tellez, T.** (2008, June). Creating community-based participatory research in a diverse community: A case study. *Journal of Empirical Research on Human Research Ethics*, 3(2), 5-16.

**Turcotte, D. & Silka, L.**(2008) Reflections on the concept of social capital. In L. Pho, J. Gerson, S. Cowan (Eds.), *Southeast Asian refugees and immigrants in the mill city: Changing families, communities, institutions –Thirty years afterwards*. Durham: The University Press of New England.

## **2007**

**Silka, L.** (2007). Immigrants in the Community: New Opportunities, New Struggles. *Analyses of Social Issues and Public Policy*, 7, 1, 1-17

**Silka, L.** (2007, Dec.) Immigrants in the Community: New Opportunities, New Struggles. *Analyses of Social Issues and Public Policy*, 7, 1, 75-91.

## **Journal Editorial Boards**

Dr. Linda Silka is on the editorial and/or review boards for various journals and she is a member, National Study Advisory Committee, Community Campus Partnership for Health.

## **9. Conference Presentations**

### **2008**

**Barry, S. & Daley, L.** (2008). *Broad based support in collaboration to deliver career awareness to 9<sup>th</sup> grade cohort*. Presentation at the GEAR UP National Conference, Washington, D.C., July 23, 2008



**Donnelly, E.;** Gibson, J.; Lynch, K.; **Silka, L;** **Tucker, B.**(2008) *Building Stronger Collaboration between Secondary and Post-Secondary Faculty and Staff: A School-University Model*. Presented at the College Board Conference: Regional Academic Symposium on Advancing College Readiness, Rigor, Relevance, Curriculum Alignment, and P-16 Collaboration, Worcester, MA April 25, 2008.

Hay, C.; Jack, W.; **Tucker, B.;** Winn, C. (2008) *Achieving the Dream Together: Professional Development through Vertical Teaming as a Vehicle to Students' Success*. Presented at the National GEAR UP Conference: Celebrating our Past and Shaping the Future, Washington, DC, July 22nd, 2008.

**Silka, L.** (2008). Managing chronic disease and eliminating health disparities. Presentation at The Massachusetts Department of Public Health Northeast Regional Health Dialogue. Lowell, MA, May 28, 2008.

**Turcotte, D.** (2008). *Cases Studies in Urban Sustainable Housing Development*. Paper presented at the Urbanism Affairs Association Conference, Baltimore, Maryland, April 25, 2008.

## 2007

Chalupka, S. & **Turcotte, D.** (2007). *Strengthening the capacity of health professionals serving minority and low-income communities to better identify, manage, and prevent environmental health risks*. Presentation at the American Public Health Association 135th Annual Meeting, Washington, DC, November 6, 2007

Kim, H. J.; Coluntino, D.; Martin, F. G.; **Silka, L.;** & HA Yanco, H. A. (2007). *Artbotics: Community-based collaborative art and technology education*. Presentation at the International Conference on Computer Graphics and Interactive Techniques, San Diego, California.

**Silka, L.** (2007). Immigrants in the Community: New Opportunities, New Struggles. Paper presented in Plenary Symposium *Addressing Immigration: Psychological Research and Social Engagement* at the American Psychological Association Annual Convention, San Francisco, California, August 18, 2007

**Silka, L.** (2007). *Keynote*. Strengthening Universities and Community through Engagement Conference. University of Maine Orono, September 26, 2007

**Silka, L.** (2007). *Strengthening community-university engagement: The UML experience*. Presentations at Edith Cowan Universities, Perth Australia; University of Western Sydney, Sydney Australia; Queensland Institute of Technology, Brisbane Australia; Swinburn University of Technology, Melbourne, Australia

**Turcotte, D.** (2007). *A Framework for Sustainable Housing Development: Moving Beyond Green*. Invited presentation at the Forum on Application of Sustainability Theory to Urban Development Practice, University of Cincinnati, Cincinnati, Ohio, August 11, 2007.

**Turcotte, D.** (2007). *Safer Environments for Children: Homes, Child Care Settings, and Schools*. Presentation at the Protecting Massachusetts's Children from Environmental Risks: Problems and Solutions Conference, Shrewsbury, MA, June 13, 2007.



**Turcotte, D. (2007).** *Safer Environments for Children: Homes, Waste Sites/Brownfields and Workplaces.* Presentation at the Protecting Massachusetts's Children from Environmental Risks: Problems and Solutions Conference, Shrewsbury, MA, June 13, 2007.

### **10. Collaboration with other Centers/Institutes and/or Departments**

We work to involve faculty, staff and students from throughout the university in developing new collaborations that will strengthen links between UML and region. During the year we collaborated with the following Departments and Centers at the University:

- Center for Industrial Competitiveness
- Center for Industrial Theory and Assessment
- Center for Sustainable Production
- Center for Women and Work
- College of Arts and Sciences, Psychology, Regional Economic and Social Development, Sociology, English, Computer Science
- College of Engineering
- Environmental Management Services Program
- Graduate School of Education
- Office of Admissions
- Office of Residential Life
- School of Health and Environment
- Student Financial Services Center
- Student Activities and Multicultural Affairs

### **11. Regional/Local Outreach**

Our community partners this year included:

- African Assistance Center
- Boys and Girls Club Greater Lowell
- Brew'd Awakening Coffeehaus
- Cambodian Mutual Assistance Association
- Casey Family Services
- Coalition for a Better Acre
- Community Software Lab
- Community Teamwork Inc.
- Cultural Organization of Lowell, COOL
- Fair Housing Center of Greater Boston
- Family Service, Inc.
- Keep Lowell Beautiful
- Lao Family Mutual Association
- Lawrence Department of Planning and Development
- Lowell Adult Education
- Lowell Community Health Center
- Lowell Community Technology Consortium
- Lowell Division of Planning and Development
- Lowell High School
- Lowell Housing Authority
- Lowell National Historic Park
- Lowell Police Department
- Lowell School Department
- Lowell Telecommunications Corp.
- Massachusetts Alliance of Portuguese Speakers
- Merrimack Valley Economic Development Council
- Merrimack Valley Housing Partnership
- Merrimack Valley Planning Commission
- Merrimack Valley Project
- Merrimack Valley Regional Housing Consortium
- Middlesex Community College
- National Park Service
- Northeast Assn of Realtors
- North East Builders Assn
- Parent Information Center
- The Revolving Museum
- United Teen Equality Center



- Lowell Health Department

## 12. Proposals Submitted/Awarded 2007/2008

### *Proposals 2007-2008*

#### *Awarded*

- National Science Foundation “The Science of Small Things”
- Nellie Mae Education Foundation “Summer Learning Loss Working Group”
- Nellie Mae Education Foundation “Summer Pilot Evaluation”
- Nellie Mae Education Foundation “Lowell High School-University of Massachusetts Partnership for College Preparation”
- Family Service Inc “Strengthening Couples Evaluation”
- Family Service Inc “AMIGOS Mentoring Evaluation”
- Executive Office of Environmental Affairs “Sustainable Outreach Partnership Initiative (SOPI): Creating Green Buildings and Healthy Communities”
- MA Campus Compact Americorps VISTA “UML-Lawrence Partnership”
- Campus Community Partnerships for Health “Faculty for the Engaged Campus”
- City of Lowell “Lowell Schools Health Curriculum Evaluation”
- National Park Service “An Ethnographic Study of Lowell, MA: Immigration, Globalization and Enterprise in the ‘All-American City’” with Robert Forrant and Christoph Strobel
- Parker Foundation “Technical Assistance and Research Center for Housing Sustainability”

#### *Submitted (pending or not awarded)*

- US HUD “Healthy Homes” *pending*
- NIH “Building Collaborative Research: Piloting Positive Productive Partnerships in Lawrence” *not awarded*
- US DOE FIPSE “Supporting College Access and Aspirations for Students with Disabilities” *not awarded*



## 13. CENTER FOR FIELD SERVICES AND STUDIES

### Annual Report

2007-2008

#### 1. Mission Statement of Center

The mission of the Center for Field Services and Studies is to assist public elementary and secondary schools in the improvement of teaching and learning. A critical component of this assistance is brokering of University resources, staff and facilities, on behalf of schools. During its twenty-four years of service to schools in the region, the Center has established relationships of mutual respect and trust with more than twenty school districts in the northeast region of Massachusetts. The Center takes a proactive stance in collaboration with these districts, helping schools clarify issues and develop solutions to persistent concerns, as well as identifying promising practices and resources for educators.

#### 2. General Description and Goals

The Center for Field Services and Studies (CFSS), now in its twenty-fourth year of operation, serves public elementary and secondary schools in the northeast region of Massachusetts, and increasingly throughout the state. The Center, an initiative within the University of Massachusetts Lowell, Graduate School of Education, reflects the University's commitment to excellence in public education. A direct outgrowth of the Lowell Model for Educational Excellence, a comprehensive study of a local public school system, the Center was formed in 1984 to improve PreK-12 education in local elementary and secondary schools and to create and foster viable educational partnerships among university faculty, professional groups, community agencies and the private sector to respond to the needs of public schools. Our strategic goals are:

- a. To assist elementary and secondary schools in the improvement of PreK-12 education
- b. To broker resources from the university, community agencies and the private sector on behalf of public schools
- c. To enhance local school district capacity to assess educational needs, identify appropriate responses, access resources, implement change, and incorporate successful programs into regular operation of the schools
- d. To provide school leaders and teachers with information and training based on best research and practice in education
- e. To build advocacy and marshal support for public education in community, parent and business groups

#### 3. Research Focus Areas

Current research topics include:

- School/college/industry partnerships
- School leadership development



- Small Schools
- Professional development in history, science, math, technology and engineering
- Student support programs for college preparation
- Distance learning
- K-16 education
- Technology applications for teaching and learning

#### **4. Associated Personnel**

##### **Center Director:**

Judith Boccia

##### **Associated University Faculty:**

Dean Bergeron, College of Arts and Sciences, Professor Emeritus  
Charles Christensen, Graduate School of Education, Assistant Professor  
Michaela Colombo, Graduate School of Education, Assistant Professor  
Patricia Fontaine, Graduate School of Education, Assistant Professor  
Robert Farrant, Regional Economic and Social Development, Professor  
Anita Greenwood, Graduate School of Education, Interim Dean  
John Hodgman, Howard Foley Professor of Workforce Development, College of Engineering  
Jill Lohmeier, Graduate School of Education, Assistant Professor  
Allyssa McCabe, College of Arts and Sciences, Professor  
James Nehring, Graduate School of Education, Assistant Professor  
Vera Ossen, Graduate School of Education, Director of Educator Licensure  
Regina Panasuk, Graduate School of Education, Professor  
Melissa Pennell, College of Arts and Sciences, Professor  
Michelle Scribner-MacLean, Graduate School of Education, Assistant Professor  
Mitch Shuldman, Media Services, Director  
Carol Barry, College of Engineering, Professor

##### **CFSS Staff:**

Andrew Alfano, Systems Analyst, Instructional Network  
Cynthia Bent, Assistant Director College Prep  
Kathleen Conole, Teaching American History Specialist  
Marjorie Dennis, Project Manager  
David Hadley, Media Technician  
Robin Hall, New Horizons Program Coordinator  
Michael Lucas, Coordinator Instructional Network  
Nancy Pitkin, Coordinator Partnership Projects  
William Suppa, Systems Analyst, Instructional Network  
David Tennyson, Video Technician, Instructional Network  
Hector Torres, Director of College Prep and Lawrence Outreach  
John Wren, Technology Support Specialist



## 5. New Associated Faculty and Staff

Lisa Abdallah, School of Health and Environment, Assistant Professor  
Kavitha Chandra, College of Engineering, Professor  
Oliver Ibe, College of Engineering, Associate Professor  
Chad Montrie, History Department, Assistant Professor,  
Christoph Strobel, History Department, Assistant Professor  
Fred Martin, Computer Science, Assistant Professor  
Charles Thompson, College of Engineering, Professor  
Li Xu, Computer Science Department, Assistant Professor

## 6. Students Supported

### Graduate Students:

Ryan Hagen, Research Assistant, Bartlett Literacy Study  
Leeanne Toohey, Research Assistant, Teaching American History

### Undergraduate Students:

Nefertiti Borders, Student Assistant, CFSS  
Joseph Mullaney, Student Assistant, Distance Learning  
Evelin Ovalles, Student Assistant, College Prep  
Lauren Sicard, Student Assistant, College Prep

## 7. Current Research and Regional/Local Outreach Projects

### Lowell Public Schools Collaborative

The Center has a long history of collaboration with the Lowell Public Schools. Targeted collaboration with the Murkland Elementary School, Stoklosa Middle School, Bartlett Community Partnership School, and Lowell High School includes provision of tutoring, student teachers, enrichment programs, and other resources to these downtown neighborhood Lowell schools. At the Bartlett Community Partnership School, five week extended day enrichment programs were offered to the students in grades 5-8 three times during the school year. A variety of workshops were offered for example, in Art, Music, Paper Airplanes, Electricity and Dance. A partnership between Lowell Parks and Conservation Trust and Massachusetts Audubon enabled UML to facilitate the program, Stewardship Through Leadership: Backyard Adventures. The goal of this program is to expose urban youth to the outdoor classroom where they will build upon their in-school curricula, become engaged in constructive environmental stewardship in their community, and build self-esteem through team and leadership opportunities. 20 students at the Bartlett CP School participated in this exciting venture in extended day programming.

**Bartlett Partnership School Literacy Study**, Allyssa McCabe (Psychology) and Judith Boccia (Education).

This project was funded initially by CFCI Collaborative Grants, and currently by the Parker Foundation. The project aims to improve the literacy-related oral language skills of eighty (80) 4-year-old children enrolled in a Lowell Public School preschool by providing individual or small-group experiences run by trained volunteer students from UMass Lowell.



Children are tested in fall and spring to determine their progress. Scores from intervention children are compared to those of the comparison school. First year results are extremely encouraging in support of this intervention for preschool children. It demonstrates that it is possible to increase the vocabulary, narrative, and other oral language abilities of at-risk preschoolers so that they will enter kindergarten with a reasonable chance of acquiring literacy and achieving educational success rather than starting from behind and falling into the spiral of failure. Aggressive fundraising efforts are now underway to expand this project to another school and sustain it in the Bartlett.

### **Instructional Network**

The Instructional Network maintains the U MASS Lowell's video distribution system which utilizes microwave, satellite, broadband, fiber optic and ip based transmission methods. An investment in interactive video equipment has created a state-of-the-art distance-learning environment in 8 electronic classrooms on the University campuses. The Instructional Network also maintains streaming video and classroom lecture capture services throughout the UML campus. Additionally, the Instructional Network coordinates all videoconferences, teleconferences and satellite downlink programming for all departments within the campus and for our outreach partners.

The Instructional Network is playing an increasing role in technology implementation across all areas of the university, including infusing new technology into teaching areas, updating conference facilities, providing tech support for campus special events, consultation on departmental technology purchases, coordinating technology installations with the Office of Facilities on renovation projects, and has become a major resource for other campus needs focused on technology integration.

HAWKi is a dynamic messaging system managed by the UML Instructional Network which provides timely information via LCD displays located throughout the university campus. Currently 20 displays are located on both North and South campuses and include the following colleges and departments: Management, Health and Work Environment, Arts & Sciences, Education, Continuing Education, Student Services, Recreation Center, and Centers for Learning, and Engineering.

The Apreso Classroom Capture systems, located in Ball Hall 214, Ball 328, Weed Lecture Hall 1 and Weed Lecture Hall 2 allows course lectures, audio, video and computer presentation, to be captured and archived for review and playback. Users can choose to view the entire presentation, or navigate through the session to a desired point via a thumbnailed table of contents. All of the content is stored on the Instructional Network's Riverhawk Video Server. Additional backend support is provided for faculty who are using Camtasia capture software. The INET provides faculty drop boxes to store encoded lectures, and converts these files to web viewable presentations.

During the past year, the INET has provided live video streaming of the Inauguration Week and Commencement to participants unable to attend the events on campus. These events are also stored for playback in an on-demand video archive.

The INET has installed over 20 new Technology Enhanced Classrooms during the past year and continues to maintain over 80 classrooms campus-wide.



## **The Young Scholars and College Prep Program**

The Young Scholars and College Prep Program is a partnership between the University of Massachusetts Lowell and Lawrence Public Schools District. In its twenty-fourth year, the program provides college awareness, readiness and college application support to Lawrence High School students willing to commit their summers to academic class work and supplemental enrichment activities.

The program is held on the university campus for six weeks during the summer and biweekly in Lawrence during the school year. The program is embedded in both the University and the city, and is thus unusually well positioned to expand its work into the day-to-day life of Lawrence High School without confronting the typical resistance to outside influence that so often characterizes schools' responses to change.

The Young Scholars and College Prep Program concentrate on developing participants' academic confidence and competence so that post-secondary school admission is a reality for Lawrence High School students.

The majority of the students who participated in the program during the 2007-2008 academic years come from economically disadvantaged families who are now beginning to think seriously about the possibility of continuing on to higher education.

In the 2008/2009 school year, ten (10) College Prep students and graduates of Lawrence High School in 2008 will attend the University of Massachusetts Lowell and four (4) students will attend the Lowell Connections Program.

## **New Horizons -A Passport to College (Grades 9-12)**

New Horizons is a college preparatory program at Lowell High School that is conducted by the University of Massachusetts Lowell. Since 1987, New Horizons has provided academic support services to economically disadvantaged first generation college bound minority students, many of whom are struggling to overcome economic, language and/or cultural barriers. Each year New Horizons prepares 100 students for admission to four year colleges through advising; academic tutoring; standardized-test preparation; career/college exploration; assistance with college applications and financial aid forms; leadership training; community service; team building activities; and cultural awareness events. Funding is provided by the Ronald E. McNair's Massachusetts Educational Opportunity Program, University of Massachusetts Lowell and in-kind contributions are provided by Lowell High School. In recent years, 97% of the New Horizons seniors have successfully enrolled in associates or baccalaureate degree programs at various colleges throughout the United States. This year, 16 New Horizons seniors will matriculate at UML and 8 will participate in the Lowell Connections Program.

## **Northeast Network STEM Pipeline Fund Project**

The Northeast Network STEM (Science, Technology, Engineering and Mathematics) Pipeline Fund Project is a collaboration of seven higher education institutions, fourteen PreK-12 schools and school districts, three workforce development groups and private industry in the northeast region of the state committed to addressing the challenge of teacher and student knowledge and skill in STEM subjects and the shortage of young people choosing careers in STEM fields. The University of Massachusetts Lowell, Graduate School of Education, Center for Field Services and Studies, is the lead partner in the consortium which was awarded \$238,000 in 2004 and \$322,000 in 2007, from the Massachusetts Board of Higher Education for



the development and implementation of the STEM fellows program. Forty middle school teachers representing seven school districts and one charter school are current STEM fellows. Six continuing districts have 15 middle and high school teacher STEM leaders. Each fellow fulfills 30 hours of individual professional development in STEM disciplines, four full day STEM fellow workshops and 20 hours of district team time. Each district team works together to produce a capstone plan focused on the needs of the individual district. The teams are supported in this effort by STEM leaders, former STEM fellows who are trained to be peer coaches, assisting the current fellows in their planning. STEM leaders also work to implement capstone plans in their own districts. At the Massachusetts STEM Summit V on October 28, 2008, our presentation on “Growing STEM Teacher Leaders” will represent the work of the Northeast Network. The project has also been accepted for presentation at the National Association for Supervision and Curriculum Development Annual Meeting in 2009.

### **Pipeline Fund Steering Committee**

This group of 30 educators, industry leaders and workforce development specialists from the Northeast region of the state was convened by CFSS (Center for Field Services and Studies) to plan and oversee a regional network in support of science, technology, engineering and math (STEM) initiatives in Pre K-12 schools. The group’s efficacy was demonstrated in a successful proposal to renew STEM funding in the region for the 2007-2009 academic period. Quarterly meetings of the committee assess the existing project and plan for the next phase of the network and the STEM fellows’ project.

### **The Superintendents’ Forum**

The Superintendents’ Forum is an eleven year old program of meetings hosted by CFSS for area superintendents to share ideas and concerns on topics of interest to school leaders. Convened by a sitting school superintendent, the Forum offers district leaders a chance to tap into UML resources, as well as receive briefings on matters of importance to them. UMass Lowell’s new Chancellor, Martin Meehan invited area superintendents to a breakfast meeting and panel discussion on September 29, 2007 at Alumni Library. The Superintendents’ Forum theme this year was *Journeys in Leadership* and a book discussion group, *Global Education*.

## **8. Publications**

Boccia, J. Characteristics of successful local blended programs in the context of the Sloan-C Pillars (2007), With J. Moloney, C. Hickey, A. Bergin, K. Polley and J. Riley. Journal of Asynchronous Learning Networks 11 (1): pp. 29-47.

### **9. Conference Presentations**

Hodgman, J. and Rancourt, M. (October 2007) *Opportunities and Challenges in Developing STEM Plans*. Presentation at Massachusetts STEM Summit, Sturbridge, MA

Belcher, M, Bent, C. and Torres, H.N. (January, 2008) *College Prep Program: A Highly Motivated Super Dedicated University/School Partnership*. Presentation at the College and Career Readiness Summit, Worcester, MA



Boccia, J., Dennis, M. and Rancourt, M. (January 2008) *Developing Regional Collaborations in STEM Education*. Presentation at the College and Career Readiness Summit, Worcester, MA

Columbo, M., Lohmeier, J. and Nehring, J. (March 2008) *Conversion of a Large, Urban High School to Small Schools: Leadership Challenges and Opportunities* Presentation at the Annual Meeting of American Educational Research Association, New York City, NY

## **10. Collaboration with Other Centers/Institutes/Departments**

The Center's primary work in the university is linking university faculty and facilities to public schools. In this role, we build collaborations with all colleges and support cross-campus initiatives, such as TEAMS Academy, STEM outreach work to schools, Teaching American History projects, and other programs that may be developed. In addition, the Instructional Network supports many departments and centers seeking technology support for distance learning, video streaming, and digitizing media for instruction. Continuing Education, Bioinformatics, the inter-campus Marine Science program, and Media Services were active users of IN services in 2007-2008.

Among the major partnership projects CFSS has forged in the past year are:

### **Lawrence Small Schools Initiative**

CFSS facilitates a partnership between Lawrence Public Schools educators and university faculty and staff in support of the new Lawrence High School thematic curriculum. Currently 45 university faculty and staff from across campus work with teams of Lawrence High School educators to design the academic programs at the six small schools. In 2007-2008, the University has a designated room in the new high school to provide admissions counseling, dual enrollment courses, and professional development for teachers.

### **Teaching American History**

The collaborative group of six school districts, a charter school, ten university faculty, and eight cultural organizations that developed this million dollar grant to the Andover Public Schools was convened and facilitated by CFSS. We will provide operational support to the project over the next three years.

### **National Science Foundation GK-12 Fellows Proposal**

A group of university faculty asked CFSS to identify and recruit urban school districts to partner in a five year, \$3,000,000 proposal to NSF. We brought together leaders of the Lowell and Lawrence School Districts with faculty and helped pilot a project and develop a proposal of mutual benefit to both sides. Funding decision to be announced in January 2009.

### **Lowell Public School Collaborative and Wider Horizons**

As part of their commitment to education for mutual understanding 2 colleges in Belfast and 2 colleges in Dublin have collaborated with a range of educational establishments in Massachusetts to provide a course of study and practice in multicultural education for 3rd year



student teachers.

The program, now entering its 17<sup>th</sup> year, is unique in so far as it provides an opportunity for student teachers from Northern Ireland and from the Republic of Ireland to live and work together. CFSS, in collaboration with the Center for Family Work and Community, provides leadership and team building experiences for the visiting teachers in preparation for their work in Lowell summer schools.

## 12. Proposals Awarded/Submitted 2007/2008

CFCI Annual Innovation Enhancement Grant	\$6,300
College Prep/Young Scholars Program (District Grant Lawrence Public Schools)	\$190,000
Motorola Foundation, Support for Lowell and Lawrence HS Physics Project	\$50,000
Wider Horizons	\$1,485
Board of Higher Education, McNair Funding for New Horizons	\$59,000
Board of Higher Education, Northeast Network STEM Pipeline Fund	\$322,000
Teaching American History: U.S. Dept Of Education subcontract	\$317,273
Theodore Edson Parker Foundation, Support for Bartlett Literary Study Sovereign Bank, Support for Bartlett Literacy Study	\$10,000

## Proposals Submitted/Pending 2007/2008

Fund for the Improvement of Postsecondary Education, US Department of Education, Lawrence High Schools Transformation Study	\$750,000
NSF GK-12 Proposal, with Electrical Engineering and Computer Science – Waves and Vibes	\$ 3,000,000
Commonwealth Corp - IMPACT, Mass. Service Alliance	\$53,600
US Dept. of Education, Institute for Education Science, Bartlett Literacy Project	\$1,000,000
Staples Foundation - Support for the Mary Bacigalupo Educational Forum	\$7,500
Sovereign Bank - Spirit of Your Neighborhood Campaign - Support for the Mary Bacigalupo Educational Forum	\$4,000
Aubert J. Fay Charitable Fund - Support for the Mary Bacigalupo Educational Forum	\$4,000



14. CENTER FOR GREEN CHEMISTRY  
Annual Report  
University of Massachusetts  
JULY 2007 – JUNE 2008

### 1. Mission Statement

The UML Center for Green Chemistry (CGC) serves to focus activities across the University that are engaged in the synthesis and design of materials and products that reduce or eliminate the use and/or generation of hazardous materials. The UML CGC promotes cross-disciplinary collaborations across various centers and colleges through research, teaching and community outreach. The center provides a meeting ground for groups within academia, industry and government to work together for creation and dissemination of the principles and practice of Green Chemistry.

### 2. General Description and Goals

The primary goal is to build and support an interdisciplinary team of researchers comprising post-doctoral researchers, graduate, undergraduate students as well as high school students that can focus on developing new materials and demonstrating novel phenomena using sustainable/environmentally friendly methods.

### 3. Research Focus Areas

During 2007-2008, the research focus was on three main areas namely: (1) Novel *in situ* synthesis of semi-conducting polymers for solar cell applications (2) Enzymatic synthesis of electrically conducting polymers (3) Greener routes to halogen free flame retardant materials.

### 4. Associated Personnel/faculty

During the past year, the research and educational activities have been very multidisciplinary with the following faculty involved from various departments:

Asst. Prof. Ramaswamy Nagarajan, Department of Plastics Engineering  
Prof Jayant Kumar, Director, Department of Physics and Center for Advanced Materials  
Prof. William Bannister, Department of Chemistry  
Prof. Susan J. Braunhut, Department of Biological Sciences

### 5. New/Temporary faculty affiliations for 2007/2008 with Center

New: Prof. Susan Braunhut

### 6. Students supported

Graduate students:



- (i) Sharavanan Balasubramaniam, Department of Plastics Engineering (CFCI supported)
- (ii) Subhalakshmi Nagarajan, Department of Chemistry, Polymer science program
- (iii) Sethumadhavan Ravichandran, Department of Chemistry, Polymer science program
- (iv) Rahul Garhwal, Biomedical Engineering and Biotechnology program

#### High-school students:

- (i) Joshua R. Infantine, Phillips Academy, Andover, MA.
- (ii) Connie Li, Chelmsford High School (supported by U.S Army, Academy of Applied Sciences)

### **7. Current Research Projects**

#### **a. Novel *in situ* synthesis of semi-conducting polymers for solar cell applications**

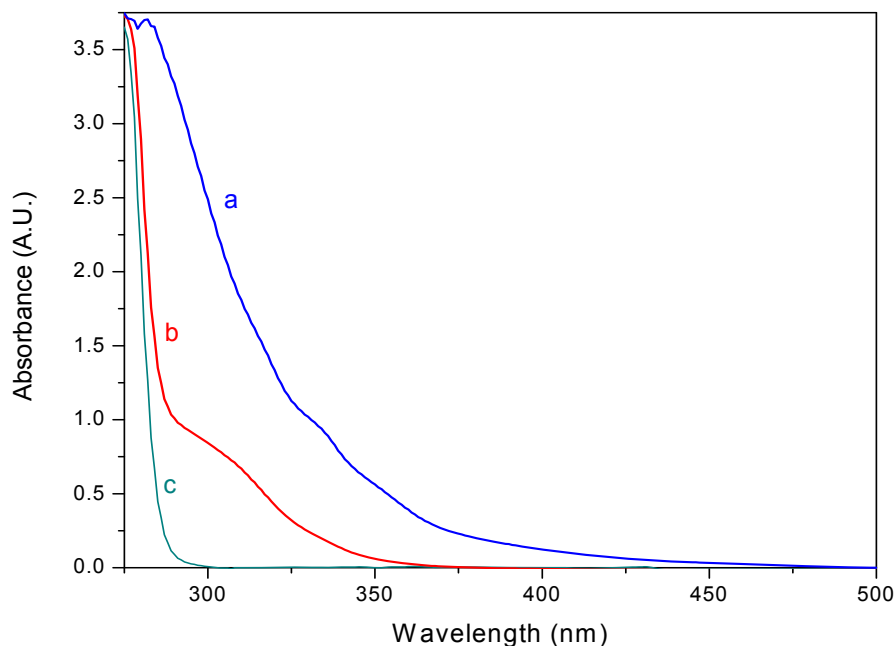
The escalating demand for cost-effective, renewable energy sources has given a major thrust to the development and utilization of solar cells. High costs associated with single-crystal solar cells and the leakage and/or corrosion problems associated with liquid electrolyte-based dye-sensitized solar cells (DSSCs) have necessitated research in the area using conjugated polymers as hole-transport materials. Wang *et.al* have recently demonstrated the solid-state polymerization of a diacetylene monomer in nanocrystalline TiO<sub>2</sub>.<sup>1,2</sup> These oligomers can be used as hole transport materials in solar cells. The primary goal of this project has been to explore the possibility of photocatalytically synthesizing thiophene-based polymers inside the pores of titania.

(1) Synthesis and Purification: Conjugated oligomers of 3,4-ethylenedioxythiophene (EDOT) were photocatalytically synthesized in the presence of metal oxide nanoparticles. Titanium dioxide (P25 TiO<sub>2</sub>, Degussa AG) and zinc oxide (ZnO, Aldrich) nanopowders were used as the photocatalysts. Typically, slurries were prepared by mixing 50 parts (by weight.) of the monomer dissolved in 1 ml of solvent (ethanol) with 75 parts (by weight.) of the metal oxide. Slurries were also prepared under solventless conditions.

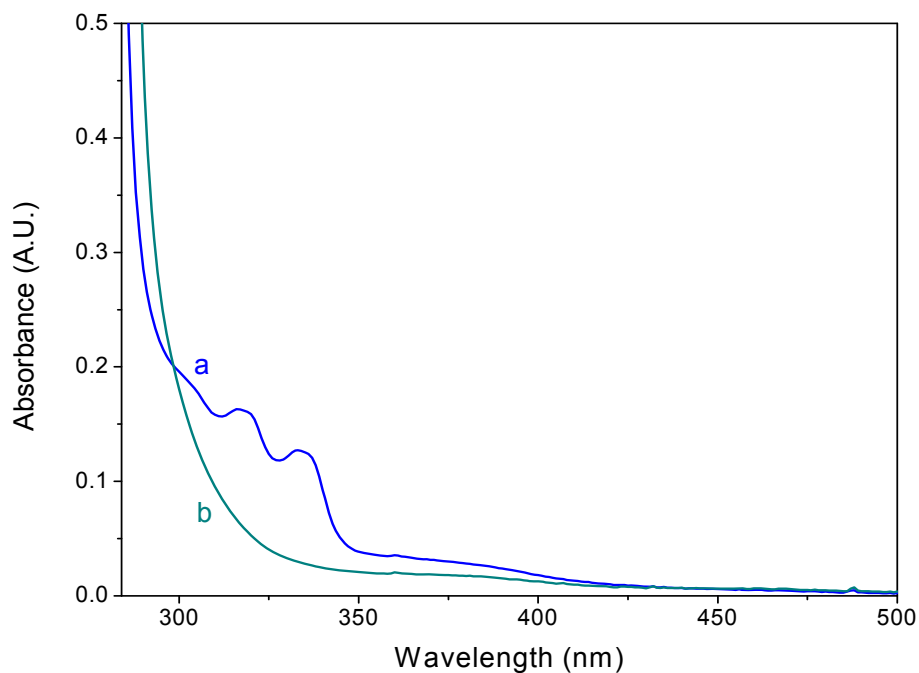
The prepared slurries were irradiated with Ultra Violet (UV) light at a wavelength of 365 nm and ambient light for 4 hours. The slurries were also kept under dark for comparison. The effect of lowering the temperature was studied by freezing the reaction mixture in a bath of acetone/dry ice mixture and subsequently exposed to UV light at 365nm. After four hours, the reaction mixture was diluted with 4 ml of dichloromethane and the products extracted by filtering the mixture using a 0.2 μm nylon filter. The filtrate was used for further spectroscopic characterization.

(2) Characterization: (i) *UV-Vis Spectroscopy*: UV-Visible spectra were recorded using a Perkin Elmer Lambda 9 spectrophotometer. Quartz cuvettes with 1 mm path length were used. Figure 1 depicts the UV-Visible spectra for the oligomerization of EDOT using TiO<sub>2</sub> as a photocatalyst. The reactions were carried out under UV light, at ambient conditions and in the dark. As seen in the figure 1-c, the oligomerization did not proceed in the absence of light. Control experiments (without metal oxide present) were carried out to confirm that oligomerization does not happen

in absence of the metal oxide (data not shown). This clearly indicates that the oligomerization is metal oxide catalyzed and requires the presence of light. Oligomerization proceeded at ambient (1-b) and under UV light (1-a) as seen by absorptions in the visible regime, indicating the presence of species with extended conjugation. The absorption characteristics are very similar to the reported electronic absorption spectra of the EDOT dimers<sup>3</sup>.

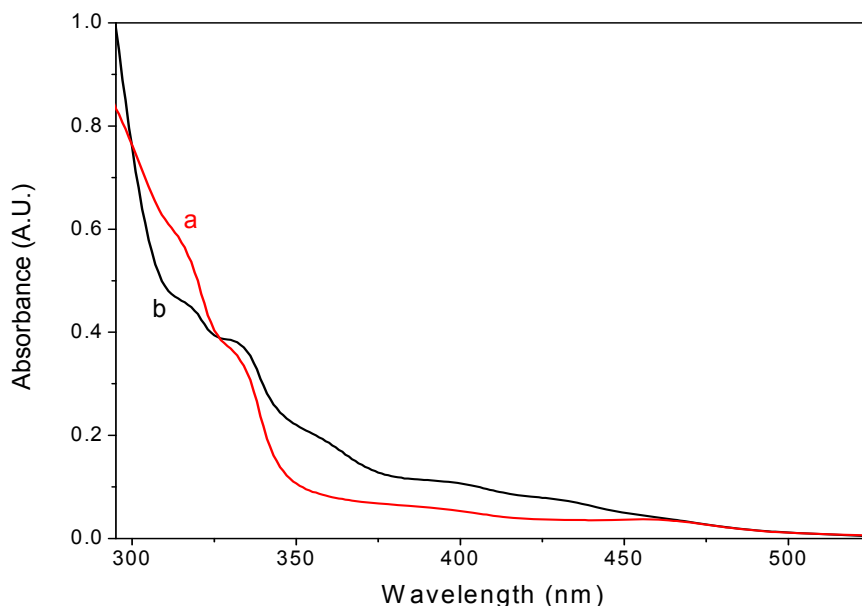


**Fig. 1:** UV-Visible spectra of the EDOT oligomers synthesized using  $\text{TiO}_2$  as catalyst (a) under UV light (b) under ambient light (c) in dark



**Fig. 2:** UV-Visible spectra of oligomeric EDOT synthesized using ZnO as catalyst under (a) UV light (c) dark

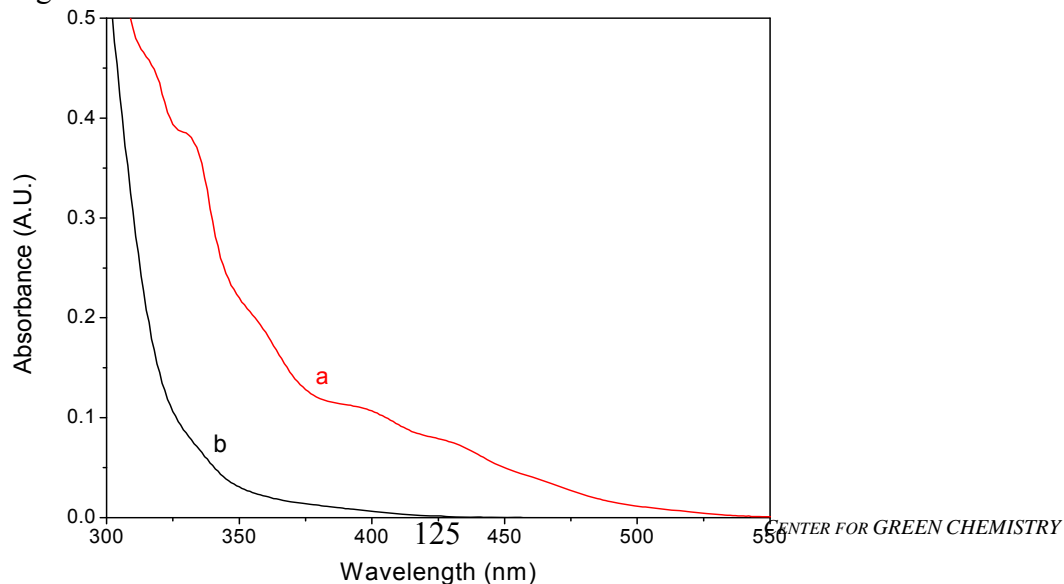
We found that ZnO could effectively catalyze the oligomerization of EDOT when irradiated with UV light at 365nm. The oligomerization did not proceed in the absence of light. ZnO catalyzed synthesis of oligomeric EDOT under ambient light is being investigated.



**Fig. 3:** UV-Visible spectra of EDOT oligomers with (a) ZnO (b) TiO<sub>2</sub> under UV light.

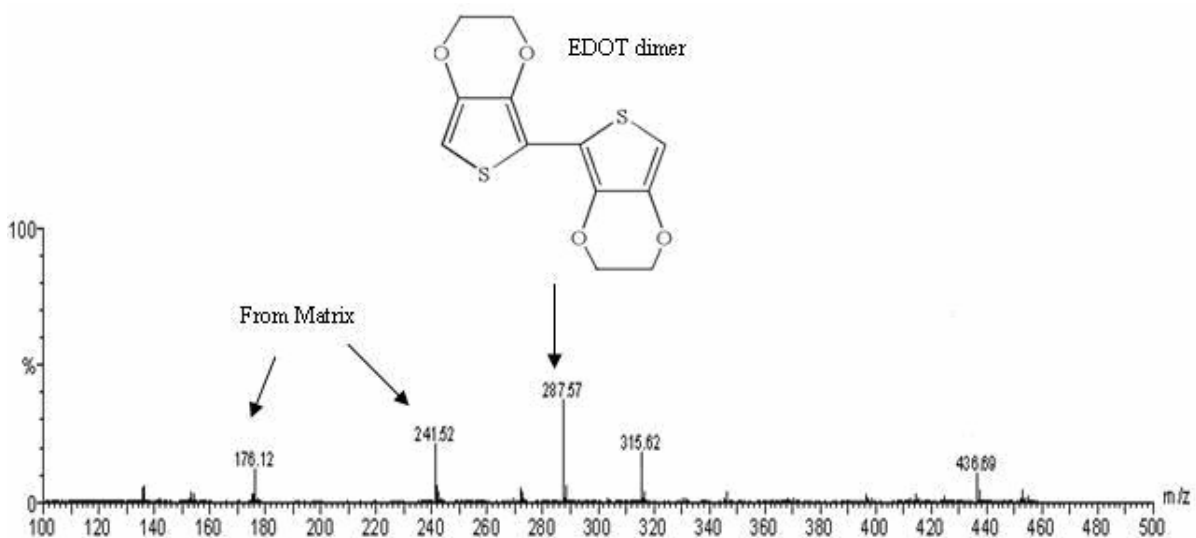
Fig 3 shows the comparison of EDOT oligomers under TiO<sub>2</sub> and ZnO. While the EDOT oligomers obtained using TiO<sub>2</sub> photocatalysis exhibits slightly higher absorption, MALDI-TOF-MS results indicate the formation of dimers and possibly trimers in both cases.

In order to understand the role of the mobility of the monomer and its ability to diffuse into the nanopores, the reaction was carried out by freezing the slurry. Under frozen conditions, the reaction mixture was irradiated with UV light at 365nm. Fig 4 shows that the reaction did not proceed under frozen conditions. We believe that the restricted mobility of the monomers chains prevents progress of the reaction. Further studies are underway to understand the mechanism and kinetics of the oligomerization.



**Fig 4.** UV-Vis spectra of product with EDOT/TiO<sub>2</sub> slurry under (a) normal and (b) frozen conditions  
(ii) *Matrix Assisted Laser Desorption Ionization (MALDI-TOF) Mass Spectroscopy*

Matrix Assisted Laser Desorption Ionization – Time of Flight Mass Spectrometry (MALDI-TOF MS) measurements were done on a Waters MS2700 equipped with a 337 nm nitrogen laser. 2,5-dihydroxybenzoic acid (DHB) was used as a matrix. Analyte and matrix were dissolved in dichloromethane and the analyte/matrix ratio was 1:10. **Fig. 5** depicts the MALDI-TOF MS of the EDOT dimers. As seen, MALDI-TOF-MS shows the presence of a peak at  $m/z=287$ . This peak was absent in the spectrum of the matrix and can be attributed to the dimer EDOT. This provided clear evidence for the formation of dimer of EDOT.



**Fig. 5:** MALDI-TOF mass spectrum of EDOT oligomer

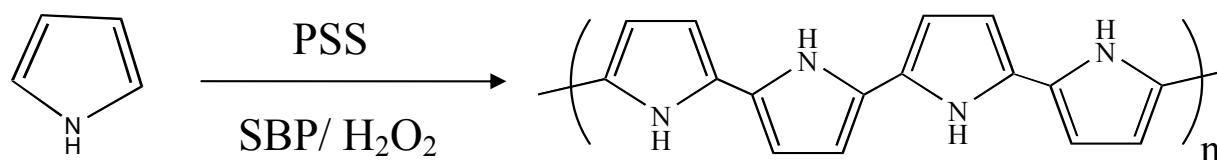
Current research efforts are focused on exploring the possibility of separation of these oligomers and characterization using fluorescence spectroscopy. In addition solar cells are being fabricated with these thiophene oligomers as the solid state hole transport layer (instead of the liquid electrolytes).

### **b. Enzymatic synthesis of electrically conducting polymers**

Among electrically conducting polymers polypyrrole has attracted tremendous attention over the past decade due to the ease of synthesis and relatively lower toxicity. Conventionally polypyrrole is synthesized either electrochemically or chemically using strong oxidants which are often toxic or incompatible with biological systems. Recently, it has been shown that oxidative polymerization reactions can be catalyzed by plant peroxidases.

We have developed a new biocatalytic template-assisted approach for the polymerization of pyrroles catalyzed by soybean peroxidase in aqueous conditions. Poly (sodium 4-styrene sulfonate) PSS was used as the polyelectrolyte template that provides water-solubility to the polypyrrole synthesized. PSS also provides the counter-ion for doping the conducting polymer formed (**Fig.6**). Spectroscopic characterization indicates the formation of an electrically conducting polymer.

This enzymatic route provides the opportunity to synthesize polypyrrole at a higher pH than reported earlier. The favorable pH combined with aqueous reaction media supports the possibility of extending the use of polypyrrole to applications such as biomedical devices or biosensing where there may be a requirement to synthesize polypyrrole in the presence of the biological entity.



**Fig. 6:** Enzymatic synthesis of Polypyrrole

References cited:

1. Yanping Wang, Ke Yang, Seong-Cheol Kim, Ramaswamy Nagarajan, L. A. Samuelson, Jayant Kumar, *Chem Mater.* **18** (2006) 4215-4217.
2. Yanping Wang, Ke Yang, Xiaoyu Wang, Ramaswamy Nagarajan, L.A. Samuelson, Jayant Kumar, *Organic Electronics*, **7** (2006) 546-550.
3. D. Wasserberg, *et. al*, *J. Am. Chem. Soc.*, **128 (51)** (2006) 17007-17017.

## 8. Publications

1. Subhalakshmi Nagarajan, Jayant Kumar, Ferdinando F. Bruno, Lynne A. Samuelson, and Ramaswamy Nagarajan “Biocatalytically Synthesized Poly(3,4 ethylenedioxythiophene)” *Macromolecules*, **41 (9)**, 3049–3052, 2008.
2. Patent disclosure: “Photocatalyzed synthesis of conjugated polymers/oligomers using semiconductors” Jayant Kumar, Lynne Samuelson, Yanping Wang, Lian Li, Subhalakshmi Nagarajan, Ramaswamy Nagarajan, patent disclosure submitted to CVIP office in 2008.

## 9. Conference Presentation

“Biocatalytically Synthesized Polypyrrole” Ramaswamy Nagarajan, Rahul Garhwal, Subhalakshmi Nagarajan, Jayant Kumar, Ferdinando F. Bruno, and Lynne A. Samuelson, presented at 12<sup>th</sup> Annual Green Chemistry and Engineering Conference, Washington D.C., June 24-25, 2008,



## **10. Collaboration with other Centers/Institutes/Departments**

The faculty and students at the Center for Green Chemistry (CGC) work collaboratively with faculty and researchers from other centers and departments including the Center for Advanced Materials (CAM) and the. In the projects outlined above, the research was carried out by scientists and students from the departments of Physics, Chemistry, Polymer Science and Plastic Engineering. CGC's expertise in developing environmentally friendly and sustainable technologies will be instrumental in developing this technology.

## **11.Regional/Local Outreach**

Outreach has always been an integral part of research at CGC. Seeding research interest in young minds is an important aspect of outreach and will act as a strong motivation for them to take up science as a career. Summer students (Connie Li and Joshua Infantine) from Chelmsford high School and Phillips Academy are currently working on various research projects in the center. At CGC, these students are being trained on the synthesis, characterization and on the use of different types of instrumentation typical used in characterization of novel materials. These students are mentored on the various aspects of the project by the faculty and graduate students involved in the projects.

## **12. Proposals submitted/Awarded 2007/2008**

Awarded:

“Greener-routes to Halogen-free Flame retardants” submitted to Toxics used reduction Institute, July 2007, by Profs. Jayant Kumar (PI) and Ramaswamy Nagarajan  
Award amount \$20,000

Submitted:

“Novel semi-synthetic, polymerized catechins as chemotherapeutics for treatment of breast cancer” – November 2007, submitted to Susan G. Komen for the cure grants program, by Profs. Susan Brauhn (PI), Jayant Kumar and Ramaswamy Nagarajan  
Amount \$599,419



## 15. CENTER FOR HEALTH AND DISEASE RESEARCH

### **University of Massachusetts Lowell**

#### **CFCI Report 2007-2008**

#### **Mission Statement**

The Center for Health and Disease Research (CHDR) seeks to promote biomedical and health-related research advances to support and enhance the development of a sustainable industrial economic sector. The CHDR performs basic and applied research in several key areas of chronic and acute health problems, such as cardiovascular disease, eye disease, cancer, diabetes, obesity, inflammation and Alzheimer's disease and functions as a cohesive, interdisciplinary facility, which serves to unify scientists with common interests.

#### **General Description and Goals**

The primary role of the Center for Health and Disease Research (CHDR) is to promote biomedical and health-related research advances to support and enhance the development of a sustainable industrial economic sector. The CHDR performs basic and applied research in several key areas of chronic and acute health problems such as cardiovascular disease, eye disease, cancer, diabetes, obesity, inflammation and Alzheimer's disease and functions as a cohesive, interdisciplinary facility, which serves to unify scientists with common interests. More recently, CHDR has become actively involved in developing nano-delivery systems for nutraceuticals, pharmaceuticals and cosmeceuticals. As a result, researchers in CHDR have engaged in initiating efforts resulting in intellectual property, patents, commercialization and the formation of two spin off companies. The CHDR actively promotes mutual University, Hospital and Industrial collaboration to ensure multidisciplinary approaches to sustain funding for its research agenda, while facilitating the rapid transfer of innovative and new technologies. The CHDR expects to play a significant role in the future economic development of the region by engaging in outreach disease prevention/wellness initiatives that involve hospitals, corporations, nursing homes and assisted senior living facilities.

#### **Research Focus Areas**

- Pharmaceutical and nutraceutical interventions in cardiovascular disease, diabetes, cancer and age-related macular degeneration.
- Nanoemulsion delivery of pharmaceuticals, nutraceuticals and cosmeceuticals.
- Nanoemulsion technology as it relates to formulation of films and coatings.



## **Associated Personnel**

### Faculty:

Dr. Thomas Wilson	University of Massachusetts Lowell Department of Clinical Laboratory and Nutritional Sciences
Dr. Stephen McCarthy	University of Massachusetts Lowell Department of Plastics Engineering
Dr. Thomas Shea	University of Massachusetts Lowell Department of Biology
Dr. Susan Houde	University of Massachusetts Lowell Department of Nursing
Thomas L. Foxall	University of New Hampshire, Durham, NH
Ira Ockene, M.D.	University of Massachusetts Medical Center, Worcester, MA
John Dagianis, MD	Ophthalmologist, Nashua Eye Associates

### Staff:

Elizabeth Goodrow	University of Massachusetts Lowell Department of Clinical Laboratory and Nutritional Sciences
Maureen Faul	University of Massachusetts Lowell Department of Clinical Laboratory and Nutritional Sciences

## **New and Temporary Faculty Affiliations**

Dr. Susan Houde	University of Massachusetts Lowell Department of Nursing
Dr. Stephanie Chalupka	University of Massachusetts Lowell Department of Nursing
John Dagianis, MD	Ophthalmologist, Nashua Eye Associates
Tara McHugh	Research Leader United States Department of Agriculture
Charles Cappetta, M.D.	FitKids Program Director



## **Students Supported**

### Graduate Students:

- Fonghsu Kuo
- Anton Edmond
- Swetha Kanbalapally
- Alicia Lepore
- Richard Long
- Nirmal Paliwal
- Rohini Vishwanathan
- Balaji Subramanian
- Srikanth Kakumanu
- Mukta Bagul
- Shawn Konecni

## **Current Research Projects**

- Effect of Lutein enriched eggs on the progression of dry age-related macular degeneration (AMD)
- Bioavailability Study of Nanoemulsion Formulations Containing Quercetin, Tyrosine and Curcumin in Rats.
- Bioavailability Studies of Lutein and Zeaxanthin from a Nanoemulsion Preparation.
- Reducing Risk Factors in Peripheral Arterial Disease (Northwestern)
- Hypercholesterolemic Effects of Test Fiber Preparations versus Psyllium in Hamsters
- Rice Bran Extract: Cholesterol-Lowering Potential and Mechanism of Action
- Cholesterol and PK Effects of Three Different Doses of a Novel Drug in Hamsters
- Lawrence Latino Diabetes Prevention Program
- Efficacy of a Nanoemulsion Preparation of ASF (Antioxidant Synergy Formulation) on Inflammation in Mice.
- Efficacy of a Nanoemulsion Preparation of Aspirin on Inflammation in Mice.



## **Publications**

Fongshu K, Kotyla T, Wilson T, Kifle L, Ortiz D, Panagiotou T, Gruverman I, Tagne, JB, Shea T, Nicolosi R. **A Nanoemulsion Encapsulated Anti-Oxidant Synergy Formulation Reduces Neuroblastoma-Induced Tumors in Mice.** J. Exp. Therapeutics & Oncology (2007) 6,2:129-135.

Wilson TA, Orthoefer F, **Nicolosi RJ.** **Soy Protein Concentrate Lowers Serum High-Density Lipoprotein Cholesterol Concentrations Compared with Casein in Ovariectomized Rats Fed a Low-Fat, Cholesterol-Free Diet.** Nutr. Res (2007)27, 417-422.

Wilson TA, Nicolosi RJ, Kotyla T, Fleckinger. **Soy Protein Without Isoflavins Reduces Aortic Total and Cholesterol Ester Concentrations Greater Than Soy Protein with Isoflavones Compare to Casein in Hypercholesterolemic Hamsters.** Nutr. Res.(2007) 27, 498-504.

Kotyla T, Kuo F, Moolchandani V, Wilson T, Nicolosi R. **Increased Bioavailability of a Transdermal Application of a NanoSized Emulsion Preparation.** International J of Pharm (2008) 347, 144-148.

Tagne JB, Kakumanu S, **Nicolosi RJ.** **A Nano-emulsion Formulation of Tamoxifen Increases Its Efficacy in a Breast Cell Line.** Molecular Pharmaceutics (2008)5/2, 280-286.

## **Manuscripts Accepted for Publication**

Subramanian B, Kuo F, Ada E, Kotyla T, Wilson T, Nicolosi RJ. **Enhancement of Anti-Inflammatory Property of Aspirin in Mice by a Nanoemulsion Preparation.** (Pharmaceutical Research, In Press 2008).

## **Conference Presentations**

**Nanotechnology in Nutrition Medicine,** University of San Francisco at Quito, Ecuador  
**Role of the Animal Model in Developing Pharmaceuticals for Treatment of Hypercholesterolemia,** Johnson & Johnson, Philadelphia, PA.

**NuSun Sunflower: Rationale for Use and Dietary Guidelines,** Frito Lay, Dallas, Texas

## **Collaboration with other Centers/Institutes and/or Departments**

Center for Cellular Neurobiology & Neurodegeneration Research	Tom Shea, Ph.D.
Institute of Nanotechnology	Arthur Watterson, Ph.D.
Institute for Plastics Innovations	Stephen McCarthy, Ph.D.



**Regional/ Local Outreach**

- Nutrition related staff inservice programs at D’Youville Senior Care Center
- Presented Healthy Eating Seminars at the Andover Senior Center.
- Lecture on “The Science of Nutrition and Healthy Eating” at the Bartlett School, Lowell

**Proposals Awarded**

- > **U.S. Army Natick Research** **\$100,000.00**
  - o Evaluation of Nanoemulsion Formulations Containing Quercetin, Tyrosine and Curcumin.
- > **University of Massachusetts Medical School/NIH** **\$22,596.00**
  - o Lawrence Latino Diabetes Prevention Program
- > **Egg Nutrition Center/USDA** **\$299,803.00**
  - o The Effect of Lutein Enriched Eggs on the Progression of Dry Age-related Macular Degeneration (AMD)
- > **Egg Nutrition Center/USDA** **\$99,271.00**
  - o Egg Yolk Consumption in Older Adults taking Cholesterol-lowering Medication
- > **Massachusetts Lions Eye Research Fund** **\$15,000.00**
  - o Bioavailability Studies of Lutein & Zeaxanthin from a Nanoemulsion Preparation
- > **Microfluidics** **\$12,000.00**
  - o Use of Nanoemulsion Technology to Increase Fluorescence Intensity
- > **NatuRi** **\$60,398.00**
  - o Biological Activity of Proprietary Rice Micronutrient Extract
- > **Johnson & Johnson**  
**\$102,482.00**
  - o A Novel Drug that Inhibits Arterial Mast Cell Activities in Early Aortic Lesions of Hypercholesterolemic Hamsters.
- > **ProPharmaceuticals** **\$10,373.44**
  - o Characterization of Three ProPharmaceuticals’ Carbohydrate-based Drug Formulations.



## 16. CENTER FOR INDUSTRIAL COMPETITIVENESS

### **Annual Report 2007-2008**

#### **I. MISSION STATEMENT**

The Center for Industrial Competitiveness conducts path-breaking research on industrial innovation, regional development, corporate governance, and sustainable prosperity. Through an accumulation of detailed studies of industrial sectors, we strive to develop a profound understanding of the inner workings of the Massachusetts economy. At the same time, we are engaged in research and on industrial competitiveness throughout the world; for example, Britain, France, India, Japan, Malaysia, Mexico, Northern Ireland, Norway, Slovenia, South Korea, and Sweden. The Center also analyzes the impacts of industrial restructuring and innovation on skill formation, work organization, employment opportunities, and economic development. The Center is engaged in research and outreach in direct support of regional, state and local partners, including facilitating student participation and internships. We bring a truly global perspective and unique analytical capabilities to the problems of regional development.

#### **II. GENERAL DESCRIPTION AND GOALS**

CIC faculty, staff, students and allied researchers utilize and develop competencies across program areas that integrate quantitative and qualitative data collection and analysis, comparative and historical case study methodologies, and network development and support among sponsoring and stakeholder communities. The skills and techniques include survey administration and analysis; conducting in-depth interviews and content analysis, industry cluster identification and analysis; integrated analysis at the firm and industry level of technology and organizational development, strategy and performance; and assessment of workforce training needs and training program development. These CIC activities are funded by federal, state, regional and local agencies, as well as by foundations that support social science research and policy analysis and training programs. The results of CIC activities are provided in reports, books and publications in the popular media and peer reviewed journals as well as project activities with partnered organizations.

#### **III. RESEARCH FOCUS AREAS**

The activities of the Center for Industrial Competitiveness are in eleven areas of research, analysis, policy and program development, and performance evaluation. The first project is led by Michael Best, projects 2-4 are led by William Lazonick, projects 5-7 are led by William Mass, projects 9 and 10 are led by Chris Tilly, and Project 11 is led by Philip Moss and Robert Forrant.

- 1) Anticipating Technology Trends - vTHREAD
- 2) Innovative Enterprise and Sustainable Prosperity
- 3) The Globalization of the High-Tech Labor Force
- 4) Innovation and competition in the global communications technology industry
- 5) Employment and Regional Development in the United States and Mexico
- 6) Renewable Energy in New England: Technology, Industry and Workforce Policies



- 7) New England Initiative
- 8) Measures and Indicators Collaborative Visualization (MICo-Viz)
- 9) Job Quality, Inequality and Regional Development
- 10) Global Retailers, Global Strategies
- 11) Community Development & Work Study Program

**IV. ASSOCIATED PERSONNEL**

**UNIVERSITY OF MASSACHUSETTS LOWELL**

*Directors: (Name and Department)*

Michael Best	University Professor Emeritus	COM
William Lazonick	Regional Economic & Social Development	CASH
Edward March	Office of Regional Development	UML
William Mass	Regional Economic & Social Development	CASH

*Senior Research Fellows:*

Robert Forrant	Regional Economic & Social Development	CASH
Laurence Gross	Regional Economic & Social Development	CASH
Philip Moss	Regional Economic & Social Development	CASH
David Soule	Senior Research Fellow	CIC
Chris Tilly	Regional Economic & Social Development	CASH
Donald Zizzi	Senior Fellow	CIC

*Research Associates: (Name and University)*

Takeshi Abe	Osaka University, Japan	
Beth Almeida	International Association of Machinists	
Mercedes Arce	Colegio de Tlaxcala, Mexico	
José Luis Álvarez Galván	London School of Economics	
Henrik Glimstedt	Stockholm School of Economics	
Georges Grinstein	Computer Science	CAS Julia
Lane	American University and Bureau of the Census	
Steven McCarthy	Plastics Engineering	COEg
Mariana Mazzucato	Open University, Milton Keynes, UK	
Mary O’Sullivan	University of Pennsylvania	
Steve Quimby	Jobs for the Future	
Hal Salzman	Urban Institute	
Onur Tulum	National University of Ireland, Galway.	
Kazuo Wada	Tokyo University	
Sara White	Cambridge College	

**V. New and Temporary Faculty Affiliations (last 3 years)**

Mercedes Arce	Colegio de Tlaxcala, Mexico
---------------	-----------------------------



Marie Carpenter	University of Bordeaux
José Luis Álvarez Galván	London School of Economics
Henrik Glimstedt	Stockholm School of Economics
Ulrich Jürgens	Science Center Berlin
Mariana Mazzucato	Open University, Milton Keynes, UK
Yannick Lung	University of Bordeaux
Sara White	Cambridge College

## **VI. Graduate Student Research Assistants:**

Iraida Elena Blanco	University of Massachusetts Lowell
Bob Wayne Bell	Harvard University
John Fraser	University of Massachusetts Lowell
Mustafa Erdem-Sakinc	University of Massachusetts Lowell
James Giddings	University of Massachusetts Lowell
Gao He	University of Massachusetts Lowell
Benjamin Hopkins	Harvard University
Farooq Kahn	University of Massachusetts Lowell
Jonathan Latner	University of Massachusetts Lowell
Tom Merrill	University of Massachusetts Lowell
Raymond Spinazola	University of Massachusetts Lowell
Yue Zhang	University of Massachusetts Lowell

## **VII. CURRENT RESEARCH PROJECTS**

### **1. Anticipating Technology Trends - vTHREAD**

Economic policymaking increasingly involves technology-based initiatives. vTHREAD (Techno-Historical Regional Economic Analysis Database) is a historical database of high tech companies and research tools to deepen our understandings of regional industrial specialization, growth, decline, and reinvention. vTHREAD includes approximately 60,000 public and private, nationally located high tech producers classified by a finely granulated taxonomy (licensed from CorpTech which also supplies the major company directory) in which 18 industry codes explode to 300 major product codes, and to 3000 minor product codes. vTHREAD is a database tool to ‘discover’ a region’s competitive advantage and to characterize a region’s underlying technology capabilities, deep craft skills, and cluster dynamics. It is a firm specific, bottom-up approach to conduct technology audits and technology roadmap exercises, to research skill needs, and to anticipate technology trends.

The unique 15 year historical feature combined with 147 fields of the database also offers the capability to generate reports on company growth rates in employment and sales, evolution of product profile, technology capabilities, executives, and changes in company ownership (public/private, domestic/foreign). A mapping feature is a tool to identify technology mini-clusters and to characterize technology genealogy, industry churn measured by the entry and exit of firms in specific technologies and locations. Professor Best recently completed a study of the rise and rapid growth of the medical devices industry in Massachusetts that deploys an historical



dataset of high tech companies to characterize the forces that drive industrial transitions and the emergence of new clusters. Presently he is funded by a Marie Curie Fellowship to transfer the research methodology to the Centre for Innovation and Structural Change, National University of Ireland, Galway.

## **2. Innovative Enterprise and Sustainable Prosperity**

This research project seeks to understand the social conditions that underpin the ability of national economies to generate stable and equitable economic growth. In particular, we focus on the ways in which different “business models” – characterized by certain types of investment strategies, organizational structures, and financial relations – support or undermine the quest for sustainable prosperity. The current research agenda builds on Professor Lazonick’s book manuscript, *Sustainable Prosperity in the New Economy?: Business Organization and High-tech employment in the United States*, completed in January 2008 under a grant from the W. E. Upjohn Institute for Employment Research. Lazonick is currently editing this book for publication by the Upjohn Institute.

Based on the research in *Sustainable Prosperity in the New Economy*, and an article “The US Stock Market and the Governance of Innovative Enterprise” that appeared in *Industrial and Corporate Change* in December 2007, Professor Lazonick is doing further research and writing on the role of the stock market in the US economy, with a particular emphasis on the impact on sustainable prosperity of the acceleration in corporate stock repurchases since 2003.

With Edward March and Öner Tulum, Lazonick also directed research on the sustainability of the prevailing business model in the US biopharmaceutical industry. This research explores the roles of government funding and subsidies, technological change, patent policy, product market demand (including government medical care programs), price regulation, the stock market, and corporate financial behavior on the performance of the biopharmaceutical industry.

## **3. The Globalization of the High-Tech Labor Force**

This project employs in-depth institutional and organizational studies to analyze the forces that driving the globalization of labor in the information and communication technology (ICT) industries. Since the 1960s the development strategies of national governments and indigenous businesses in many Asian nations have interacted with the investment strategies of western ICT companies and the immigration policies of western advanced economies to generate a global labor supply of educated and experienced ICT workers. This process has entailed flows of western capital to Asian labor as well as flows of Asian labor to western capital. As a result new possibilities to pursue high-tech careers, and thereby develop productive capabilities, have opened up to vast numbers of individuals in many Asian nations. At the same time, in North America and the European Union, many well educated and highly experienced ICT employees are vulnerable to having their jobs offshored. The analysis of the globalization of the high-tech labor force is essential for understanding a) the dynamics of development in major Asian nations such as China and India, b) the possibilities for these dynamics to take hold in Eastern Europe,



Latin America, and Africa, and c) the appropriate policy responses in the advanced economies to the loss of high-quality jobs.

#### **4. Innovation and competition in the global communications technology industry**

This project analyzes the role of business organization in the ongoing evolution of employment opportunities in the information and communications technology (ICT) industries. By delving into changes in the investment strategies and employment practices of high-technology enterprises we are identifying structural changes in the availability of remunerative, stable, and creative jobs for well-educated and well-trained members of the US and global labor force. This research helps policy makers understand trends in the demand for and supply of high-tech labor in the United States and Globally.

In the 2000s communications technology remains a highly innovative industry, with intense competition among companies, some over a century old and others just getting off the ground – and still others that are entering the industry from bases in information technology. The markets for the products of the communications technology industry are global, with the important opportunities for growth coming from the developing economies.

In August 2007, Professor Lazonick ran a conference of three dozen people, half from industry and half from academia, who gathered together for two days at INSEAD in Fontainebleau, France to engage in deep discussion about the past, present, and future of the communications technology industry. The conversation centered around a number of papers on the evolution of the leading companies in the industry. Many of these papers represented collaborations between academic and industry participants. Subsequently, the global consulting company, Arthur D. Little (ADL), decided to co-edit a volume on the subject of the INSEAD conference with Professor Lazonick and his colleagues Edward March (formerly UMass Lowell, not at Dartmouth College), Marie Carpenter (Bordeaux Business School), and Henrik Glimstedt (Stockholm School of Economics).

We expect that this book to be the definitive volume on industrial dynamics on the communications technology industry. It will appeal not only to those who have an interest in this particular industry but also to anyone interested in the evolution of the New Economy on a global scale. Our objective is to deliver a scholarly, yet highly accessible, analysis of the industry to practitioners as well as, through its adoption for courses, graduate students. We plan to have a website that will support the use of volume, and keep the materials up-to-date. ADL will be actively involved in disseminated the volume. We have begun discussions with David Musson of Oxford University Press about publication of the book.

This volume will be a product of the newly formed Academic-Industry Research (AIR) Network. The general purpose of The AIR Network is to foster and support analyses of industrial dynamics that combines rigorous academic research methods with the knowledge and insights of industrial practitioners. A detailed outline of the specific purposes and prospective activities of The AIR Network will be available soon.



## **5. Renewable Energy in New England: Technology, Industry and Workforce Policies**

Since the state and federal restructuring of regulations governing the electricity supply industry in the late 1990s, new policy avenues have emerged to promote the development of the distributed generation of electricity in general and the role of renewable energy sources in particular. This program seeks to understand the interaction between competitive and policy influences on the pace and direction of technological capabilities, product commercialization, and regional industry growth and performance of renewable energy in New England. The first study in this program focused on workforce development policies related to the photovoltaic industry. Working collaboratively with other centers in the UMass System, research has examined policy initiatives that can improve on the regional innovation system advancing the renewable energy sector, including solar, wind and related power electronics necessary to achieve price competitive distributed generation. Current research is focused on the renewable energy businesses in New England, the sub-industry composition by sector and state, compared to the national pattern, as well as recent regional growth trends by sub-industry.

## **6. New England Initiative**

The six states in New England are the most widely recognized regional geography in the country. The New England Initiative (NEI) researches, analyzes, promotes region wide debate and discussion, and provides technical and strategic assistance to better understand the nature of regional challenges and opportunities to advance the quality of life in the region. As a region of states relatively small in area or population, many of the social, economic and environmental dynamics of change are interdependent and cross-state boundaries. Many of the common challenges are best addressed through multi-municipal regional entities where the NEI offers technical and strategic support and assistance to advance mutual learning among regional organizations. Other challenges can only be addressed more effectively through state policy. Most significantly there remain opportunities for improving New England wide approach to federal program priorities and initiative. This applies to a broad range of concerns, including the incubation of innovative emerging sectors, the stability of the manufacturing economic base, physical infrastructure and environmental quality, and workforce development. The NEI strives to work with organizational partners throughout New England to meet the region wide challenges by providing research and technical assistance, advancing common understanding of regional challenges, and identifying better solutions through coordinated and complementary responses.

The lead partners with the CIC New England Initiative are the New England Council (NEC), the oldest region wide trade association in the United States, and the New England Association of Regional Councils (NEARC) which encompasses all regional planning councils in New England. Director Mass and CIC Senior Research Associate David Soule have made presentations throughout New England to promote the New England Initiative. The CIC NEI is also a founding and active participant in the New England Smart Growth Alliance and the New England Futures partnership < [www.newenglandfutures.org/](http://www.newenglandfutures.org/)>. Current activities include research into the history of the New England Regional Commission and collaborative efforts to establish a New England



Compact as ongoing capacity to support region wide policy development to expand and support the capacities of other regional organizations.

## **7. Measures and Indicators Collaborative Visualization (MICo-Viz)**

An outgrowth of the New England Initiative was the emergence of a priority on the development of open source Measures and Indicators Collaborative Visualization (MICoViz) a collaboration between the CIC and the Institute for Visualization and Perception Research (IVPR). Seed funding has been generated by the CIC, IVPR, the CFCI, NEARC, Data Havens, the Boston Foundation, and the National Academy of Sciences.

Indicator projects and regional planners have key common challenges in visualizing, analyzing, and presenting data for their own needs and for the needs of their users seeking information and knowledge through the web sites they provide. MICo-Viz (Measures and Indicators Collaborative Visualization) is a high performance, highly interactive and usable geospatially integrated software system that can be configured for novice, intermediate and advanced users. High performance means high response time for updates of data visualizations and maps. High interactivity means that users can query data with simple interfaces and define mapping boundaries rather than select only from preset queries or preconfigured mapping options. High usability means that attention has been paid to simplicity, ease of use (e.g., choices for color deficient individuals) and access controls based on user security levels. These capacities support advanced users (researchers and experts) and developers (those setting up web pages for novice and intermediate users). Users range from the general public to educators, media, and other special interest groups

## **9. Job Quality, Inequality and Regional Development**

Social scientists, policy-makers, and the public at large are engaged in ongoing debates about economic inequality and job quality. Is the United States, and the world as a whole, becoming more unequal? Is the quality of jobs declining? What are the underlying causes of trends in inequality and job quality? What are the policy implications? Building on past research funded by the Ford Foundation and The Russell Sage Foundation, Chris Tilly and collaborators are pursuing these questions in a series of related papers and a forthcoming book.

## **10. Global Retailers, Global Strategies**

In collaboration with the National Retail Federation, the retail industry is being transformed by dramatic market shifts and rapid technological change. To better understand the consequences of these changes, this study focuses on turnover and retention, training, service levels, and product knowledge in the frontline workforce in the food and consumer electronics sectors. The study will explore what is changing in the industry and how companies are developing selection, training, compensation, and supervision strategies to cope with these changes. By gathering information directly from people who are implementing and experiencing changes in the industry, including industry association staff, company executives, store-level managers, and employees, the study will generate well-informed and practical recommendations for preparing and managing the retail workforce of the future. This study is part of a larger multinational effort



examining the retail workforce in Denmark, France, Germany, Mexico, the Netherlands, and the United Kingdom as well as the United States, and comparing new developments in these countries. This study is funded by the Russell Sage Foundation, the largest foundation entirely devoted to funding social science research.

The rapid growth of Wal-Mart has directed attention in the United States to the growing importance of retailers in global supply chains. But Wal-Mart is only one of a number of expanding, increasingly powerful global retailers. Carrefour, Metro, Tesco, Ahold, and others are buying supermarket chains, building stores, and contracting with suppliers all over the world. In this research, we are beginning to characterize the changing structure of global retail, and to examine the impact of rapid globalization in this sector, particularly for jobs in the sector.

## **11. Community Development & Work Study Program**

A two-year grant from the Department of Housing and Urban Development (HUD) led by CIC faculty affiliate Chris Tilly and supported graduate students from the University's Regional Economic and Social Development Department (RESO). Instead of working as research or teaching assistants, the grant, which was matched by the University, requires students to work 15 hours a week as community development fellows. This past year this work continued with the City of Lowell Department of Planning and Development, Coalition for a Better Acre, and Lawrence Community Works. Dave Turcotte, program manager with the Center for Family, Work and Community and adjunct faculty in RESO, assists in finding placements after meeting with the students to determine their work preferences and economic eligibility.

In addition and building on these efforts, CIC faculty affiliate Phil Moss, working with Lawrence CommunityWorks, has provided support and oversight working with graduate students to promote development and implementation of participatory budgeting in Lawrence, MA. Along with a RESO graduate student, Phil has written and analyzed the results from a survey of Lawrence residents on their views about city services, and what can be done to improve the quality of services in their city. He is currently writing a second, improved round of this survey. Phil has also coordinated work with RAs in support of Coalition for a Better Acres and participated in research and strategy setting for a campaign to promote more affordable housing in Lowell. Moss also consults with Massachusetts Law Reform for a fair housing case involving a class action suit by former residents of the Julian Steele public housing project against the city of Lowell for perpetuating and exacerbating residential segregation in Lowell.

## **VIII. Recent Publications**

### **Michael Best**

Working paper: "A Baltic Success Story? Estonian Manufacturing in the EU Single Market"  
(with John Bradley). February 2008: 24 pages.

"Cluster Dynamics in Malaysian Electronics," in K.S. Jomo (ed.) *Malaysian Industrial Policy*, NUS Press, 2007.

### **Robert Forrant**

"Prospects for the northeast Region," *MassBenchmarks*, 2007, volume nine, issue two, 17-22.



*Metal Fatigue: American Bosch and the Demise of Metalworking in the Connecticut River Valley Industrial Corridor*, Baywood Publishers, in the Series, Work, Health and Environment, forthcoming 2008.

Editor, 4-article special issue of *New Solutions* on community-university partnerships for environmental sustainability, Forthcoming.

“Achieving Continuity in the Face of Change in Community-University Partnerships,” *International Journal of Community Research and Engagement*, with Linda Silka, et.al, forthcoming

### **William Lazonick**

“Evolution of the New Economy Business Model,” in Eric Brousseau and Nicola Curien, eds., Internet and Digital Economics, Cambridge University Press, 2007: 59-113.

“Varieties of Capitalism and Innovative Enterprise,” Comparative Social Research, 24, 2007: 21-69.

“Globalization of the ICT Labor Force,” in Robin Mansell, Chrisanthi Avgerou, Danny Quah, and Roger Silverstone, eds., The Oxford Handbook of Information and Communication Technologies, Oxford University Press, 2007: 75-99.

“Business History and Economic Development,” in Geoffrey Jones and Jonathan Zeitlin, eds., The Oxford Handbook of Business History, Oxford University Press, 2007: 68-95.

“Shareholder Value and the Governance of Innovative Enterprise,” in U. Jürgens, G. Schuppert, D. Sadowski, and M. Weiss, eds., Perspectives of Corporate Governance, Nomos, 2007: 472-500.

“Economic Institutional Change and Employer Pensions,” in Teresa Ghilarducci and Christian E. Weller, eds., Employee Pensions: Policies, Problems, & Possibilities, Labor and Employment Relations Association Research Series, 2007: 29-68.

“Transitions of a Displaced High-Tech Labor Force,” co-authored with Steven Quimby, in Tom Juravich, ed., The Future of Work in Massachusetts, University of Massachusetts Press, 2007: 111-134.

“Corporate Governance, Innovation, and Economic Development,” in Ha-Joon Chang, ed., Institutional Change and Economic Development, United Nations University Press, 2007: 115-134.

“The US Stock Market and the Governance of Innovative Enterprise,” Industrial and Corporate Change, 16, 6, 2007: 983-1035.

“The Quest for Shareholder Value: Stock Repurchases in the US Economy,” *Louvain Economic Review*, forthcoming.

“Contemporary Capitalism,” in Steven N. Durlauf and Lawrence E. Blume, eds., The New Palgrave Dictionary of Economics, 2<sup>nd</sup> edition, Palgrave Macmillan, 2008 (online at [http://www.dictionaryofeconomics.com/article?id=pde2008\\_C000570](http://www.dictionaryofeconomics.com/article?id=pde2008_C000570)> doi:[10.1057/9780230226203.0304](https://doi.org/10.1057/9780230226203.0304))

Sustainable Prosperity in the New Economy?: Business Organization and Employment Opportunities in the ICT Industries, W. E. Upjohn Institute for Employment Research, 2008 (forthcoming)

### **William Mass**

“Bristol Main Street Textiles and Teleflex Medical NEG: A Program Summary and Initial Assessment,” with Thomas Merrill, Report to Commonwealth Corporation, revised July 2007.



“A Comparison of Selected Best Practice Indicator Frameworks to Inform Key National Indicators,” with Jim Giddings, Report to The State of the USA (SUSA), April 2008.

“Strategic Organization Building, Synergy and Rivalry in Regional Planning: NERCOM, 1967-1980,” Business and Economic History online, forthcoming.

### **Philip Moss**

"Under Construction: The Continuing Evolution of Job Structures in Call Centers," with Chris Tilly and Harold Salzman, accepted 12/06 by Industrial Relations.

### **Chris Tilly:**

*The Gloves-Off Economy: Problems and Possibilities at the Bottom of the American Labor Market.* Co-edited with Annette Bernhardt, Heather Boushey, and Laura Dresser. To be published as the Labor and Employment Relations Association 2008 Annual Volume by Cornell University Press. Forthcoming 2008.

*Real World Latin America.* Co-edited with Dan Fireside and Alejandro Reuss. Boston: Dollars and Sense, forthcoming 2008.

“Under construction: The continuing evolution of job structures in call centers.” With Philip Moss and Hal Salzman. *Industrial Relations*, April 2008.

“Avere un lavoro: i limiti del sistema di sostegno sociale contributivo negli Stati Uniti” (“Get a job: The limits of work-based social support in the United States”). With Heather Boushey. *Annali della Fondazione di Vittorio* (Rome), special issue on “New poverty, new priorities: Rethinking social inclusion.” February 2008 (in Italian).

“Global restructuring in retail: What impact on labor?” *International Labor Brief* (Korea Labor Institute, Seoul), November 2007 (in Korean).

“Challenging Coke’s thirst for water: The Apizaco story.” With Marie Kennedy. *Progressive Planning*, Fall 2007.

## **IX. CONFERENCE PRESENTATIONS**

Robert Farrant:

“Inventing America: Lowell and the Industrial Revolution,” Tsongas Industrial History Center Lecturer, Summer. Program funded by National Endowment for the Humanities, 2007.

Springfield Public Schools Socials Studies Professional Development Workshop, ‘The Way We Were: Looking at the Post-Second World War Connecticut River Valley,’ August 28, 29, 2007.

William Lazonick:

Featured speaker, “Entrepreneurship, Innovation, and Development,” International Summer School of e-Business and Complexity: New Management Practices, University of Salento, Ostuni, Italy, July 12, 2007.

Invited speaker, “Globalization of the High-Tech Labor Force,” Second International Conference on Management of Globally Distributed Work, Indian Institute of Management, Bangalore India, July 25, 2007.

Organizer and featured speaker, Conference on Innovation and Competition in the Global Communications Technology Industry, INSEAD, Fontainebleau, France, August 23-24, 2007.



- Seminar presentation, “Boston's Biotech Boom,” With Edward March, New England Study Group of the Federal Reserve Bank of Boston, September 6, 2007
- Featured speaker, “The Theory of Innovative Enterprise,” at Ecole Thématique CNRS, Les méthodes de l'analyse institutionnelle, La Rochelle , France, September 18, 2007
- Featured Speaker, “The Theory of Innovative Enterprise,” at International Summer School, Policies for Innovation and Growth, Villalago, Terni , Italy, September 26, 2007
- Featured speaker, “The US Stock Market and the Governance of Innovative Enterprise,” Workshop on Finance, Innovation, and Inequality, sponsored by Innovation Knowledge Development Centre of The Open University and DIME (Dynamics of Institutions and Markets in Europe), Regents Park Development Centre, London, UK, November 9, 2007.
- Keynote speakers, “Creating Value, Building Knowledge”, with Edward March, and William Mass Nypro Technical Conference, University of Massachusetts Lowell, November 26, 2007.
- Paper presentation, “From Microtech to Nanotech by Way of Biotech,” Jointly prepared with Edward March (presenter), Nanotechnology, Literature, and Society Conference, University of Massachusetts Lowell, December 6, 2007.
- Invited speaker, “Dynamic Capabilities and Sustained Innovation,” Conference on Dynamic Capabilities and Beyond, Graduate School of Management, St. Petersburg State University, St. Petersburg, Russia, December 7, 2007
- Seminar presentation, “Boston's Biotech Boom,” CIC/RESD Seminar Series, University of Massachusetts Lowell, December 13, 2007.
- Seminar Presentation, “Innovation and Competition in the Global Communications Technology Industry”, Institute of International Business, Stockholm School of Economics, Stockholm, Sweden, February 22, 2008.
- Invited Speaker, “The New Economy Business Model and Sustainable Prosperity,” 3rd International Comparative Research in Law and Political Economy (CLPE) Workshop: The Embedded Firm, Osgoode Hall Law School, York University, Toronto, Canada, March 21, 2008.
- Invited speaker, “Entrepreneurial Ventures and the Developmental State” Conference on Rethinking Development in the Age of Globalization, Southern New Hampshire University, Manchester, New Hampshire, April 5, 2008.
- Invited speaker, “Why Corporate Finance and the Stock Market Matter to Innovation Strategies, Policies, and Outcomes”, 1st DIME Scientific Conference Knowledge in Space and Time: Economic and Policy Implications of the Knowledge-based Economy, University Louis Pasteur, Strasbourg, France, April 9, 2008
- Invited speaker, “Entrepreneurial Ventures and the Developmental State” The Kauffman Foundation Innovation Scholars Research Network, Georgia Tech University, Atlanta, Georgia, April 11, 2008
- Paper presenter, “Boston’s Biotech Boom”, Business History Conference Annual Meeting, Sacramento, California, April 12, 2008
- Invited speaker, “The New Economy Business Model and Sustainable Prosperity,” Session on Companies and Countries, Alfred P. Sloan 2008 Industry Studies Conference, Boston, Massachusetts, May 1, 2008.
- Seminar presentation, “Entrepreneurial Ventures and the Developmental State” Innovation and Entrepreneurship Research Seminar, Imperial College, London, UK, May 20, 2008.
- Seminar presentation, “The Globalization of the High-Tech Labor Force,” Workshop on Swedish Multinational Companies in India, Stockholm School of Economics, June 10, 2008.



William Mass:

Keynote speakers, “Creating Value, Building Knowledge”, with Edward March, and William Lazonick, Nypro Technical Conference, University of Massachusetts Lowell, November 26, 2007.

“New England: Measures & Indicators and Collaborative Visualization – Six States, New Tools,” with Georges Grinstein, New England Association of Regional Councils, Annual Meeting, College of Holy Cross, Worcester, MA, January 29, 2008.

“Strategic Organization Building, Synergy and Rivalry in Regional Planning: NERCOM, 1967-1980,” Business History Conference, Session 5: Regional Planning, Sacramento, California, April 11, 2008.

Measures and Indicators Collaborative Visualization (MICO-Viz), Presentations and Demonstrations with Georges Grinstein, Alex Baumann and other graduate students assisting to:

Data Haven, Board of Directors, October 17, 2007

Indiana Business Research Center, Carol Rogers, Deputy Director & Chief Information Officer, November 14, 2007 at UML

Atlanta Neighborhoods Indicators Project, November 16, 2007, at UML

Indiana Business Research Center, Jerry Conover, Director, December 3, 2007

Ben Warner, Jacksonville Community Indicators December 7, 2007

SUSA December 11, 2007

Community Research Partners, Columbus, OH, December 18, 2007

United Way of Metropolitan Atlanta, January 17, 2008

New England Association of Regional Councils, College of Holy Cross, Worcester, MA, January 29, 2008

Community Research Partners, Columbus, OH, February 15, 2008.

Atlanta Neighborhoods Indicators Project, February 15, 2008

Baltimore Neighborhood Indicator Project & Annie E. Casey Foundation, May 22, 2008.

Oregon Progress Board, May 30, 2008

Atlanta Regional Commission, June 6, 2008.

Community Research Partners, Stakeholders & Foundations, June 9, 2008.

Oregon Progress Board Stakeholders & Foundations, June 16, 2008

Barr Foundation, June 19, 2008

Arizona, June 24, 2008

Chris Tilly:

Paris School of Economics, Seminar on “Travail et Politiques Publiques.” “Beyond Wal-Mart: U.S. retail jobs in comparative perspective.” May 23, 2008. Paris, France.

Amnesty International, Massachusetts Institute of Technology chapter, movie/lecture series on “Corporations and Human Rights.” “Recuperated businesses in Argentina: Challenges and Prospects.” April 23, 2008. Cambridge, MA.

Salem State College, Political Science Department. “Occupy! Resist! Produce! Argentines rebuild their economy from the bottom up.” March 20, 2008. Salem, MA.

Grassroots International. “Peasant and labor movements in South Korea and Indonesia.” February 29, 2008. Boston, MA.



- City University of New York, Bildner Center for Western Hemisphere Studies. “Wal-Mart and workers: Not the same all over the world.” February 20, 2008. New York, NY.
- New School University, International Affairs Program. “Wal-Mart in the world: Different strategies in different contexts.” February 19, 2008. New York, NY.
- Boston University School of Social Work, Social Welfare Analysis Colloquium. “Wal-Mart in the world: Different strategies in different contexts.” February 14, 2008. Boston, MA.
- University of California Los Angeles, Institute for Research on Labor and Employment. “National institutions meet the big-box revolution: Retail jobs around the world.” February 8, 2008. Los Angeles, CA.
- Labor and Employment Relations Association, Annual Meeting. “An introduction and overview of the ‘gloves-off economy’.” January 6, 2008. New Orleans, LA.
- University of Massachusetts Boston, Public Policy Ph.D. Program, Seminar Series. “Wal-Mart in the world: Different strategies in different contexts.” November 28, 2007. Boston, MA.
- National Autonomous University of Mexico, College of Economics, Second Seminar on Heterodox Economics. “El tamaño sí importa: El monopolio, el monopsonio y el impacto de Wal-Mart en México.” October 11, 2007. Mexico City, Mexico.
- Latin American Studies Association, session on “Primarization, inequality, and poverty: Economic results of the export-led model.” Discussant. September 6, 2007. Montreal, Canada.
- Latin American Studies Association, session on “Democracy and social movements in Latin America.” Discussant. September 5, 2007. Montreal, Canada.
- Atma Jaya University, School of Economics and Development Studies, International Seminar. “What is the relationship between inequality and growth?” August 29, 2007. Jakarta, Indonesia.
- Atma Jaya University, School of Business Administration, International Seminar on “Quo vadis labor management in the globalization era.” “Retail globalization and labor: Wal-Mart as a window on a new world.” August 28, 2007. Jakarta, Indonesia.
- Trade Union Rights Center. “Discounting and globalization in retail: How has labor responded?” August 27, 2007. Jakarta, Indonesia.
- Atma Jaya University. “Interweaving university and community.” August 27, 2007. Jakarta, Indonesia.
- Korea Labor Institute. “Corporate restructuring and the workforce.” August 22, 2007. Seoul, South Korea.
- Chung-Ang University, Department of Sociology. “What is the relationship between inequality and growth?” August 22, 2007. Seoul, South Korea.
- Korea University, Department of Sociology. “Wal-Mart in the world: Different strategies in different contexts.” August 21, 2007. Seoul, South Korea.
- Korea Labor and Society Institute. “The downside of discounting: Retail jobs in the United States and around the world.” August 20, 2007. Seoul, South Korea.
- Chung-Ang University, Department of Sociology. “Occupy! Resist! Produce! Argentineans rebuild their economy from the bottom up.” August 20, 2007. Seoul, South Korea

## **X. COLLABORATION WITH OTHER CENTERS/INSTITUTES AND/OR DEPARTMENTS**



Robert Forrant, CIC Faculty affiliate, participated in a collaborative winning grant proposals. First, “An Ethnographic Study of Lowell, MA: Immigration, Globalization and an All-American City” is a newly funded three-year contract (approx. \$100,000) that represents a collaboration between Middlesex Community College, various departments at UMass Lowell, community and neighborhood groups and agencies and the Lowell National Historical Park. There is money for 2 RA’s a year starting 2007-2008 academic year. Principal investigators are Robert Forrant and Linda Silka, Director of CFCW, and Christoph Strobel in the History Department.

William Lazonick and Ed March collaborated with Engineering on the biotechnology and communications technology industries.

William Lazonick, Ed March and William Mass collaborated with Plastics Engineering and College of engineering on preparation of keynote presentation at Nypro Technical Conference, University of Massachusetts Lowell, November 26, 2007.

William Lazonick, Ed March and William Mass held discussions for collaboration between UML CIC and UML nanotechnology initiative. Paper by William Lazonick and Edward March on: “Microtech to Nanotech by way of Biotech” to be prepared for the University of Massachusetts Lowell/Center for High-rate Nanomanufacturing Interdisciplinary Conference: Nanotechnology, Literature, and Society, December 6-7, 2007

William Lazonick has the following academic affiliations and collaborative relationships as:  
Research Fellow (in process), Institute of International Business, Stockholm School of Economics.  
Invited Professor (in process) Faculty of Economics, University of Bordeaux.

William Lazonick was the organizer, Conference on “Innovation and Competition in the Global Communications Technology Industry,” INSEAD, Fontainebleau France, August 23-24, 2007.

William Mass continued collaboration with George Grinstein, Director, Institute for Visualization and Perception Research and graduate research assistants from both centers working on the New England Indicators and Measures Collaborative Visualization Project. This project is creating a national consortium that will have participation of 7-9 regional partnerships of regional planners and indicator projects. The project includes leadership and collaboration with Charlotte Kahn, Director, Boston Indicators Project, The Boston Foundation.

Chris Tilly led Community Development Work Study Program, a collaborative effort with the Center for Family, Work, and Community.

Chris Tilly is a consultant on the “Employment conditions as social determinants of health” for a collaborative project with UML faculty in the Departments of Work Environment and Economics, with Supriya Lahiri, Rafael Moure-Eraso, Marian Flum, Robert Karasek, and Ephraim Massawe.

## **SEMINAR SERIES**



The joint CIC-RESO Seminar Series provides a forum for bringing leading academics, policy analysts and program administrators in the area of economic and regional development to the UMass Lowell campus, and for presenting the ongoing research of CIC faculty, fellows, and affiliates. The series attracts other U Mass Lowell faculty as well as other faculty and students from around the region. The seminar series establishes or consolidates links with prominent and path breaking academics and practitioners in key areas. In addition to providing access to leading researchers, students gain exposure to career paths in a variety of social and economic policy arenas and programs. During Fall 2007 individual seminars were jointly sponsored by Center for Public Health Research and Health Promotion; Committee for Industrial Theory and Assessment; Department of Civil and Environmental Engineering/College of Engineering; Department of Community Health and Sustainability; Environmental, Earth and Atmospheric Sciences Department; Labor Extension Program; & Lowell Center for Sustainable Production.

**Seminar Series Fall 2007**  
**Regional Economic and Social Development**  
**Center for Industrial Competitiveness**  
**“Inequality, Organization and Development”**  
**Sustainability and New Prospects: Regional, National and Global**

September

- 17 Yasheng Huang, MIT  
“Can India Overtake China”
- 24 Bethany Moreton, University of Georgia  
“The World’s Largest Employer: Walmart, Politics and Policy in Latin America and the U.S.”

October

- 1 Evan Dobbelle, President, New England Board of Higher Education  
“Higher Education in New England: 21st Century Challenges”
- 10 Mark McKenszie, President, New England AFL-CIO,  
“New England Labor: 21st Century Challenges” (or Nov 15)  
(Wednesday on Monday schedule - Columbus Day University Closed)
- 15 Kathy Swartz, Health Policy and Economics, Harvard Medical School  
“Health Insurance Reform: Massachusetts and the U.S.”
- 22 Molly Anderson, Food Integrity Systems & Senior Wallace Fellow, Winrock International  
"Sustaining & Transforming Northeastern Food Systems: Opportunities & Challenges".
- 29 Timothy Costello, Global Labor Strategies  
“China’s New Contract Labor Law: Contested Policy in the U.S. and China”

November

- 5\* John Rogers, Senior Energy Analyst, Union of Concerned Scientists  
“Confronting Climate Change in the U.S. Northeast: Science, Impacts and Solutions”
- 15\* Fred Salvucci, Civil & Environmental Engineering, MIT; former MA Secretary of  
Transportation (scheduled but cancelled due to illness)  
“Transportation Challenges Facing New England:  
Where we are, Where we need to be, and How to get there”  
(Thursday on Monday schedule - Veterans Day University Closed)



- 19 Rachel DeMotts, RESD, UML  
“An Elephantine Epidemic in the Caprivi: Embedding HIV in the Environment”
- 26 William Lazonick and Edward March, UML  
“Boston’s Biotech Boom: A ‘New Massachusetts Miracle’?”

December

- 3 Sanford Lewis, Director, Strategic Counsel on Corporate Accountability  
“Greening Corporations and Corporate Accountability:  
Environmental and Shareholder Activism”

## **XI. Regional/Local Community Outreach**

Robert Farrant leads the work with Massachusetts Benchmark, a joint effort of UMass and the Federal Reserve Bank of New England. Massachusetts Benchmark provides descriptions and analyses for any entity concerned with economic development in the Merrimack Valley and northeast Massachusetts. Robert Farrant is also a regular commentator on the state economy on radio station WUML’s morning wakeup program and a monthly columnist at the Lowell Sun,

In his dual roles as CIC Director and Director of the Office of Regional Development Ed March until December 2007 hds engaged in several key Industrial Outreach efforts including:

March has collaborated with Economic Development Councils in several initiatives to advance industrial cluster formation within the region in partnership with the Merrimack Valley Economic Development Council.

March was involved in a project in progress to identify new commercial opportunities for analytical instrument companies in the region by fostering a closer working relationship with pharmaceutical companies attempting to address the challenges of the FDA initiative “Process Analytical Technology”.

In Fall 2007, a new project was initiated to develop a response to the issues documented in the “Reconnecting Gateway Cities” report sponsored by Mass Inc. Focusing on the cities of Lowell, Lawrence, and Haverhill, one area of consideration is on the identification of industrial clusters that have growth potential in the region and the capability of creating new employment opportunities for a range of worker skill levels, from entry level to professional.

Additionally, in partnership with the North Shore Technology Council and Babson College, the March and others at UML are working to identify the high growth potential industrial clusters in the North Shore region and developing a strategy to accelerate this growth through a coordinated utilization of emerging technology and cross-sector business alliances.

The New England Initiative led by William Mass with its two lead partnering regional organizations, the New England Association of Regional Councils and the New England Council, is also a founding partner of the New England Futures Partners that also includes Institute for Sustainable Communities, The Boston Foundation, Orton Family Foundation, Mount Auburn Associates and Citistates Group. These organizations endorsed and support the New England Indicators Project. This past year The New England Futures funded a CIC project that entailed interviewing regional leaders and drafting a “Game Plan for New England”. This



plan culminated in a July 9, 2007 meeting at the New England Federal Reserve bank of leading New England organizations to discuss the development of a regional New England Compact to enhance regional policy development and coordination. The meeting was hosted by Congressman John Larson (CT), the fourth ranking Democrat. Participants included Chancellor Meehan, the above organizations and the New England Governors Conference, New England Board of Higher Education, and the Northern Forest Center.

The CIC NEI is also a founding and active participant in the New England Smart Growth Alliance where David Soule and now Don Zizzi are regular participant and collaborates with the Lincoln Institute of Land Policy, the Federal Home Loan Bank Board, and Region 1 of the US EPA.

The Community Development Work Study Program placed students in: City of Lowell Department of Planning and Development, Coalition for a Better Acre, and Lawrence Community Works. In collaboration with Lawrence Community Works, in 2005-2006 Phil Moss aided in the production of "Our Money, Our Future, Our Right to Know: The People's Guide to the Lawrence City Budget." [http://www.lcworks.org/docs/City\\_Budget\\_Guide\\_English.pdf](http://www.lcworks.org/docs/City_Budget_Guide_English.pdf). As an outgrowth of this activity, during 2006-2007 Moss wrote and implemented a survey of city residents concerning their evaluation of city public services, the quality of life in Lawrence, and their priorities for future public services that he is currently updating. He continued to work on two projects with the Coalition for a Better Acre 1) Upper Merrimack Street citizens' planning initiative and 2) Affordable housing campaign. As part of the latter efforts Moss consulted for the Massachusetts Law Reform for a fair housing case involving a class action suit by former residents of the Julian Steele public housing project against the city of Lowell for perpetuating and exacerbating residential segregation in Lowell.

The project "Continuity and change in low-wage work in retail trade in the United States" is a collaboration directed by Chris Tilly with the Center for Social Policy, UMass-Boston.

## **XII. Proposal Submitted/Awarded 2006/2007**

Chris Tilly, Ford Foundation. "Low-Wage Work: A Synthesis of Selected Research," with Françoise Carré. \$77,000. 2007-08.

The entire 2007-2008 CFCI award was used to support grad research assistants from RESD. The CFCI funded RA assistance supported the development of three aspects of the New England Initiative and the Measures and Indicators Collaborative Visualization project. This activity led to other funding described below.

William Lazonick submitted to the Ford Foundation, June 26, 2007, on "Transnational collaboration on participative democracy," linking activities of the CIC, CFWC and RESD UMass Lowell and Janaagraha Center for Citizenship and Democracy, for \$135,528. Participating UCUIC affiliates included Farrant, Mass, Moss and Tilly. Not awarded and still under review in new program area.



William Lazonick submitted a Collaborative proposal on finance and innovation to the European Commission, Framework 7 program, organized by the Open University, UK, and through University of Bordeaux, France. Submitted May 10, 2007; ranked highly in evaluation round.

William Lazonick received funding from INSEAD R&D for the Conference on Innovation and Competition in the Global Communications Technology industry, held at INSEAD, Fontainebleau France, August 23-24, 2007; 23,000 Euros.

William Lazonick is a participant in a project at the Institute of International Business, Stockholm School of Economics, funded by Svenska Handelsbanken. His portion will fund a RESD RA working with the CIC over several years.

William Lazonick is Principal Investigator, with William Mass, et. al. “Innovative Enterprise and Sustainable Prosperity,” submitted to National Science Foundation, March 2008, for 399,519, three year period.

William Mass was awarded \$6,000 by Institute for Sustainable Communities for work undertaken by Senior Research Fellow David Soule to develop a “Game Plan for New England Futures” that was a follow on to the New England Futures project. This report was completed March 20, 2007.

William Mass and Georges Grinstein were awarded \$21,000 (\$11,000 from the National Academy of Sciences and \$10,000 from The Boston Foundation as matching grants) in support of the development of a demo project for New England Indicators and Measures, June to August 2007. This project is a collaborative project with IVPR and Director Georges Grinstein is a Co-Principal Investigator. This project emerged out of the efforts stimulated by and with limited support from CFCI award of \$5,150 in January 2006 as part of the Innovation Grants program.

William Mass was awarded \$14,500 from the State of the USA (SUSA) Project for a series of reports on Massachusetts high tech employment and exports, and regional high technology industry development for the seven Benchmark regions. All but two of the reports were completed by August 31, 2007.

William Mass secured donations to the CIC New England Initiative program of \$2500 from the New England Association of Regional Councils and its members.

William Mass and Georges Grinstein have submitted proposals for “MICO-Viz Consortium and Software Development Agreement” to 10 regional and state entities for funding of \$75,000 per year for two years from each organization to begin in September 2008. The minimum number of consortium members is six and the maximum nine to be closed by Spring 2009.



## 17. THE CENTER FOR INTELLIGENT BIOMATERIALS

**Annual Report: July 30, 2008**

**Director: Professor Kenneth A. Marx**

### **EXECUTIVE SUMMARY**

The Center for Intelligent Biomaterials (CIB) has carried out research in a number of different project areas. We have actively collaborated internally at UML with: Prof. Georges Grinstein, IVPR, Center for Biomolecular and Medical Informatics, Prof. Alkim Akyurtlu, Dept. Elec. Eng, and CMOS, Prof. Susan Brauhn, Dept. Biol. Sciences, Prof. Joel Therrien, Dept. Elec. Comp. Eng, Prof. Valeri Barsegov, Dept. Chemistry, and Profs. Joey Mead and Carol Barry, Dept. Plastics Eng., NSF Nanomanufacturing Center. Externally, we have collaborated with Dr. M.L. Ujwal, Brandeis University, Director of Bioinformatics and Scientist at Eli Lilly, Prof. S. Badylak, McGowan Inst. Tissue Regeneration, Univ. Pittsburgh and Prof. R. Dima, University of Cincinnati. A total amount of \$ 370,800 in grant funding was received during this past year to fund CIB related projects and was used to fund research. Significant funding was obtained from DARPA during this past year's research, as well as an Army Biosensor development grant. The various projects involved 5 Ph.D. students within the center collaborating with various Ph.D. students from other Departments, Postdoctoral fellows, technicians in the different centers or academic groups with which we collaborated. This research resulted during 2007 and 2008 in the publication or in press status of 10 full length refereed papers. Two major Review articles written by the Director, have also appeared this past year as Book Chapters in the volumes entitled: 'Smart Biosensor Technology' and 'Piezoelectric Sensors' Vol. 6. The Director also served as Guest Editor for a Special Thematic Issue of *Microscopy Research and Technique*, where he is on the Editorial Board, entitled: "Facilitating Nanomanufacturing Using Microscopy Techniques." This Special Issue appeared recently in the June, 2007 issue of the journal with an Introduction Overview article and a separate research article contributed by the Director. Also, one continuation in part patent application was filed on Chiral Metamaterials.

### **1. MISSION STATEMENT**

The primary aim of the Center for Intelligent Biomaterials is to achieve excellence in basic and applied research on the evolved intelligent or smart properties of biological macromolecules for biomaterials applications and to promote its research advances in order to support and sustain the regional economic and social development of Massachusetts. To implement the mission we provide students with an affordable educational experience geared toward carrying out research at the undergraduate and graduate levels. The informational and smart properties of biological molecules and structures have value intrinsically (DNA information/ function, gene and protein sequence and structure recognition and function in Biotechnology) or as applied signal transduction or analyte recognition elements of integrated systems (biosensors, smart materials, clinical devices, whole cell biosensors) or in creating structures that can manipulate EM radiation in unusual ways (double negative metamaterials). To achieve these aims, we foster interdisciplinary research projects over a wide range of subject areas involving collaborations with other U Mass Lowell CFCI Centers and Institutes and research groups as well as external research groups and companies. These aims are implemented by obtaining external federal grant funding and U Mass Lowell/industry collaborative funding from the high technology and biotechnology/pharmaceutical sectors.

### **2. GENERAL DESCRIPTION AND GOALS**



The Center for Intelligent Biomaterials is a UML recognized center that carries out innovative basic and applied biomaterials/biosensors research in a number of areas at the interface of cell biology, biochemistry, computer Science, molecular biology and polymer science. Major collaborative projects involve the development of Quartz Crystal Microbalance Biosensors for clinical diagnostic use. The former will speed up the rate of wound healing and tissue regeneration and the latter will provide clinical diagnosis of oncological specimens to the practicing physician. Research in bioinformatics and cheminformatics is being pursued to understand properties of proteins and nucleic acids and their interactions with small molecules so that these macromolecules can be incorporated into the design of 'smart' biomaterials and biosensors. Biosensors are also being designed that incorporate the smart properties of whole cells into the signal transduction pathways of the devices. In our most recent collaborative project, we have focused on research to develop and construct novel Chiral Metamaterials for unusual optical applications in instrument design and specific applications such as enriching the drug discovery process. In the Center, we apply a variety of techniques in Information Technology, computational simulations, Biophysical Chemistry and Molecular Biotechnology to the systems under study.

### **3. RESEARCH GROUPS AND ACTIVITIES FOCUS AREAS**

In addition to the detailed list of projects presented in Section VI. below, the CIB has three major focus areas for research described immediately below:

1. The first area is developing the QCM device as a cell biosensor and also to characterize the meso and nano structures of thin polymeric films grown electrochemically and enzymatically. We have had great success in all of this activity with new research published on thin films as well as cell based biosensing research. We collaborate with the research group of Prof. Braunhut (Biological Sciences, Prof. Therrien, Elec. & Comp. Eng.) as well as with the NSEC Nanomanufacturing Group of Profs. Mead and Barry on different aspects of this research. During this past year, we have obtained and finished the first year of DARPA funding as part of a 6 University consortium developing novel mammalian limb regeneration technology in collaboration with Univ. Pittsburgh, Northwestern U., U. Utah, Cornell U. and the Wistar Inst.
2. The second area is in computational genomics and molecular biology. We are using the large public databases of DNA from different organisms to ask questions concerning: a) sequence usage and location in the genome; b) DNA thermodynamic stability and its relationship to other statistical metrics including the information content of the DNA sequences; c) applying high dimensionality visualization and data mining techniques to gene expression and chemical compound (quinone molecules) descriptor datasets (with Dr. Ujwal, Eli Lilly) and to Newt gene expression data sets for tissue regeneration studies (with Prof. Grinstein IVPR); and d) utilizing physical property parameter calculations of DNA sequences to understand the sequence properties and interactions with sequence specific binding proteins; e) using entropy function approaches to determine the quantitative charge distribution distributions of different protein families for the purpose of functional classification (with Prof. R. Dima); f) and developing molecular modeling approaches to understanding defensin peptides interacting with their protein targets (with Prof. Barsegov).
3. In the third area, a collaboration with Prof. Alkim Akyurtlu, Dept. Elec. & Comput. Eng. and CMOS, we have developed a significant project focused on creating novel chiral metamaterials. The objective is to create new optical components for new instrumental design applications in a variety of disciplines in the visible, near and far-IR, to name just a few possibilities.

### **4. ASSOCIATED PERSONNEL**



### **Associated Faculty**

Prof. Kenneth A. Marx - Director, U Mass Lowell, Chemistry Dept./CIB  
Prof. Georges Grinstein - U Mass Lowell, Computer Science Dept., (IVPR)  
Prof. Edwin Jahngen - U Mass Lowell, Chemistry Dept. CIB  
Prof. Valeri Barsegov – U Mass Lowell, Chemistry Dept. CIB  
Prof. Alkim Akyurtlu – Dept. Electrical and Computer Engineering, U Mass Lowell  
Dr. Nantaken Wongkasem - Dept. Electrical and Computer Engineering, U Mass Lowell, Visiting Prof. from Thailand.  
Dr. Gavin Wang, Postdoctoral Associate  
Dr. Rajiv Pande, Department of Chemistry, CIB, Yale U. MBA, IDEXX, ME.

### **Associated External Collaborators**

Prof. George C. Ruben - Dartmouth College, Biol. Sciences Dept., GeoM Co., West Lebanon, NH  
Prof. Ruxandra Dima – Chemistry Dept., University of Cincinnati, Cinn., OH  
Dr. M.L. Ujwal – Dir. Bioinformatics Program, Brandeis University, Scientist, Eli Lilly, Indianapolis

## **5. NEW RECENT FACULTY AFFILIATIONS**

Dr. M.L. Ujwal – Dir. Bioinformatics Program, Brandeis University, Scientist, Eli Lilly, Indianapolis  
Prof. Valeri Barsegov – Chemistry Dept., U Mass Lowell  
Dr. Rajiv Pande, Department of Chemistry, CIB, Yale U. MBA, IDEXX, ME.

## **6. DOCTORAL STUDENT SUPPORT/ CURRENT**

Mr. Jeffrey Bizzaro - U Mass Lowell, Chemistry Dept., Ph.D. candidate (Marx), Director, Bioinformatics.org  
Ms. Anzhi Li – U Mass Lowell, Chemistry Dept., Ph.D. Candidate (Marx),  
Ms. Dina Wassaf – U Mass Lowell, Chemistry Dept., Ph.D. candidate (Marx)  
Mr. Chia-Ho Cheng - U Mass Lowell, Chemistry Dept., Ph.D. candidate (Marx)  
Ms. Rabab Toubar- U Mass Lowell, Biomedical Engineering, Ph.D. candidate (Marx)

## **7. RESEARCH ACTIVITIES/COLLABORATIONS**

### **Computational Molecular Biology & Biochemistry**

#### **1. Homopolymer tract characterization**

These simplest of repetitive sequence elements in all eukaryotic genomes are found with quite varying but higher than expected frequencies that suggest functional roles in cells. We have characterized poly [d(A).d(T)] and poly [d(G).d(C)] tracts in 28 different eukaryotic organisms. A particular focus has been on an AT -rich organism *D. discoideum*, the slime mold, as well as human DNA and *P. falciparum*, the malaria parasite. This has been done both experimentally and by accessing and characterizing these sequences in the GENBANK database. This study is being extended to a range of other organisms of varying phylogeny as well as AT base composition, whose DNA sequences are available in GENBANK. We have also investigated the non-random spacing of poly [d(A).d(T)] tracts in the more AT-base rich organisms. These results are thought to be due to the tracts avoiding the core regions of nucleosomes. A paper was published this past year on the nucleosomal spacing of long tracts in *D. discoideum* and other A+T rich organisms.

Prof. Kenneth A. Marx, Department of Chemistry, CIB



Mr. Jeff Bizzaro, Ph.D. student, CIB  
Dr. Dang Duc Long, Ph.D. awarded, CIB

## **2. Open Source Code Bioinformatics-www.bioinformatics.org**

The www.bioinformatics.org is an international non-profit organization that serves as a collaboratory and hosts part of **The Open Lab**. Its aim is the development of open source code software in bioinformatics and cheminformatics. Loci is a UNIX based network-distributed system of clients and servers ('loci') for data processing. Clients include control structure and graphical user interface loci. All loci are represented as nodes in a 'Workflow Diagram' and are joined by lines depicting network connections. This network forms the basis for a graphical scripting language. The network distributed nature of loci deals with large datasets in a unique way with GUI loci residing on a local workstation while compute intensive processing loci execute remotely on high performance computers. The joining of loci across the internet can be used to form worldwide collaborations. Numerous development tools include: Python, GTK+ , the Gnome environment, CORBA, DOM, XML, etc. The servers for www.bioinformatics.org are housed in the CIB as a service to the international scientific community. Nearly 13,000 members worldwide use the website hosted in our Center.

Department of Chemistry, CIB:

Mr. Jeff Bizzaro, Director, Bioinformatics.org, Ph.D. candidate Dept. Chemistry, UML  
Prof. Kenneth A. Marx, Prof. Chemistry UML, Director CIB, Scientific Advisor, The Open Lab

## **3. DNA Melting Simulation-MELTSIM as a Bioinformatics Tool**

Bioinformatics tools are needed to analyse the massive sequence databases resulting from the Human Genome Project. Raw DNA sequence can be studied in terms of its equilibrium thermodynamic melting behavior. We have developed the use of MELTSIM to simulate DNA equilibrium melting properties. MELTSIM is a suite of programs built around a statistical mechanical algorithm that simulates the equilibrium melting states of any DNA sequence. We have shown that MELTSIM accurately simulates the experimental melting behavior of an entire eukaryotic genome (yeast-*S. cerevisiae*: 12,067,277 bp). MELTSIM can also calculate and display the melting behavior or regions along any given sequence. For example, we have demonstrated the utility of the positional melting feature of MELTSIM to identify exons in multi-exon genes in the AT-rich organisms *D. discoideum* and *S. mansoni*, as well as to display the melting along entire yeast chromosomes. We have extended MELTSIM to study more than 8,000 DNA sequences from nearly 30 eukaryotic organisms over the entire 20-70-% GC base composition range. MELTSIM is also being studied as a way to classify microorganisms based upon the details of the melting of their RNA species. Melting is also beginning to be used as a tool in phylogenetic analyses of short oligonucleotide sequences in collaboration with Dr. M Halpern.

Prof. Kenneth A. Marx, Department of Chemistry, CIB  
Adjunct Prof. Richard D. Blake - U Mass Lowell, Chemistry Dept./CIB(Emeritus Prof., U. Maine)  
Dr. Micah Halpern – Midland Molecular Institute, Midland, MI  
Mr. Jeffrey Bizzaro, Ph.D. student, Department of Chemistry, CIB, Dir. www.bioinformatics.org

## **4. Physical Property Calculations of DNA Sequences- Helping to Model DNA-Proteins interactions in the Eukaryotic Centromere**

We utilize experimentally parameterized dinucleotide and trinucleotide DNA sequence property datasets to calculate sequence properties and demonstrate correlations with the experimentally determined physical properties of those DNA sequences as well as the protein binding properties of those DNA sequences. Our initial proof-of-principle research work has focused on the short yeast Centromere sequences. We have demonstrated novel and interesting correlations of calculated physical properties of



two specific protein binding sites with the specific protein affinity constants as well as real biological outcomes such as measured chromosome loss rates in characterized DNA mutants of the the yeast centromeres. During this past year we have had one major paper published in a high impact factor journal (BMC Bioinformatics), and another was published in the IEEE Proceedings Symposium 7<sup>th</sup> Intl BIBE Conf. Also, we have finished experimental electrophoretic studies of the interactions of cations with DNA and compared these to results obtained computationally using Manning's Counterion Condensation Theory.

Prof. Kenneth A. Marx, Department of Chemistry, CIB  
Dr. Dang Duc Long, Ph.D. awarded, Department of Chemistry, CIB  
Mr. Brad Hennemuth – U Mass Lowell, Chemistry Dept, Ph.D. candidate (Marx)  
Ms. Anzhi Li – U Mass Lowell, Department of Chemistry, CIB, Ph.D. Candidate (Marx)

### **5. Vis/Datamining of large biological databases**

We are carrying out visualization and data mining analyses of genomic DNA and protein sequence data from the Human Genome Project, as well as other large biotechnological and pharmaceutical company functional genomics datasets. In the past, funding from Pfizer, Millenium Pharmaceuticals and Genetics Institute has supported previous work in collaboration with the IVPR at UML. We have been heavily involved in setting up a joint Bioinformatics Option Program at the B.S., M.S. and Ph.D. level in the Computer Science, Biology and Chemistry Departments at UML. Currently, we are working with a former AnVil start-up and Brandeis University colleague, Dr. ML Ujwal, now at Eli Lilly, IN. on the characterization of quinoid compounds in the NCI Cancer Compound Screening Database.

Prof. Kenneth A. Marx, Department of Chemistry, CIB  
Prof. Georges Grinstein, IVPR at UML  
Dr. Dang Duc Long: Ph.D. awarded (Marx)  
Dr. M.L. Ujwal, Dir., Bioinformatics Program, Brandeis Univ., Scientist, Eli Lilly

### **6. Chiral Metamaterials**

We have continued studies, initially via EM Theory calculations, to identify novel optical properties of various repeating structures that form metamaterials. Metamaterials possess double negative, and in some cases, chiral properties that allow them to differentially interact with different light polarizations. Experiments in the past focused on devices in the microwave and THz (with Prof. Bill Goodhue) frequency ranges have verified that real devices possess the simulated properties we had previously calculated. This new class of optical materials will be useful in creating new types of unique optical elements for use in many different fields of optical instrument technology. We have converted a provisional patent to a filed utility patent during the past year based upon this research and have submitted another disclosure to the CVIP for an application of metamaterials to the design of a novel nanoprobe instrument. In addition, 4 full length papers have been published and a fifth has been submitted.

Prof. Kenneth A. Marx, Department of Chemistry, CIB  
Prof. Alkim Akyurtlu, Department of Elec. Eng., CMOS  
Nantaken Wongkasem, Department of Elec. Eng., Ph.D. awarded, CMOS, Returning Visiting Professor from Thailand.

### **7. DARPA Funded Mammalian Limb Regeneration**

This DARPA funded multi-institution collaboration involves data mining of salamander microarray experiments conducted by experimentalists at the Univ. of Utah and Northwestern U. and new mouse microarrays. We have finished the second year of funded research activity. We are involved in developing a molecular signature for the regenerating mammalian blastema during digit regeneration following



amputation. Also, we will be involved in the development of a model for the regenerating mammalian limb in the later stages of the DARPA funding.

Prof. Kenneth A. Marx, Department of Chemistry, CIB  
Prof. Susan Braunhut, Department of Biological Sciences  
Mr. Chia-Ho Cheng, Department of Chemistry, CIB, Ph.D. student (Marx)  
Mr. John Sharko, Department of Computer Science at UML, student (Grinstein)  
Prof. Georges Grinstein, Department of Computer Science, UML

*Other DARPA Team Members:*

Prof. Steve Badyak, Univ. Pittsburgh  
Prof. Ellen Heber Katz, Wistar Institute  
Prof. Lorraine Gudas, Columbia Univ.  
Prof. Shannon Odelberg, Univ. Utah  
Prof. Hans Georg Simon, Northwestern U.  
Dr. Cathy Hatcher, Columbia Univ.

## **8. Computational Protein-Drug Structure & Biochemistry**

A new collaboration this year has been initiated with Prof. V. Barsegov, Chemistry Dept. and a collaboration continues with Prof. R. Dima, University of Cincinnati. The focus is on the use of bioinformatics and cheminformatics approaches to carry out a number of computational research tasks. The first with Prof. Dima is to classify the hundreds of protein structure/function families in the public databases based upon the statistics of their amino acid residue type distributions within the primary sequences of the members of each family. These studies have potential biomedical implications for drug development. The second project with Prof. Barsegov is to carry out molecular modeling of the defensin peptide- regulatory protein interactions that lie at the heart of their antiviral, antibacterial, and immunological/metabolic properties.

Prof. Kenneth A. Marx, Department of Chemistry, CIB  
Prof. Valeri Barsegov, Department of Chemistry, CIB  
Prof. Ruxandra. Dima, Department of Chemistry, University of Cincinnati  
Ms. Dina Wassaf, Department of Chemistry, CIB, Ph.D. student (Marx)  
Ms. Rabab Toubar, Department of Biomedical Engineering, CIB, Ph.D. student (Marx)

### **Smart Systems Development**

#### **1. QCM Studies of cells-cellular biosensor & wound healing system development**

In this collaboration with the research group of Prof. Susan Braunhut in the Dept. of Biological Sciences at UML, we have examined two project areas. 1) The attachment and viscoelastic properties of normal and transformed endothelial cells binding to the gold electrode surface of the Quartz Crystal Microbalance (QCM). It may be possible to develop a useful sensor for whole cell properties using this approach. This approach could be used as a complex and sensitive cell based biosensor of interest to the biotechnology and pharmaceutical industry for the detection of molecules having distinct effects on attached cells. As well, we are hoping that the QCM will be useful for the diagnosis of patient oncological biopsy specimens. This has led us to funding from the Army for a Homeland Security Grant oriented grant to investigate the use of cell QCM biosensor for detection of airborne chemicals and toxins. 2) We recently finished a DARPA funded Grant to investigate the growth stimulation effects and uncover the mechanism of underlying negative potentials on adhering endothelial cells as a model for wound healing. We have also filed two pending patents, one on a 'smart' bandaid concept and the other on use of the whole cell QCM biosensor in drug discovery and clinical diagnosis. This research has led to the significant 6-institution consortium DARPA funded grant award mentioned above to develop Human Limb



Regeneration capability. A new activity to be initiated soon this year will be a biosensor project to develop a robust QCM for field deployment using living cells for detection of complex biological threats.

Two major Review articles in the area of biosensors written by the Director, have appeared as Book Chapters in the volumes entitled: 'Smart Biosensor Technology' and 'Piezoelectric Sensors' Vol. 6.

Prof. Kenneth A. Marx, Department of Chemistry, CIB  
Prof. Susan Brauhn, Department of Biological Sciences  
Dr. Gavin Wang, U Mass Lowell, Department of Chemistry, CIB, Postdoctoral Fellow  
Mrs. Donna McIntosh, Senior Technician, Biology Dept.

## **2. NSF NSEC Nanomanufacturing**

We engaged in research as part of a 5-year funded NSF project, which is to create a nanobiosensor that may be applied to breast cancer detection. Initially, the project goals are to create a substrate with nanoscale features that can be used to immobilize oriented antibodies specific for the detection of cancer protein antigens. We finished trying a chemistry oriented approach for antibody orientation.

. The Director also served as Guest Editor for a Special Nanomanufacturing Thematic Issue of the research journal *Microscopy Research and Technique*, where he is on the Editorial Board. The special June, 2007 issue recently appeared and contained an Introduction and one research article written by the Director as well as 7 other refereed articles. The Special Issue is entitled: "Facilitating Nanomanufacturing Using Microscopy Techniques."

Prof. Kenneth A. Marx, Department of Chemistry, CIB  
Prof. Susan Brauhn, Department of Biological Sciences  
Dr. Rajiv Pande, Department of Chemistry, CIB, Yale MBA  
Mr. Vikram Shankar, Department of Biological Sciences, UML  
Prof. Joey Mead, CHN, Dept. Plastics Eng.  
Prof. Carol Barry, CHN, Dept. Plastics Eng.

## **8. PUBLICATIONS & PATENTS (only 2007 & 2008 & refereed)**

### **Patents**

"Chiral Metamaterials" (A. Akyurtlu, K.A. Marx, N. Wongkasem) Utility patent filed 1/18/06 with US Patent Office.

CIP to this "Chiral Metamaterials" patent filed in Oct, 2007.

### **Publications**

I was Guest Editor of a Special Thematic Issue of the journal *Microscopy Research and Technique*: "Facilitating Nanomanufacturing Using Microscopy Techniques". Around 9 contributed research articles were submitted to me and sent for review. I also contributed an Overview Introductory paper for this published issue, June (2007).



“Electropolymerized Tyrosine Based Thin Films: Selective Cell Binding via Peptide Recognition to Novel Electropolymerized Biomimetic Tyrosine-RGDY Films,” (K.A. Marx, T. Zhou, D. McIntosh and S.J. Braunhut), *Analytical Biochemistry*, submitted (2008).

“Vectorized RadViz and Its Application to Multiple Cluster Datasets,” (J. Sharko, G. Grinstein, K.A. Marx), *IEEE Visualization 2008*, in press (2008).

“Gold Surface Adsorption Properties of the Enzymatically Polymerized Amphiphilic Decyl Ester of L-Tyrosine,” (K.A. Marx, S. Oh and A.P. Angelopoulos), *J. Macromolecular Sci. A, Pure and Appl. Chem.*, **45**, 503-510 (2008).

“A Machine Learning Approach to Pharmacological Profiling of the Quinone Scaffold in the NCI Database: Effective Against Melanoma and Leukemia Cell Lines,” (M.L. Ujwal, P. Hoffman and K.A. Marx), *Proceedings 7<sup>th</sup> IEEE Conf. BIBE*, 131-136 (2007).

“Evidence for Proximal to Distal Limb Amputation Site Effects from Global Gene Expression Correlations found in Newt Microarrays,” (K.A. Marx, J. Sharko, G.G. Grinstein, S. Odelberg and H.G. Simon), *IEEE Proceedings 7<sup>th</sup> BIBE*, 456-463 (2007).

“Heat Map Visualizations Allow Comparison of Multiple Clustering Results and Evaluation of Dataset Quality: Application to Microarray Data,” (J. Sharko, G.G. Grinstein K.A. Marx, J. Zhou, C.H. Cheng, S. Odelberg and H.G. Simon), In: *Proceedings 11<sup>th</sup> Int'l Conf. Information Visualization*, IEEE Computer Society, Wash, D.C. 521-526 (2007).

“Development of Negative Refractive Index Chiral Metamaterials in the Optical Frequency Regime,” (N. Wongkasem, A. Akyurtlu, K.A. Marx), *IEEE Trans. Antennas & Propagation*, Special Issue on Optical and THz Antennae Technology, **55**, 3052-3062 (2007).

“Fabrication of a Novel Micron Scale Y-Structure Based Chiral Metamaterial: Simulation and Experimental Analysis of its Chiral and Negative Index Properties in the Terahertz and Microwave Regimes,” (N. Wongkasem, A. Akyurtlu, K.A. Marx, W.D. Goodhue, J. Li, Q. Dong, E.T. Ada), *Microscopy Res. Tech.*, **70**, 497-505 (2007).

“Enabling Nanomanufacturing Using Microscopy Techniques,” (K.A. Marx), *Microscopy Res. Tech.*, **70**, 493-496 (2007).

“A Comparative Study of the Cytoskeleton Binding Drugs Nocodazole and Taxol with a Mammalian Cell Quartz Crystal Microbalance Biosensor: Different Dynamics Responses and Energy Dissipation Effects,” (K.A. Marx, T. Zhou, A. Montrone, D. McIntosh and S.J. Braunhut), *Analytical Biochemistry*, **361**, 77-92 (2007).

“The Quartz Crystal Microbalance and the Electrochemical QCM: Applications to Studies of Thin Polymer Films, Electron Transfer Systems, Biological Macromolecules, Cells and Biosensors,” (K.A. Marx) In: *Piezoelectric Sensors 5*, (A. Janshoff and C. Steinem, eds.) Springer-Verlag, Berlin and Heidelberg, Series on Chemical Sensors and Biosensors, 371-424 (2007). [REVIEW ARTICLE]



“Toward Understanding the Intelligent Properties of Biological Macromolecules-Implications for Their Design into Biosensors,” (K.A. Marx) In: *Smart Biosensor Technology*, (G. Knopf and A. Bassi, eds), CRC Press, Taylor & Francis, New York, 3-81 (2007). [REVIEW ARTICLE]

## **9. CONFERENCES/PANELS**

1. Attended 15<sup>th</sup> Conversation in Biomolecular Structure and Dynamics, SUNY Albany, Albany, NY on 6/19-6/23/07. I presented a research study along with my Ph.D. student Dina Wassaf.
2. 7<sup>th</sup> Int'l BIBE, IEEE Conf. Workshop Co-Chair of 4<sup>th</sup> UMass Bioinformatics Conference- Oct. 14-17, 2007.
3. CHN Nanomanufacturing Site Visit Conference June, 2008
4. Attended and presented talks at the following DARPA Funders conferences for RIR Project:
  - a. Grand Teton Lodge, Jackson Hole Wyoming, June, 2007
  - b. Wistar Institute, Philadelphia, PA.

### **Clinical Biosensor, Wound Healing, Metamaterials and Bioinformatics Commercialization Technology Presentations Made to Obtain Development Funding:**

U Mass Lowell Industry Day 4/28/08

Q-Sense, Inc. Collaboration Presentation Discussion, June, 2008

## **10. INTRA-UNIVERSITY and INTER-UNIVERSITY COLLABORATIONS**

The CIB carries out active intra-university collaborations with a number of different Centers and individual investigators. Here I list them briefly. I have already described these collaborations in great detail in section VI. Current and Recent Research Projects and refer the reader to the appropriate pages.

1. High Dimensionality Visualization and Data mining in Bioinformatics-collaboration between my CIB and the IVPR, Director Prof. Georges Grinstein and with Dr. ML Ujwal, Dir. Bioinformatics Program Brandeis Univ. and Eli Lilly.
2. Development of QCM cell biosensor technology for Homeland Security (new Army Biosensor Grant), drug discovery and clinical diagnostics and DARPA funded Mammalian Limb Regeneration between my CIB and research group of Prof. Susan Brauhut, Dept. Biological Sciences. This collaboration involves 5 other University and Research Institutions: Univ. Pittsburgh, Univ. Utah, Northwestern Univ., Wistar Institute, Cornell Univ.
3. Developing novel chiral metamaterials systems that possess unusual optical properties for all types of optical instrumentation and telecommunications activities. A collaboration with the CIB and the research group of Prof. Akyurtlu (Dept. EE) in CMOS. In this project we collaborate as well with other investigators on the fabrication of metamaterials structures.
4. Bioinformatics and cheminformatics studies of protein sequences in the public databases to understand the functional classification of proteins based upon their distributions of charged residues analyzed through an entropy based metric. Also, molecular dynamics and molecular stretching studies



will be performed on the biologically important tubulin polymerizing protein system interacting with medically important drugs in current and future use as cancer chemotherapeutic agents. This is a collaboration with Prof. R. Dima, Univ. Cincinnati, OH.

5. New this year is a collaboration with Prof. Valeri Barsegov, Chemistry Dept. This begins with a Molecular Dynamics modeling study of the human defensins, small peptide/proteins that possess a range of antibacterial, antiviral, immunological and regulatory functions through their interactions with GPCR integral membrane signaling proteins.

## **11. REGIONAL/LOCAL COMMUNITY AND INTERNATIONAL TECHNICAL OUTREACH**

In the area of regional, national and international technical outreach, for the past 9 years the CIB has hosted The Open Lab, at [www.bioinformatics.org](http://www.bioinformatics.org). [www.bioinformatics.org](http://www.bioinformatics.org) is a >15,000 member international open source code software collaborative comprised of over 1000 active volunteer software developers worldwide. Its aim is to create free software for the bioinformatics community worldwide. The CIB hosts two servers that house the [www.bioinformatics.org](http://www.bioinformatics.org) website and helps promote the activities of this volunteer service non-profit organization. Mr. Jeffrey Bizzaro, Director of The Open Lab, is currently a Ph.D. student in Prof. Marx's research group within the CIB.

## **12. FUNDING**

**Funded Current/Past Year** total: \$ 370,800

DARPA Funding-Mammalian Limb Regeneration (3/15/06-3/14/08) Co-PI with Prof. Sue Braunhut, PI	\$ 75,000
Army Sensor Nanomanufacturing Program, PI with Prof. Braunhut	\$ 141,000
Chiral Metamaterials Seed Funding, PI with Prof. A. Akyurtlu	\$ 132,800
CFCI Innovation Grant RA Funding- 1 yr	\$ 22,000

## **13. JOURNAL EDITORIAL/REVIEW BOARDS/SCIENTIFIC ADVISORY BOARDS**

***Journal Editorial Boards:*** Microscopy Research & Technique; Journal of Bionanoscience.

***Journal Review Boards:*** Proceedings National Academy of Science, USA; Biopolymers; J. Biomolecular Structure and Dynamics; Biochim Biophys. Acta.; Inorganica Chimica Acta.; Protein Purification and Expression; Biochemistry; Biophysical Journal, Microscopy Technique & Structure, Biomacromolecules, Langmuir, Biosensors and Bioelectronics, Biotechnology Progress

***Consulting/contract research:*** consulting for and contract funding from a variety of biotechnology, pharmaceutical and biomaterials companies- Morphogenesis, Inc., GeoMCo., AnVil, Inc., ChiScientific, Inc., External Reviewer for Center Proposals for the Science Foundation Ireland.

***Scientific Advisory Board Memberships:*** Co-Founder of AnVil Informatics, Inc. and Scientific Advisory Board Member and Consultant; ChiScientific, Inc., Scientific Advisor and consultant. Scientific Advisor of The Open Lab (at [www.bioinformatics.org](http://www.bioinformatics.org)), an international Open Source Bioinformatics Software development collaborative.



**Grant Reviewer:** National Science Foundation, Army Research Office, State of Maine Agricultural Grants Program, California Seed Grants Program, UML Seed Grant Program, USDA,

**Textbook Reviewer:** Benjamin Cummings Co., Inc.; Oxford University Press, University Science Books, Addison Wesley, John Wiley & Sons

## **14. STRATEGIC GOALS**

Our major Center (CIB) strategic goals are as follows:

1. In collaboration with the Center for Biomolecular and Medical Informatics, the CIB will continue to promote the new Bioinformatics Options in Computer Science and Biological Sciences, as well as promote the interdisciplinary interaction necessary to foster novel bioinformatics research between our two Centers and on the UML campus as a whole. The 4th University of Massachusetts Bioinformatics Conference was held on Oct. 14, 2007 at the 7<sup>th</sup> Int'l BIBE, an IEEE Conference held at Harvard Medical School, as a result of our Centers working together.
2. The CIB's collaboration with Prof. Alkim Akyurtlu, Dept. Electrical Engineering, on the development of novel chiral metamaterials properties is now in its fourth year. We have made substantial progress both from the standpoint of calculated simulations of how the real device interacts with EM radiation as well as experimental verification in the microwave and THz via device fabrication and experimentation. This has resulted in submitted disclosures to CVIP: a filed utility patent application as well as an additional CIP filing; and an NSF Proposal to create a novel nanoprobe THz Scanning Tunneling Gap Spectroscopy device incorporating metamaterials. We are actively seeking funding through DARPA and other federal funding agencies.
3. We have recently broadened the collaboration between the CIB and the research group of Prof. Susan Braunhut, Dept. of Biological Sciences. We have adopted a QCM cell biosensor to Homeland Security diagnostics applications. The CIB has now finished the second year of participation in a major 6-university consortium DARPA Proposal to develop a mammalian limb regeneration model system. We are continuing to analyze the mouse microarray data that has resulted from this project.
4. We have developed a new collaboration with Prof. V. Barsegov, Chem. Dept. on molecular modeling of biologically important systems. We are focused initially on investigating defensin signal peptide-regulatory protein interactions.



## **18. CENTER FOR NETWORK AND INFORMATION SECURITY (CNIS) Annual Report of Major Research Activities**

**For the Period of August 2007 to July 2008**

**Jie Wang, Director**

### **Table of Contents**

- 1. Mission Statement of CNIS**
- 2. General Description and Goals**
  - 2.1. Purpose
  - 2.2. Goals
- 3. Research Focus Areas**
- 4. Associated Personnel**
- 5. Students Supported Research**
- 6. Laboratories**
- 7. Publications (August 2007-July 2008)**
- 8. Regional/Local Outreach and Professional Service**
  - 8.1. Research Seminar
  - 8.2. Colloquium Talks
  - 8.3. NSF and Other Funding Agencies Grant Proposal Reviewing
- 9. External Proposals Awarded/Awarded (August 2007-July 2008)**
- 10. Results of CFCI Support**

### **1. Mission Statement of CNIS**

The Center for Network and Information Security (CNIS) is a multiple disciplinary teaching and research center in network security, wireless security, systems security, applied cryptography, privacy, and other areas.

### **2. General Description and Goals**

Network and information security (NIS) is an important, fast growing area in industrial development, academic curriculum, and theoretical research. CNIS involves multiple disciplines including computer science, computer engineering, and mathematics.

#### **2.1. Purpose**

1. Provide a structure and platform to implement and improve teaching and research in network and information security across multiple disciplines in multiple departments.
2. Improve visibility of UMass Lowell's network security programs and research activities.



## 2.2. Goals

Increase productivity of CNIS teaching and research across multiple disciplines:

1. Involve and attract students to study network and information security.
2. Increase activities of joint grant proposals and carry out joint research projects.
3. Direct doctoral and master's theses.
4. Recruit undergraduate students to participate in research projects.
5. Increase collaboration with computer companies, US government, and US military agencies.

## 3. Research Focus Areas

CNIS focused its research in the reported period on the following areas:

1. Online social networks
2. Enterprise wireless network management
3. Sensor-integrated camera surveillance
4. Wireless network monitoring and intrusion detection
5. Wireless sensor network properties and applications
6. Network processor programming paradigm and compiler optimization
7. Database security and spatial-temporal database management
8. Software forensics
9. Performance modeling and analysis of network processors

## 4. Associated Personnel

*Professor:*

1. Dr. Jie Wang, Director
2. Dr. Giam Pecelli

*Associate Professor:* None

*Assistant Professor:*

3. Dr. Cindy Chen
4. Dr. Guanling Chen, Associate Director
5. Dr. Adam Elbirt (left UMass Lowell in May 2008)
6. Dr. Ben Liu
7. Dr. Yan Luo



8. Dr. David Martin (left UMass Lowell in December 2007)
9. Dr. Li Xu

Affiliated personnel from other universities

10. Dr. Wenjing Lou, WPI (Her activities are not reported in this report)

Affiliated personnel from industry

11. Lucien Labrecque, Astaro Inc.

## 5. Students Supported

### Doctoral students:

1. Stanley Barr (Advisor: J. Wang and B. Liu)
2. Stephen Brington (Advisor: J. Wang)
3. Jie Fan (Advisor: Y. Luo)
4. Zheng Fang (*Supported in part by FY-2007-08 CFCI grant*—resulted in one paper publication; Advisor: J. Wang)
5. Nan Li (Advisor: G. Chen)
6. Wei Li (Advisor: C. Chen and J. Wang)
7. Guan Peng (Advisor: B. Liu)
8. Piti Piyachon (Advisor: Y. Luo)
9. Faruq Rahman (Advisor: TBA)
10. Anwar Saipulla (Advisor: B. Liu and J. Wang)
11. Ke Xiang (Advisor: Y. Luo)
12. Jane Yang (Advisor: J. Wang)
13. Zhijun Yu (Graduated in May 2008; Advisor: J. Wang)

### MS students:

14. Homayara Akter (Graduated in December 2007; Advisor: G. Chen)
15. Chunyan Du (Graduated in December 2007; Advisor: J. Wang)
16. Prabhu Govindaswamy (Graduated in December 2007; *Supported in part by FY-2006-07 CFCI grant*—resulted in one thesis and one paper publication; Advisor: G. Chen and J. Wang)
17. Chris Hayes (Advisor: Y. Luo)
18. Justin Latham (Advisor: Y. Luo)
19. Sourav Maity (Advisor: Y. Luo)
20. Wesley Owen (Graduated in May 2008; Advisor: D. Martin)
21. Aiken Pang (Graduate in May 2008; Advisor: Y. Luo)
22. J. Santo Paul (Advisor: C. Chen)
23. Betty Yang (Advisor: C. Chen and J. Wang)
24. Zhi Yang (Advisor: L. Xu)
25. Hongda Yin (Graduated in December 2007; Advisor: G. Chen)

## 6. Research Laboratories



1. Y. Luo. Directed the Laboratory of Computer Architecture and Network Systems (**CANS Lab**)
2. G. Chen and B. Liu. Directed the Secure Wireless Network Lab (**SWIN Lab**).
3. J. Wang. Directed the Network and Systems Security Lab (**NSS Lab**).
4. L. Xu. Directed the CAML Compilers Lab (**CAML Lab**).

## 7. Publications (August 2007-July 2008 – CNIS Members in Bold)

### Edited Books

1. Xudong Hu and **Jie Wang**. [\*Computing and Combinatorics\*](#). Springer Series of [\*Lecture Notes in Computer Science\*](#), Vol. 5092, Springer, 2008. ISBN 978-3-540-69732-9

### Refereed Journals and Book Chapters

2. Yong Sheng, **Guanling Chen**, Keren Tan, Udayan Deshpande, Bennet Vance, **Hongda Yin**, Chris McDonald, Tristan Henderson, David Kotz, Andrew Campbell, and Joshua Wright. MAP: A scalable monitoring system for dependable 802.11 wireless networks. *IEEE Wireless Communications, Special Issue on Dependability Issues with Ubiquitous Wireless Access*. August 2008. In Press.
3. Yurong Xu, **Guanling Chen**, James Ford, and Fillia Makedon. Detecting wormhole attacks in wireless sensor networks. In Sujeet Shenoi (eds.), *Critical Infrastructure Protection*, pages 267–280, Springer. November 2007.
4. **Jie Wang** and **Ning Zhong**. Minimum-Cost Sensor Arrangement for Achieving Wanted Coverage Lifetime. *International Journal on Sensor Networks*. **3**(3):165-174, 2008.
5. P. Berman, B. DasGupta, M.-Y. Kao, and **Jie Wang**. On constructing an optimal consensus clustering from multiple clusterings, with. *Information Processing Letters*. **104**(4):137-145, 2007.
6. **Li Xu**, A Modular Approach to Language Engineering Using XML and Inexpensive Robots. *Journal of Computing Sciences in Colleges*. **23**(5), 133-141, 2008.

### Refereed Conferences

7. **Wei Li**, **Cindy X. Chen**, and **Jie Wang**. An Efficient Clustering Method for High-Dimensional Data. In *Proceedings of the 4th International Conference on Data Mining (DMIN'08)*. July 14-17, 2008.
8. **Wei Li** and **Cindy X. Chen**. [\*SQS: A Secure XML Querying System\*](#). In *Proceedings of the 10th International Conference on Enterprise Information Systems (ICEIS'08)*, Barcelona, Spain, June 2008

9. **Guanling Chen, Prabhu Govindaswamy, Nan Li, and Jie Wang.** Continuous camera-based monitoring for assistive environments. In *Proceedings of the 1st International Conference on Pervasive Technologies Related to Assistive Environments (PETRA)*, Athens, Greece. July 2008.
10. Yi Ouyang, Zhengyi Le, **Guanling Chen**, and Fillia Makedon. Providing location privacy in assisted living environment. In *Proceedings of the 1st International Conference on Pervasive Technologies Related to Assistive Environments (PETRA)*, Athens, Greece. July 2008.
11. Yong Sheng, Keren Tan, **Guanling Chen**, David Kotz, and Andrew Campbell. Detecting 802.11 MAC layer spoofing using received signal strength. In *Proceedings of the IEEE Conference on Computer Communications (INFOCOM)*, Phoenix, AZ. April 2008.
12. Hongda Yin, **Guanling Chen**, and **Jie Wang**. Detecting protected layer-3 rogue APs. To appear in *Proceedings of the Fourth IEEE International Conference on Broadband Communications, Networks, and Systems (BROADNETS)*, Raleigh, NC. September 2007.
13. **Benyuan Liu**, Olivier Dousse, **Jie Wang**, **Anwar Saipulla**. Strong barrier coverage of wireless sensor networks. In *Proceedings of the 9<sup>th</sup> ACM MobiHoc*, Hong Kong, 2008.
14. Liaoruo Wang, **Benyuan Liu**, Dennis Goeckel, Cedric Westphal, Don Towsley, "Connectivity in Cooperative Wireless Ad Hoc Networks", In *Proceedings of the 9<sup>th</sup> ACM MobiHoc*.
15. **Benyuan Liu**, Don Towsley, Anathram Swami. Data Gathering Capacity of Large Scale Multihop Wireless Networks. In *Proceedings of IEEE International Conference on Mobile Ad-hoc and Sensor Systems (MASS)*, 2008.
16. **Yan Luo** and Chunhui Zhang. The Design of A Programmable Network Edge Node with Hybrid Multi-core Processors for Virtual Networks. In *Proceedings of the IEEE ICCCN*, St Thomas, VI, August 3-8, 2008.
17. **Piti Piyachon** and **Yan Luo**. Design of High Performance Pattern Matching Engine Through Compact Deterministic Finite Automata. In *Proceedings of IEEE/ACM Design Automation Conference (DAC)*, Anaheim, CA, June 8-13, 2008.
18. **Yan Luo** and Jie Fan. Fault Tolerant Practices on Network Processors for Dependable Network Processing. In *Proceedings of the 13th IEEE Workshop on Dependable Parallel, Distributed and Network-Centric Systems*, in conjunction with IPDPS'08, Miami, FL, April 14-18, 2008
19. Song Huang, **Yan Luo** and Wu-chun Feng. Modeling and Analysis of Power in Multicore Network Processors. In *Proceedings of the Fourth IEEE Workshop on High-Performance, Power-Aware Computing*, in conjunction with IPDPS'08, Miami, FL, April 14-18, 2008
20. Chris Hayes and **Yan Luo**. DPICO: A High Speed Deep Packet Inspection Engine using Compact Finite Automata. In *Proceedings of ACM Symposium on Architectures for Networking and Communications Systems*, Orlando, FL, Dec 3-4, 2007



21. **Zheng Fang and Jie Wang.** Convex combination approximation for the min-cost WSN point coverage problem. In *Proceedings of the 3<sup>rd</sup> International Conference on Wireless Algorithms, Systems and Applications (WASA08)*, Dallas, October, 2008. Springer LNCS. Accepted.
22. **Zhijun Yu and Jie Wang.** [Fault-tolerant sensor coverage for achieving wanted coverage lifetime with minimum cost](#). In *Proceedings of the 2<sup>nd</sup> International Conference on Wireless Algorithms, Systems and Applications (WASA07)*, Chicago, August, 2007. IEEE Computer Society Press, Pages 95-102.
23. **Li Xu,** Language Engineering in the Context of a Popular, Inexpensive Robot Platform. In *Proceedings of the 39th SIGCSE technical symposium on Computer Science Education*, pages 43--47, 2008.

## 8. Regional/Local Outreach and Professional Service

### 8.1. Research Seminar

CNIS organized a weekly research seminar each Friday. Each seminar lasted for two hours. Faculty members, students, and outside speakers presented and discussed papers of their own or papers of other people. People from outside CNIS attended various seminar talks.

### 8.2. Invited Talks

1. **Jie Wang.** *Strong Barrier Coverage using Networks of Randomly Deployed Sensors.* Colloquium. Department of Computer Science. Tsinghua University, Beijing. June 24, 2008
2. **Jie Wang.** *Routing and Random Access Control of Mobile Ad Hoc Networks (MANET).* Colloquium. Center for Network and Information Security. National University of Defense Technology. Changsha, June 30, 2008
3. **Jie Wang.** *Strong Barrier Coverage using Networks of Randomly Deployed Sensors.* Colloquium. National Key Laboratory of Wireless Networks, National University of Defense Technology, Changsha, June 30, 2008.
4. **Jie Wang.** *Robust Detection of Rogue Wireless Access Points.* Colloquium. Department of Computer Science, Zhongshan University, Guangzhou, July 3, 2008.
5. **Benyuan Liu.** *Cooperative Connectivity in Wireless Ad hoc Networks.* Colloquium. Department of Computer Science, University of Connecticut. 2008
6. **Benyuan Liu.** Colloquium talk. Capacity of wireless ad hoc networks with infrastructure, ECE, Worcester Polytechnic Institute. 2007

### 8.3. NSF and Other Funding Agencies Proposal Reviewing

1. **Cindy Chen.** NSF Panelist. 2007



2. **Jie Wang.** NSF CNS Panelist. June 2008

## **9. External Grant Proposal Awarded (2007-08)**

### **Grants Awarded (\$445,320):**

1. **Benyuan Liu.** NSF CNS. \$150,000. September 2007.
2. **Yan Luo,** Kavita Chandra, **Guanling Chen,** and **Jie Wang.** NSF CNS-0709001, Programmable Network Infrastructure with Emerging Technologies. \$150,000. September 2007.
3. **Li Xu.** NSF CCLI, RobotStudio: A Modular IDE-Based Holistic Approach to Teaching Language Engineering and Compilers Using Educational Robots. Xu (PI). \$145,320. January 2008.

**Submitted over eight NSF regular grant proposals and ARO grant proposals**

**Submitted four NSF CAREER Award proposals**

**Submitted a number of industry grant proposals to HP, Intel, and Google.**

## **10. Results of CFCI Support**

Zheng Fang was the recipient of the CFCI 2006-07 research assistantship. He was working on min-cost point coverage in wireless sensor networks. His work has resulted in one accepted publication in WASA'08.



19. THE CENTER FOR HEALTH PROMOTION AND RESEARCH

# Annual Report

**Academic Year 2007-2008**

**Submitted by**

**Co-Directors: Dr. Barbara Mawn and Dr. Craig Slatin**

**July 28, 2008**

(or there about)



## **Mission Statement**

The Center focuses on an important component of sustainable social and economic development: establishing the basis for optimal health for all. Its mission is to promote health and the prevention of illness, disability, and premature mortality. We use the World Health Organization's definition of health as a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity. The Center conducts research, service, and intervention activities that can inform and shape the education of health professionals, and it supports participatory research and community-based involvement in health improvement measures. As part of a public university, the Center values the role of campus-community partnerships in attending to the healthcare and health promotion needs of the surrounding region.

The Center strives to understand and explain the social determinants of health. We collaborate and work with other UML centers, institutes, colleges, and departments, along with community-based and advocacy organizations, government, employers, labor unions, environmental and environmental justice organizations, and healthcare provider organizations. We are committed to the pursuit of social justice and the elimination of socioeconomic inequalities in health.

## **Specific Goals and Objectives:**

- Promote collaboration across the multiple disciplines within the university that are involved in public health.
- Examine significant public health questions including but not limited to, those related to effective health education, promotion, and policy.
- Explore the use of health education, promotion, and research to improve public health and health care, with special attention to environmental and occupational health.
- Promote and practice rigorous research using established and innovative approaches including both qualitative and quantitative methods.
- Establish UML as a regional base for collaboration around efforts to develop sustainable solutions to public health problems.
- Conduct research and research-related activities regarding the social determinants of health and health disparities.
- Encourage the development of partnerships with agencies and organizations in the Merrimack Valley and elsewhere as a way to advance the Center's understanding and commitment to the health education and promotion needs of diverse communities.
- Develop methods and conduct research focused on preventing disability by facilitating social participation and interaction for people across the full range of the human experience.



## Research Focus Areas

The major research focus areas within CHPR include the following categories. They will be described in more detail in the “Current Research” and “Proposals submitted” sections of this report.

### 1. Workers’ Health and Safety and Environmental Health

- PHASE in Healthcare (Promoting Healthy and Safe Employment in Healthcare). This project examined health disparities among healthcare workers. It included research and community outreach and education program components. While the funding for this project has been completed, during the past year presentations have been given at national and international conferences. In addition two manuscripts were published this year and another is in final review. Two others are in progress. (Funded by NIOSH)
- Occupational Health and Safety / Worker Health Education: The New England Consortium, Hazardous Waste / Emergency Response Workers Health and Safety Training Project. Worker Health Education evaluation research conducted. One manuscript from this work has been accepted for publication. (Funded by NIEHS)
- Evaluation of the worker health education and training program of the American Federation of State, County, and Municipal Employees (AFSCME). (Funded by NIEHS)
- Occupational and Environmental Health Concerns Regarding Nanoprocesses and Nanomanufacturing.

### 2. Health in Low Income and Immigrant Populations

The Center has advanced capacity to address a range of important health issues for low income and immigrant populations. The primary immigrant population given attention has been the Brazilian community, but we seek to address a broader set of communities and issues. Much of this work has explored community and individual health and morbidity patterns within the context of their social and biological determinants.

## Associated Personnel

Dr. Barbara Mawn, Co-Director  
Dr. Craig Slatin, Co-Director

Affiliated faculty:

Nursing Dept.: Dr. Karen Melillo, Dr. Ainat Koren, Dr. Stephanie Chalupka, Dr. Betty Morgan



Physical Therapy Dept.: Sean Collins, Deirdra Murphy

Community Health and Sustainability: Dr. Beverly Volicer, Dr. Michael O’Sullivan, Dr. Nicole Champagne, Dr. Patrick Scollin, Dr. A. James Lee, Dr. Eduardo Siqueira, Dr. Mansoureh Tajik

Economics: Dr. Monica Galizzi

Work Environment: Dr. Laura Punnett, Dr. Charles Levenstein (UML Professor Emeritus), Dr. Cora Roelofs

Consulting Researchers: Dr. Lee Ann Hoff, Dr. Carole Pearce (UML Professor Emeritus)

Faculty from Other Universities: Dr. Beth Rosenberg, Tufts University Medical School, Department of Family and Community Medicine.

### **Associated Staff:**

- Diane Doherty, Project Administrator, PHASE in Healthcare and TNEC
- David Coffey, Special Projects Manager, TNEC
- Tom Estabrook, Lead Trainer, TNEC
- Judy Martineau, Staff Assistant, TNEC
- Paul Morse, Project Director, TNEC
- Therese O’Donnell, Outreach and Marketing Coordinator, TNEC
- Richard Sadkowsky, Technical Resources Coordinator, TNEC
- Wayne Sanborn, Project Management Consultant, TNEC
- Bridget McGuinness, Worker Health Trainer
- Rebecca Gore, Biostatistician, PHASE in Healthcare
- Marian Flum, AFSCME Training Project, Evaluator

### **New Faculty Affiliations within Last Three Years**

Dr. Cora Roelofs – Research Assistant Professor, Department of Work Environment.

### **Students Supported**

- Amy Rival, a 2nd year masters student in Health Policy in the Department of Community Health and Sustainability, served as research assistant on the American Federation of State, County and Municipal Employees (AFSCME) project. She has played an integral role in developing the newsletter, preparing for the Iowa sessions, reviewing and organizing the hundreds of photos taken for the PhotoVoice project, working with the evaluation team, and using NVivo qualitative software to analyze data.
- Yelena Yanovitskaya, a 1<sup>st</sup> year nursing masters student has worked with the co-directors to help prepare a proposal that Dr. Mawn submitted for an innovation enhancement grant. She has worked closely with the qualitative research network and has conducted literature searches for center researchers.



## Current Research Projects

**Health Disparities Among Healthcare Workers - PHASE in Healthcare (Promoting Healthy and Safe Employment in Healthcare).** All data collection was completed a year ago. Data analysis and development and publication of research manuscripts continues. One dissertation (Jon Boyer, Work Environment) was successfully completed in July 2008 (see below). Several publications listed below resulted from this work. One publication is under review by a labor/management relations journal (ILLR Cornell U.). Another manuscript is nearly ready for submittal to Qualitative Health Research (Sage Publications). Several presentations were made this year.

### WORKER HEALTH EDUCATION EVALUATION RESEARCH

**The American Federation of State, County, and Municipal Employees (AFSCME):  
Funding level: 87,999.00**

Worker Health and Safety Training Evaluation Program conducted a number of evaluation activities during the 2007-23008 grant year. A participatory evaluation team included union members from Upstate New York, Toledo, Ohio, Tucson, AZ, Miami-Dade County FL, and Washington DC. The Peer Evaluation Team is led by PI Eduardo Siqueira and Co-PI Marian.

This year the team focused on evaluation of Train-the-Trainer (TTT) courses, reflecting AFSCME's training priorities. The team developed pre- and post surveys to be conducted at the beginning and end of a TTT program. An impact survey for new trainers was to be administered after new trainers had taught one or two courses. The post-training survey was piloted with trainees in Syracuse, NY, completing a TTT course in Work Zone Safety. The New Trainer Impact Survey was administered to school custodians in Miami, FL, who had completed a TTT in Hazard Communication several months before. Another post-TTT survey was conducted following a Confined Space TTT in Saratoga, NY. Overall the TTT programs seem to effective in helping rank and file workers feel more confident about training. The impact survey demonstrates that as health and safety trainers they are not only seen by others in a new light, but they feel a sense of pride and responsibility in helping their co-workers understand the hazards they face on the job and how to protect themselves.

The team also returned to the University of Iowa to follow-up on the evaluation of the joint Labor-Management Health and Safety Program conducted last year, which included focus groups with workers, interviews with key management and with union leaders. A PhotoVoice project was conducted with custodians to determine causes of workplace injury, and a computer-based survey was administered to nearly 700 Facilities Management personnel at U of Iowa. This year follow-up interviews were conducted management and union leaders. Group interviews were conducted with maintenance and custodial workers who suffer the highest injury rates on campus. An on-line follow-up survey has been developed, but due to the flooding of the Iowa campus, it will not be launched until late fall.



### **The New England Consortium – Worker Health Education Evaluation Research:**

Research was conducted to better understand 1) health and safety management in the population of companies and agencies identified by TNEC, 2) managers' evaluation of TNEC training and, 3) what impact TNEC training might have had on the management of health and safety at the companies and agencies served by that training.

A web-based survey was anonymous. A total of 22 health and safety managers responded (20% of those recruited). The 15-20 minute 25 item questionnaire consisted primarily of close-ended and Likert scale-based questions. The majority of the twenty-two respondents worked for private sector environmental services firms. Most of these firms were small businesses although several had parent companies that help them with their health and safety programs. The public sector was represented as well.

Findings will be submitted for publication this Fall. The strength of this research demonstrates the need to conduct a similar survey on a larger scale. There is a dearth of literature about employers' and managers' beliefs, attitudes, and practices regarding employee health and safety measures. Understanding their perspectives may provide useful information for promoting more effective worker health and safety measures.

This survey of health and safety managers, the first of its kind to address the potential impact of worker training on the programs and operations of their employers, validates the quality and the impact of TNEC's training. We believe that the survey is a strong instrument and should be adapted and utilized by other H&S training programs to generate more data that could contribute to our understanding of the impact of worker training on health and safety programs and worker safety.

### **"Lifestyle and Personal Health Habits of Brazilian Immigrants in Greater Boston: a Pilot Study" (CHPR and Brazilian Women's Group). Funded through a grant from the W.K. Kellogg Community Health Scholars Fund (\$5000)**

The purpose of this study was to develop and pilot test a Brazilian Portuguese-language translation of the Health-Promoting Lifestyle Profile II (HPLP-II) instrument in order to evaluate the psychometric properties of equivalency, reliability, and score distribution of the instrument in a cross-cultural health study that explores health promoting behaviors and lifestyle in Brazilian immigrant populations. HPLP-II instrument encompasses 6 domains: spiritual growth, stress management, interpersonal relationships, nutrition, health responsibility, and physical activity. The subscales are designed to measure health promoting lifestyle defined as "a multidimensional pattern of self-initiated actions and perceptions that serve to maintain or enhance the level of wellness, self-actualization and fulfillment of the individual.

A convenient sample of sixty (60) bilingual Brazilian immigrant adults (18 and older) were recruited from Greater Boston area through the efforts of the staff at the Brazilian Women's Group. The participants were from diverse socio-economic and educational backgrounds and included house cleaners, academics, students, and other professionals and individuals. The sampling criteria included self-identification as Brazilian, bi-lingual skills (Portuguese and English), and willingness to participate in a short (approximately 15 to 20 minutes) health



survey. The initial phase of the study was an experimental design in which participants (once recruited) were randomly assigned and completed either the English or the Portuguese version of the HPLP-II survey. The surveys were administered by two bi-lingual interviewers who had been trained by the principal investigator from mid-September through mid-October 2007. Currently, we are in analysis and write up phase.

**A Peer-Reviewed, International Journal:** The center is the UML home of a journal.

**New Solutions, A Journal of Environmental and Occupational Health Policy. Co-editors: Craig Slatin, Eduardo Siqueira, Beth Rosenberg, Chuck Levenstein, editor emeritus. Publisher: Baywood Publishing Company, Inc., Amityville, NY.**

## **Publications**

2008 Manuel Cifuentes, Boyer, J., Rebecca Gore, Angelo d'Errico, Patrick Scollin, Jamie Tessler, Debra Lerner, David Kriebel, Craig Slatin, Laura Punnett, PHASE in Healthcare Research Team,. (2007). "Job Strain Predicts Survey Response in Healthcare Industry Workers." *American Journal of Industrial Medicine*, Vol. 51:281-289 (2008)

2008 Cheryl West, Slatin, C., Sanborn, W, and Volicer, B. "Computer-Based Simulation in Blended Learning Curriculum for Hazardous Waste Site Worker Health and Safety Training." *International Journal of Information and Communication Technology Education*. Accepted and publication pending – Volume 5, Issue 1.

2007 Manuel Cifuentes, J. B., Rebecca Gore, Angelo d'Errico, Jamie Tessler, Patrick Scollin, Debra Lerner, David Kriebel, Laura Punnett, Craig Slatin, PHASE in Healthcare Research Team,. (2007). "Inter-method agreement between O\*NET and survey measures of psychosocial exposure among healthcare industry employees." *American Journal of Industrial Medicine*, 50(7), 545-553.

2007 Michael J. O'Sullivan, C. Eduardo Siqueira, Kathy Sperrazza, Aina Koren, Karen Devereaux Melillo, Lee Ann Hoff, Edna M. White-O'Sullivan and **Craig Slatin**. " 'It's Part of the Job:' How Health Care Restructuring and the Culture of Health Care Contribute to the Detriment of the Health and Safety of Workers in Community Hospitals and Nursing." In F. Ewan & P. Hyde & L. McKee (Eds.), *Organising and Reorganising: Power and Change in Health Care Organizations*. Houndsmills, Basingstoke, Hampshire, UK: Palgrave Macmillan. Pages 99 – 111. December 2007

## **Manuscripts pending review:**

Mansoureh Tajik and Eduardo Siqueira: Health Survey Instrument Development through a Community-Based Participatory Research Approach: Health Promoting Lifestyle Profile (HPLP-II) and Brazilian Immigrants in Greater Boston (submitted to the *Journal of Immigrants and Minority Health*)



## Conference Presentations

**“Emerging Issues for Hazardous Waste / Emergency Response Worker Health and Safety Over the Next Decade.” Craig Slatin, Convener and Moderator.** Breakout session, NIEHS, WETP, Technical Workshop – “The Future of Hazardous Materials and Training.” October 17 – 19, 2007, Chapel Hill, NC.

**AFSCME Evaluation Team:** developed and conducted a workshop on PhotoVoice, a participatory action research methodology, for AFSCME’s annual trainer refresher conference.

Boyer, J., Galizzi, M., Cifuentes, M., Gore, R., Punnett, L. **Using an ergonomic job exposure matrix to estimate risk of hospital workers’ compensation claims reporting for musculoskeletal disorders.** UML-UCONN Sturbridge Symposium. Sturbridge, MA. January 11, 2008.

Boyer, J. **Ergonomic exposures, socioeconomic status and musculoskeletal disorder risk among healthcare workers.** Doctoral Dissertation Defense. University of Massachusetts Lowell. Lowell, MA. July 7, 2008.

**“What Did You Say Your Name Was? Creating Memorable Opening Statements for Presentations”** by Bridget McGuiness National Environmental Health Association 71<sup>st</sup> Annual Educational Conference and Exhibition held June 18-21, 2007 in Atlantic City, NJ

**“Highway and Roadway Work Zone Safety”** by Bridget McGuiness. National Environmental Health Association 71<sup>st</sup> Annual Educational Conference and Exhibition held June 18-21, 2007 in Atlantic City, NJ

**“Highway and Roadway Work Zone Safety”** by Bridget McGuiness and Tom Estabrook New England Water Environment Association 2008 (NEWEA) 76<sup>th</sup> Annual Conference held January 31, 2008 in Boston, MA

## Collaboration with Other Centers/Institutes/Departments

The center has collaborated with the following centers/institutes/departments.

***Center for Family, Work, and Community:*** Craig Slatin worked closely with Linda Silka to develop a proposal to Community-Campus Partnerships for Health in response to their request for applications for a national workshop on Faculty Development for Community Engaged Scholarship. The proposal was submitted by a team representing all 5 UMass campuses. It was one of 20 proposals out of 120 that was accepted, and the only one from a university system. Craig Slatin attended the workshop on behalf of UML.

***Center for Industrial Competitiveness:*** Our New England Consortium project is working with Bill Mass, Director of the CIC, in an effort where a CIC researcher has mapped New England industrial firms that are likely to have employees who work with hazardous materials and waste. We use this information for more targeted outreach and marketing.



**Lowell Center for Sustainable Production:** Dr. Slatin and Dr. Joel Tickner of the LCSP developed and submitted a proposal for funding from NIEHS' new program area, Partnerships for Environmental Public Health. The proposal was not awarded funding, but scored very well in its category. If funded we would have engaged in community/labor green chemistry advocacy training in Connecticut, Massachusetts, and New Hampshire.

**School of Health and Environment:** Dr. Eduardo Siqueira submitted a successful proposal to the dean of the School of Health and Environment for a signature initiative. His proposal for a "New Voices for Health and Environment in the Merrimack Valley" project to develop the capacity for UML researchers to collaborate with ethnic media in the Merrimack Valley built upon the successful work of his COBWEB (Collaboration for a Better Work Environment for Brazilians) project. COBWEB was a multi-year outreach and research project that provided community, workplace, and environmental health supports to Brazilian immigrant communities in the Boston and Lowell areas. A 56 page media catalog was published for use by the SHE and UML community to work with a variety of media outlets.

**Center for High-Rate Nanotechnology:** Dr. Mawn continued to work this year with the health and environment group of the CHRN.

**Department of Work Environment:** Dr. Slatin has with Dr. Bello in initial discussions about a research project to produce a characterization of the toxicity of nano waste materials generated by nanomanufacturing processes. Once characterized, we would then develop an assessment of the extent of hazardous nanowaste being generated in New England and identify the processes generating this waste. This work would support development of regulations to safely manage the nanowaste as well as to encourage development of developing non-toxic nanomaterials.

**Qualitative Research Network:** Dr. Slatin continued as a member of the QRN steering committee and Dr. Mawn remained strongly involved in the QRN. The center provided resources for planning and delivering several presentations.

## **Regional/Local Outreach**

### **The New England Consortium:**

**Funding level: \$1.2M (includes grants from NIEHS, course revenues, EPA (to provide training to tribal nations), and Mass. Department of Industrial Accidents.**

The New England Consortium (TNEC), a partnership of the University of Massachusetts Lowell in the Center for Public Health Research and Health Promotion and five Coalitions for Occupational Safety and Health (ConnectiCOSH, MassCOSH, NHCOSH, RICOSH, and Western MassCOSH), has been working since 1987 to provide top quality participatory hands-on HAZWOPER training to workers throughout the region. The COSH organizations also provide a diversified set of health and safety training programs for labor union members, community organizations, school personnel, and other groups and individuals.



**During the first nine months of this grant year (August 1, 2007 through April 30, 2008), TNEC has conducted sixty-one courses for 666 workers involving 9,104 hours of instruction in its core HAZWOPER training program. TNEC has delivered nine 40-hour Site Worker sessions, five 24-hour Emergency Response courses, twenty-four 8-hour Refreshers for site workers and emergency responders, four 8-hour Site Supervisors, nine General and All Hazards awareness 8-hour ER courses, five 10-hour General Construction Safety, two 3-hour HazCom Right-to-Know, two 14-hour Confined Space Entrant courses and one 3-hour CPR/AED session.**

**TNEC continues the delivery of open enrollment HAZWOPER related and HAZWOPER supporting trainings and it is working with diverse groups of public and private sector firms and organizations in the design and delivery of customized contract courses. The consortium partners with U.S. EPA Region 1 in training New England Native American Tribes. Customized courses have been or will be delivered to the OSHA Inspectors Region 1, U.S. Geological Survey, the Massachusetts Water Resources Authority, Ben & Jerry's (VT), OFS Fitel, Connecticut Protective Services Union, Cape Ann Equipment, the Narragansett Bay Commission, Evergreen Solar, Hanscom Air Force Base, EMC2, Neuco, SEA Consultants, and Public Service of New Hampshire. TNEC will provide All Hazards Disaster-related training for New Hampshire public health officers for the seventh time over the past eight years. TNEC provided two 40-hour CERCLA, two Confined Space Entrant (new this year), two All Hazards ER Awareness courses, and two 10-hour OSHA Construction Safety sessions to the Boston-based JFY*Networks* Envirotech job program, and one 40-hour CERCLA, and one 10-hour OSHA Construction Safety course for Essex Agricultural and Technical High School (MA) students.**

**TNEC continues its strategic outreach and marketing initiative. Highlights include collaboration with UMass Lowell's Center for Industrial Competitiveness an informal alliance with Keene State's OSHA Education Center, the development of Avian Flu/Pandemic Disease curriculum and a Train-the-Trainer program for over 400 school personnel, and specialized 8-hour Emergency Response Awareness training for municipal workers and the Massachusetts Department of Safety through the Massachusetts Inter-local Insurance Agency and through member communities of the Massachusetts Water Resources Authority. The consortium is collaborating on two advanced technology projects. TNEC is assisting UMass Lowell's Department of Computer Sciences in developing advanced robotics and related technology and software for use in hazardous waste site remediation, HAZMAT emergency response, and disaster response and recovery scenarios. Additionally, Yale University's Director of Environmental Health and Safety has invited TNEC to provide technical assistance in developing a high definition Blu-ray simulation software program for use in worker training modules.**

**Project COBWEB** (Collaboration for a Better Work Environment for Brazilians), or *Parceria* in Portuguese, began in 2003 with the combined efforts of the Work Environment Department at the University of Massachusetts Lowell (UMass Lowell), the Brazilian Immigrant Center (BIC), the Massachusetts Coalition for Occupational Safety and Health (MassCOSH) and from two



health care centers: the Lowell Community Health Center and the Massachusetts General Chelsea Health Center. This last partner withdrew from the project in 2005. **Eduardo Siqueira, PI.**

Between 2003 and 2007, Project COBWEB worked with the Brazilian working community in Massachusetts, particularly in the Eastern part of the state, to promote better health and safety conditions in the work environment. Project COBWEB was financed by the National Institute of Environmental Health Sciences (NIEHS) – an American government agency that has financed other similar projects with the goal of seeking environmental justice for disadvantaged populations in the United States.

For more than four years, Radiola Brasil has been on the air on WUML 91.5 FM, an UMass Lowell radio station, on Tuesday mornings between 11 am and noon. Radiola Brasil carries Brazilian music and talk-radio discussion on interesting topics related to Brazilian workers in Massachusetts, combining entertainment and information.

**TewksburyOdor.org & WilmingtonOdor.org:** In May 2008, Drs. Tajik and Slatin met with concerned members of a community-based environmental organization that was trying to address health concerns related to a Concentrated Animal Feeding Operation for hog production in Tewksbury. We were invited to speak with them at a community meeting held at the Tewksbury Library. Dr. Tajik made a presentation based on her research in North Carolina.

## **Proposals Submitted**

**Proposal to NIH:** Dr. Lee submitted a proposal, “Effects of an Evidence-Based Nursing Protocol on Lower Respiratory Infections.” If awarded funding, this will involve a collaboration with Tewksbury Hospital. The proposal is currently pending consideration for review.

The investigators propose to test the feasibility and effectiveness of implementing a research-based nursing protocol. The protocol aims at decreasing the incidence and severity of Lower Respiratory Infections (LRI’s), including criteria confirmed and empirically diagnosed Bacterial Pneumonia, Bronchitis and Aspiration Pneumonia among non- Intensive Care Unit (ICU) patients in a long term acute care public hospital.

The specific aim of the protocol is to decrease the incidence of LRI’s by decreasing bacteria in the oropharynx. This protocol includes the use of a checklist for daily documentation of specific nursing interventions based on literature findings: an evidence-based standard of mouth care including mechanical tooth brushing and an antiseptic mouth wash; an oral assessment of the condition of the mouth, including any signs of dehydration and dentition; and dental record visit reviews for up to date dental exams and condition of the mouth, i.e., plaque scale measurement, periodontal disease. The evidenced–based standard of mouth care will be implemented on all medical patients within the entire Hospital.

Participants will include all adult medical patients residing on the DPH units at Tewksbury Hospital and will include varying ages from 21 to 100, male and female, race and ethnicity with



varying Diagnoses and co-morbidities. Current census is 200 patients. The study will be conducted using a before-and-after evaluation design, and three key hypotheses will be tested from project data: (1) an evidence-based nursing protocol for prevention of Lower Respiratory Illness (LRI) can be consistently and comprehensively implemented on a hospital-wide basis with comparatively little effort; (2) the indicated interventions will quickly and measurably reduce the incidence and severity of LRI's; and (3) the “checklist” monitoring of the standardized evidence-based mouth care protocol will increase adherence to existing protocols.

**Proposal Submitted but not awarded funding:** Dr. Barbara Mawn submitted a K01 to the National Institute of Nursing Research entitled: **Health Effects of Nanoparticles on Workers: Perceptions, Practices and Policies.** Dr. Mawn intends to revise her proposal based upon reviewers' comments.

**Proposal Submitted by not accepted for funding:** Healthy and Creative Public: A Precursor to a Creative Economy (Creative Economy Fund - unsuccessful) Mansoureh Tajik, Eduardo Siqueira, Craig Slatin

**Proposal submitted to NIEHS Partnerships in Environmental Public Health program: Worker and Environmentalist Green Chemistry Awareness Training: Green Chemistry as a Potential and Actual Tool for Cleaner Industrial Production That Promotes Environmental Public Health and Protects Environmental Integrity.** A proposal was submitted for collaborative work between The New England Consortium, the Massachusetts Alliance for a Healthy Tomorrow, The Alliance For a Healthy Tomorrow – Massachusetts, Beyond Benign, a Warner-Babcock Foundation, The United Steel Workers, The Communications Workers of America. This effort would have supported development and delivery of curriculum to train members of labor unions and community-based environmental organizations to advance cleaner industrial production that can substantially reduce human exposures to toxic materials and thereby prevent associate adverse health outcomes. Participants would learn of the potential for green chemistry as a tool for hazardous waste remediation, hazardous waste reduction and management, and substitution of hazardous materials with benign materials in production.

The proposal was not funded, but did receive a relatively high score. More than 70 proposals were submitted but available funding could only support ten proposals. **(\$50,000 requested)**



## 20. CENTER FOR SUSTAINABLE ENERGY

# University of Massachusetts Lowell

## Annual Report 2007-08

July 28, 2008

### 1. Brief Overview of Center

In the abstract, the Center for Sustainable Energy exists to develop systems to provide energy for various end uses in an environmentally and economically sustainable manner. In the concrete, past and present projects in the center have focused on rural renewable energy systems for medical, educational, town, and agricultural use; solar/electric/fuel-cell systems; photovoltaic-assisted lighting; green building thermal efficiency test methods and case studies; solar crop drying; solar design tools; solar resource databases; and solar electric vehicles. The center is unique in the degree to which it combines undergraduate and graduate education, research, public service, service-learning, and public education into its projects. In recent years focus has been placed on service-learning promotion and research not only related to energy issues but to education and service of students and faculty of engineering and other academic disciplines.

### Mission Statement

The Center for Sustainable Energy seeks to improve energy efficiency in end-use sectors and to increase the diversity of energy resources consistent with an economically and environmentally sustainable future. The center strives to combine undergraduate and graduate education, research, public service, service-learning, and public education into its projects. The mission and major purposes of the University of Massachusetts Lowell are to provide to students an affordable education of high quality and to focus some of its scholarship and public service on assisting sustainable regional economic and social development. The Center goals help support the overall mission of the university.

### 2. Objectives

More specific objectives within this broad mission include:

- Be a model of village empowerment through research and education to meet needs of the world's poor through sustained collaboration with a selected network of villages with interdisciplinary projects.



- Work with faculty to incorporate service-learning projects into mainstream courses throughout the College of Engineering in particular, but other colleges and other universities also.
- Design and install solar/hydro/biogas systems for vaccine refrigeration, transceiver radio communication, lighting, laptop PCs, water purification, and agriculture for remote medical clinics, schools, and towns in Peru and develop infrastructures for local people to take over development and maintenance of such systems.

### **3. Focus Areas: Discovery/Learning/Engagement (Research/Teaching/Service)**

Our focus areas that in general combine discovery, learning, and engagement (research, teaching, and service) include:

- The Village Empowerment Project involves the development of systems appropriate for use in developing countries: low cost; reliable; sustainable in terms of energy, environmental impact, and economics. Students, both graduate and undergraduate, develop such systems as parts of service-learning projects in courses and theses for graduate degrees. Trips have been made twice a year for two weeks since August of 1998, led and organized by the center.
- Service-Learning Integrated throughout a College of Engineering: SLICE. The goal here is integrate service-learning (S-L) projects into mainstream required courses in the engineering programs so that every student has at least one course every semester with S-L. One of the objectives, besides better learning of subject matter in the courses, is recruitment and retention of underrepresented groups in engineering. To date, over half the engineering faculty (along with a few others in other colleges) have incorporated S-L into at least one course. The center director is the faculty coordinator for this project and Principal Investigator of an NSF grant for SLICE.
- What appears to be the only academic program with graduate degrees explicitly in energy engineering (solar) is essentially run in collaboration with the center. The director of the center is the graduate coordinator of that program.
- Applied research and development: fuel cell and electrolyzer thermal modeling; electrolyzer and hydrogen and oxygen storage systems development; fuel cell vehicle hydrogen storage comparisons; complex solar system design tool for reliability; PV-thermal collector field testing; solar lantern and LED lamp development; data acquisition systems for remote PV systems; thermoelectric, solar phase-change vaccine refrigerator development; solar crop dryers; photocatalytic water purification with dye indicator for disaster relief and remote regions; life cycle environmental impact analysis of PV modules; energy efficient aquaculture; optimal design method for solar water pumping systems; solar drip irrigation; solar autoclaves; in-depth case studies of green buildings; energy implications of scoring systems for green buildings; biogas digesters for cold climates; geopressured-geothermal, solar conversion system to produce potable water; compound parabolic concentrators with thermoelectric modules; energy independence for a tribal band in New Brunswick with biomass; solar bathroom modules for a tribal band in southern Arizona; and remote sustainable development.



#### **4. Faculty/Staff Members**

The following faculty/staff are members/collaborators of the center:

John Duffy, Director (as of May 1996), Mechanical Engineering Department (solar electrolyzer/fuel cell systems, electric vehicles, thermal testing of buildings, passive solar systems, PV systems, solar rural systems)

Raul Raudales, Principal of Mesoamerican Development Institute (solar crop drying, solar water purification)

Hong Wei Sun, Assistant Professor, Mechanical Engineering (MEMS micro systems, solar thermal concentrators).

Diana Archibald, Associate Professor, English. (service-learning, Village Empowerment)

Linda Barrington, College of Engineering Director of Service-Learning.

Paul Soper, former University Chaplain, Catholic Center (developing countries)

Cheryl West, research associate, formerly with the Center for Work, Family, and Community, presently doctoral candidate Work Environment program (service-learning)

Alan Rux, Electrical Engineering Department (solar radios, assistive technology)

Bill Moeller, Professor Emeritus, Civil Engineering (sustainable development)

In addition, there are about 36 faculty members total (including the dean and three department chairs in the College of Engineering) that have incorporated service-learning into their courses as part of the SLICE initiative in the college of engineering. The initiative is led by John Duffy of the Center.

#### **5. New Faculty and Staff Affiliations (last year)**

We have collaborated with the following new faculty and staff:

- Deirdra Murphy, Assistant Professor, Physical Therapy. Advises PT students working on the Village Empowerment Project; went to Peru June 2007 and then with two students June 2008 to work with disabled local students and develop service-learning projects.
- Nicole Champagne, Associate Professor, Health Education. Service-learning projects for Health Education students. Went to Peru with two students June 2008 with the Village Empowerment project.
- Diana Archibald, Associate Professor, English. Went to Peru January 2008 with the Village Empowerment project. Her writing students have worked with VE project also.
- Chad Montrie, Associate Professor, History. A specialist in video history, Chad went to Peru January 2008 with the Village Empowerment project and took extensive videos. He is working with students to develop several videos about the project and the students involved.
- 

#### **6. Students**

The following graduate students have worked in/with the center since June of 2007:

Somchai Jiajitsawat, solar vaccine refrigerator development (D. Eng. in process)

Ujjwal Bhattacharjee, financial incentives for renewable energy (PhD. in process)



Nto Diarra, stochastic systems approach to solar water pumping design with applications in Mali (PhD. energy engineering--solar).

Manuel Heredia, solar water purification with bottles coated with TiO<sub>2</sub> and service-learning (PhD in process) (support: CFCI, NCIIA, NSF-SLICE).

Jorge Barrientos, green building case studies and life-cycle environmental impact of PV modules (M.S.).

Tanya Martinez, total renewable energy resource utilization analysis for northeastern New Brunswick (MS thesis 2008).

Eric Morgan, service-learning and photocatalyst coating of bottles for solar water purification (M.S. candidate).

Robert Williams, service-learning and study of byproducts safety of photocatalyst and dye indicator from solar water bottle purification (M.S. candidate).

Carolina Barreto, **Fulbright Scholar**, solar agricultural irrigation systems (M.S. candidate).

Rafael Castro, solar thermal towers (M.S. candidate).

Vivian Crespo, rural solar system for an Indian reservation in Arizona (M.S. candidate).

Chigbo [Mgbemene](#), **Fulbright Fellow** for one year, faculty member from Mechanical Engineering Department of University of Nigeria, Nsukka; solar compound parabolic concentrators with thermoelectric modules for electricity generation.

Bharath Srinivasan, green building design (MS in process)

Sneha Sriwastava, solar-green building design (MS in process)

Littee Kitpipit, solar utilization for industry in Thailand (D.Sc. in process)

Several others supported by the SLICE grant on service-learning under the direction of other faculty.

In all, 8 graduate students were supported financially through the center.

In addition, 6 undergraduates (Ryan Burns, Ian Crabtree, Greg Pawlowski, Shawn Furey in ME and Bonnie Tacheron and Kelly Oslin in CE) worked on capstone design projects through the center.

## 7. Current Discovery/Learning/Engagement Projects

Major current projects include:

- Solar water purification with recycled polyethylene plastic bottles coated inside with TiO<sub>2</sub> photocatalyst and with a dye indicator in the water that disappears when the water is clean. The work this past year was performed by Manuel Heredia, a doctoral student in the energy engineering program, supported in part by CFCI, as well as Robert Williams and Eric Morgan, both graduate students in the energy engineering program and supported in part by the National Collegiate Inventors and Innovators Alliance. The focus was on: changing the manufacturing process of coating the recycled plastic bottles to make it safer and easier for village microenterprises; testing the long-term storage capability of the water purified in the bottles; analysis of the efficacy of the indigo carmine pill as a dye indicator of purity. The key results to date include the following:

- Organisms and chemicals destroyed by the process: All surveyed the literature extensively for evidence of the different types of harmful organisms and chemicals destroyed by the hydroxyl ions produced by the UV light and photocatalyst. Many studies have been performed with the TiO<sub>2</sub> powder mixed with water for detoxification of waste water subjected to UV light in laboratories, but the results should be applicable to the methodology being developed in this study. Almost all bacteria, spores, fungus as well as many pesticides and herbicides in addition to toxic forms of arsenic are eliminated by UV light and TiO<sub>2</sub>.
  - Manufacturing improvements: Instead of dangerous perchloric acid to make the TiO<sub>2</sub> emulsion adhere to the inside of the bottles, through testing ten alternatives, Eric found that sodium acetate worked just as well and is much safer to use. Using the stoichiometry Eric calculated, Robert made sodium acetate in Peru from baking soda and vinegar purchased in the market and coated local recycled bottles. The bottles coat well and maintain their coating in the sun. Eric's tests in Massachusetts show this film is durable and able to withstand repeated exposure to sunlight (UV) as well as repeated refills of water.
  - Storage capabilities: Using E Coli to represent bacteria contamination in untreated water, Robert has found that E. Coli do not regrow in stored water bottles that have been coated with the safer photocatalyst emulsion and exposed to the sun until the dye disappears. Robert uses an incubated growth medium for counting the bacteria in test samples. We are storing more treated bottles and will test for E. Coli after several months.
  - Indigo carmine suitability as an indicator of purity: Manuel tested the UV and visible transmissivity of the water solutions during the dye diffusion and decay processes. The dye concentration must be high enough to be seen but low enough to allow UV light penetration through the water to the photocatalyst coating on the back wall of the bottles. Experiments so far indicate that the dye is a good indicator of the destruction of harmful organisms and chemicals since the dye is destroyed along with the other chemicals. Both the dye and TiO<sub>2</sub> are classified as food additives by the FDA.
  - Commercialization: Robert is in Peru until September 1, 2008 and is refining the manufacturing process of coating the bottles. He will try to start a small microenterprise in an appropriate village. Undergraduates developed a business plan for the bottles as a project in a business school course in innovations, taught by Professor Steve Tello.
- Village Empowerment: Two more trips were made to Peruvian villages, in January and June 2008, with 18 and 15 students/volunteers, respectively. For the first time, four other UML faculty members besides the director also made the trips this year. And for the first time in ten years, the director did not make a trip because of heart bypass surgery in December. We now have over 80 systems in 44 different villages in the same region. The villages in general have no electricity, no telephone service, no space heating, biweekly bus transportation, and untreated water, in several cases only from open streams. The systems, which harvest energy with photovoltaic modules, solar thermal collectors, and microhydro turbines and in some cases from the grid, provide radio transceiver communication, lights, vaccine refrigerators and other medical devices, water supply and water purification, roads, aquaculture fish,



laptop computers, and science experiments in schools, medical clinics, and municipalities. (<http://energy.caeds.eng.uml.edu/peru-07/index.shtm>) Some of the systems have dramatic impacts. For example, in perhaps the most remote village of the group, Huallmi, with no electricity and no telephone, in the six months prior to our installing a transceiver radio in the medical clinic in January 2006 there were seven deaths related to childbirth due to delays in getting medical help; from January 2006 to our return in June 2006 there were no deaths in childbirth. Technologies developed and installed with graduate and undergraduate students as well as volunteers during the past year include:

- Inexpensive radio transceivers for medical clinics, most solar powered. To date, 37 radio systems have been installed.
  - Solar pumping systems for water supply for whole villages.
  - Solar drip irrigation system to double yields.
  - Biodigester for methane gas production, with low cost plastic tube.
  - Physical therapy workshops for students in a special needs school, town people, and medical staff in three towns.
  - Prenatal clinic equipment, exercise programs, and health education for two hospitals.
  - Composting toilet.
  - Low cost more efficient wood stoves (courtesy of IIT student David Curtin)
  - Video and written documentation of projects, students, and the local people.
- Service-Learning Integrated throughout a College of Engineering: SLICE. The goal here is integrate service-learning (S-L) projects into mainstream required courses in the engineering programs so that every student has at least one course every semester with S-L. To date, over half the engineering faculty (along with a few others in other colleges) have tried S-L in at least one course. Over fifty courses have had S-L integrated so far. The center director is the faculty coordinator for this project. (<http://slice.uml.edu>)
  - Collaboration with the Tohono O'odham reservation in southern Arizona. About 11,500 members live on the reservation which is the size of the state of Connecticut, second to the Navajo reservation, also in Arizona. There are an estimated 10,000 families on reservations in Arizona without electricity. The center is helping UML students design adaptations to bathroom modules that the TO tribal college students are building for families without proper sanitary facilities. The adaptations are for homes without electricity and running water. Solar hot water systems, evaporative coolers, composting toilets, and photovoltaic systems were designed by four ME seniors for a spring semester capstone course and by Vivian Crespo for her MS thesis. Funding has been obtained for the project through Lyvier Conss of the Community College National Center for Community Engagement in Phoenix. Trips are planned for August and October to work with the instructors and students at the TO tribal college in building a prototype of the bathroom module.

There are many other current projects mentioned in various other sections under students, publications, grants, etc.



## 8. Publications

Duffy, John, Linda Barrington, Cheryl West, John McKelliget, Eugene Niemi, Sammy Shina, Hongwei Sun, Chris Niezrecki, Robert Parkin, Majid Charmchi, Peter Avitabile, 2007, "Service-Learning in Core Courses throughout a Mechanical Engineering Curriculum," *Proceedings American Society of Engineering Education Annual Conference*. (refereed)

Duffy, J., D. Kazmer, L. Barrington, J. Ting, C. Barry, Z. Zhang, D. Clark, A. Rux, 2007, "Service-Learning Integrated into Existing Core Courses throughout a College of Engineering," *Proceedings American Society of Engineering Education Annual Conference*. (refereed)

Barrington, L, and J. Duffy, 2007, "Attracting Underrepresented Groups to Engineering with Service-Learning," *Proceedings American Society of Engineering Education Annual Conference*. (refereed)

Kazmer, D., J. Duffy, L. Barrington, and B. Perna, 2007, "Introduction to Engineering through Service-Learning," *Proceedings of the ASME 2007 International Design Engineering Technical Conferences*, IDETC/DEC- 34491. (refereed)

Barrientos, J., U. Bhattacharjee, T. Martinez, and J. Duffy, 2007, "Green Buildings in Massachusetts: Comparison between Actual and Predicted Energy Performance," *Proceedings Annual Meeting American Solar Energy Society*.

Heredia, M., and J. Duffy, 2007, "Photocatalytic Destruction of Water Pollutants using a TiO<sub>2</sub> Film in PET Bottles," *Proceedings Annual Meeting American Solar Energy Society*.

Dubro, P., and J. Duffy, 2007, "Dye Indicator for the Effectiveness of TiO<sub>2</sub> Water Purification," *Proceedings Annual Meeting American Solar Energy Society*.

Bhattacharjee, U., C. Lin, R. Williams, and J. Duffy, 2008, Solar Energy Education with Service-Learning: Case Study of a Freshman Engineering Course, *Proceedings Annual Meeting American Solar Energy Society*. (refereed)

Duffy, J., 2008, Village Empowerment: International Service-Learning. Paper AC 2008-1163 *Proceedings of the American Society of Engineering Education Annual Meeting*. ASEE. (refereed)

Duffy, J., C. Barry, L. Barrington, D. Kazmer, W. Moeller, and C. West, 2008, Service-Learning Projects in 35 Core Undergraduate Engineering Courses. Paper AC 2008-1525, *Proceedings of the American Society of Engineering Education Annual Meeting*. ASEE. (refereed)

Burack, C., J. Duffy, A. Melchior, and E. Morgan, 2008, Engineering Faculty Attitudes Toward Service-Learning, Paper AC 2008-1521, *Proceedings of the American Society of Engineering Education Annual Meeting*. ASEE. (refereed)

Mgbemene, C., J. Duffy, H. Sun, and O. Onyegegbu, 2008, Electricity Generation from a Compound Parabolic Concentrator Coupled to a Thermoelectric Module, Paper ES2008-54122, *Proceedings of the ASME 2nd International Conference on Energy Sustainability*. ASME. (refereed)



- ◆ Published theses based on work at the center (degrees awarded by the university):
  - N'To Diarra, Design of Stochastic PV Water Pumping Systems (PhD 2007)
  - Jorge Barrientos, Environmental and Energy Impacts of Grid-Connected Photovoltaic Systems in Massachusetts (MS 2007)
  - Tanya Martinez, Total Renewable Energy Resource Utilization Analysis for Northeastern New Brunswick (MS 2008)

## 9. Conference Presentations

- ◆ Duffy, John, Linda Barrington, Cheryl West, John McKelliget, Eugene Niemi, Sammy Shina, Hongwei Sun, Chris Niezrecki, Robert Parkin, Majid Charmchi, Peter Avitabile, 2007, "Service-Learning in Core Courses Throughout a Mechanical Engineering Curriculum," *American Society of Engineering Education Annual Conference*. (L. Barrington presented)
- ◆ Duffy, J., D. Kazmer, L. Barrington, J. Ting, C. Barry, Z. Zhang, D. Clark, A. Rux, 2007, "Service-Learning Integrated into Existing Core Courses throughout a College of Engineering," *American Society of Engineering Education Annual Conference*. (L. Barrington presented)
- ◆ Barrington, L, and J. Duffy, 2007, "Attracting Underrepresented Groups to Engineering with Service-Learning," *American Society of Engineering Education Annual Conference*. (L. Barrington presented)
- ◆ Barrientos, J., U. Bhattacharjee, T. Martinez, and J. Duffy, 2007, "Green Buildings in Massachusetts: Comparison between Actual and Predicted Energy Performance," *Annual Meeting American Solar Energy Society*. (J. Barrientos presented)
- ◆ Heredia, M., and J. Duffy, 2007, "Photocatalytic Destruction of Water Pollutants using a TiO<sub>2</sub> Film in PET Bottles," *Annual Meeting American Solar Energy Society*. (M. Heredia presented)
- ◆ Dubro, P., and J. Duffy, 2007, "Dye Indicator for the Effectiveness of TiO<sub>2</sub> Water Purification," *Annual Meeting American Solar Energy Society*. (J. Duffy presented)
- ◆ Duffy, J., 2007, "Village Empowerment Project: Collaboration with Indigenous Peoples," invited presentation, Tohono O'odham Community College, Sells, AZ. (J. Duffy presented)
- ◆ Bhattacharjee, U., C. Lin, R. Williams, and J. Duffy, 2008, Solar Energy Education with Service-Learning: Case Study of a Freshman Engineering Course, *Proceedings Annual Meeting American Solar Energy Society*. (J. Duffy presented)
- ◆ Duffy, J., 2008, Village Empowerment: International Service-Learning. Paper AC 2008-1163 *Proceedings of the American Society of Engineering Education Annual Meeting*. ASEE. (K. Vedula presented)
- ◆ Duffy, J., C. Barry, L. Barrington, D. Kazmer, W. Moeller, and C. West, 2008, Service-Learning Projects in 35 Core Undergraduate Engineering Courses. Paper AC 2008-1525, *Proceedings of the American Society of Engineering Education Annual Meeting*. ASEE. (K. Vedula presented)



- ◆ Burack, C., J. Duffy, A. Melchior, and E. Morgan, 2008, Engineering Faculty Attitudes Toward Service-Learning, Paper AC 2008-1521, *Proceedings of the American Society of Engineering Education Annual Meeting*. ASEE. (K. Vedula presented)

## 10. Collaboration with other Centers/Institutes and/or Departments

The center collaborates with approximately 35 faculty members through the SLICE and Village Empowerment projects mainly in developing S-L projects in undergraduate and graduate courses, including faculty in the college of health, college of arts and science, and the business school. ( <http://slice.uml.edu> )

## 11. Regional/Local Outreach (Other Institutes of Higher Education, Industries, Government Agencies, schools, etc.)

The center collaborates with at least 12 local community partners in S-L projects (<http://slice.uml.edu>). Of course, we collaborate with various government bodies (Ministry of Health, Ministry of Education, and local town governments) in 44 villages in Peru. Other collaborative endeavors with other universities are mentioned under the faculty and publication sections above.

## 12. Proposals submitted/Awarded 2007/2008

Proposals submitted include:

- ◆ NSF International Research and Education in Engineering Program
- ◆ EPA P3
- ◆ Encore Foundation

Grants obtained include:

- Implementation of Service-Learning Integrated throughout a College of Engineering (SLICE); J. Duffy PI, sponsor: NSF (\$1,005,000; 2005-09) no-cost extension
- NSF International Research and Education in Engineering Program, supplement to SLICE grant (\$31,480; 2007-08)
- Solar Water Purification Bottles with Dye Indicator for Developing Countries; sponsor: National Collegiate Inventors and Innovators Alliance (\$17,500; 2007-2008)
- International Service-Learning Project in the Colleges of Health and Engineering, Healy public service grant, UML (\$9600, 2007-09) with Deirdra Murphy and Nicole Champagne

### Center contact:

John Duffy, Professor  
Mechanical Engineering Department  
University of Massachusetts Lowell  
One University Ave., Lowell, MA 01854  
978-934-2968; FAX: 978-934-3048  
e-mail: [John\\_Duffy@uml.edu](mailto:John_Duffy@uml.edu)  
<http://energy.caeds.eng.uml.edu>

(Draft report written July 28, 2008 by John Duffy)



## 21. CENTER FOR WOMEN & WORK (CWW) Annual Report for 2007- 08 Meg A. Bond, Ph.D., Director

### **I. MISSION OF THE UML CENTER FOR WOMEN & WORK**

The Center for Women and Work (CWW) at the University of Massachusetts Lowell is a vibrant community of scholars – representing diverse disciplines – who are dedicated to the Center’s mission to:

- Advance knowledge about the relationship between gender and work through research
- Enhance understanding of this relationship through education and training
- Challenge inequalities, particularly at its roots, through institutional change

### **II. GENERAL DESCRIPTION & GOALS**

Since its inception in 1998, the Center for Women and Work has demonstrated its strong commitment to addressing the gendered conditions of work in several key ways: by designing and implementing programs and projects that foster new ways of thinking about the gendered conditions of work; by encouraging and supporting interdisciplinary linkages across and throughout all of our networks; and by bringing to the forefront the reciprocal relationship between women’s work and the well-being of communities.

### **III. ASSOCIATED PERSONNEL (2007- 08)**

*\*\* indicates new affiliations for 07-08*

#### **Leadership Team**

Meg A. Bond, Professor, Department of Psychology  
Laura Punnett, Professor, Department of Work Environment; Co-Director, Kerr Ergonomics Institute  
Jean L. Pyle, Professor Emerita, Department of Regional Economic & Social Development  
Paula Rayman, Professor, Department of Regional Economic & Social Development

#### **CWW Associates**

\* Rachel DeMotts, Assistant Professor, Department of Regional Economic & Social Development  
Mignon Duffy, Assistant Professor, Department of Sociology  
\* Monica Galizzi, Associate Professor, Department of Economics  
Andrew Hostetler, Assistant Professor, Department of Psychology  
Michelle Haynes, Assistant Professor, Department of Psychology  
Sarah Kuhn, Associate Professor, Department of Regional Economic & Social Development  
Cheryl Najarian, Assistant Professor, Department of Sociology  
Sharon Wasco, Assistant Professor, Department of Psychology (Associate on leave)

#### **CWW Affiliates**

Maria Julia Brunette, Assistant Professor, Department of Work Environment  
Pia Markkanen, Research Associate, Department of Work Environment  
Susan Moir, Director, Labor Resource Center, UMass Boston  
\* Margaret Scarsdale, Alumna, Departments of American Studies & Sociology



Imogene Stulken, Protestant Campus Minister  
Susan Thomson, Germaine Lawrence Services  
Robin Toof, Assistant Director, Center for Family, Work, & Community  
Susan Winning, UMass Lowell Labor Extension Program

### **Working W.I.S.E. Project Staff**

Jody Lally, Project Director

### **Undergraduate and Graduate Students**

Maria Aguiar, Undergraduate Work Study Student  
Ekaterina Konovalova, Department of Psychology  
\* Rebecca Edwards, Department of Psychology  
\* Olga Guerrero, Undergraduate Work Study Student  
\* Stacie Hargis, Department of Regional Economic & Social Development  
\* Eika Hunt, Department of Regional Economic & Social Development  
\* Kahna Net, Department of Regional Economic & Social Development  
\* Sharon Therrien, Department of Psychology

## **IV. CURRENT FOCUS AREAS: RESEARCH AND ACTION PROJECTS**

**Our current research and action projects reflect the three strategic priorities that comprise our mission.**

Strategic Goal #1: Advancing Knowledge: To promote research and scholarship that will advance our understanding of the relationship between gender and work.

### **1) CWW Associates Program**

At the heart of CWW is the Associates Program, which serves as a hub for scholarly projects and helps expand the overall resource base for work that forwards the mission of CWW and the University of Massachusetts Lowell. The program promotes creative linkages across disciplines, supports grant writing within this network, and fosters collaborations with national and international professional networks. CWW Associates are all active in disseminating CWW scholarship to local, regional, and national audiences.

### **2) Center-Sponsored Research Programs**

In addition to the Associates Program, CWW currently has three core, center-sponsored research endeavors, each of which involves *interdisciplinary* collaborations.

- **Carework: People, Policies, and Politics**

The research focus of many CWW Associates revolves around the theme of “carework,” i.e., paid and unpaid caring for other people in various forms. Given our shared interests, CWW is working on several new initiatives on this theme, including spearheading an inter-campus carework policy agenda and compiling an edited volume on women, work, and caregiving. (Lead faculty: Mignon Duffy & Andrew Hostetler)

- **Women in Science, Technology, Engineering, and Mathematics**

Faculty associated with CWW have a depth of expertise and experience working on the issues facing women in science, technology, engineering and math (STEM) fields. For example, the *Working WISE Project*, funded by the National Science Foundation, brought together intergenerational scholars from diverse disciplines in order to foster dialogue among leading experts regarding workplace factors associated with women’s



success in STEM. Working WISE is currently actively engaged in diffusion of the results of this conference. Given its expertise on this topic, CWW is involved in university-wide conversations about an institutional change project at UMass Lowell aimed at increasing supports for women in STEM fields. (Lead faculty: Paula Rayman, Maju Brunette, & Meg Bond)

- ***Gendered Work Climates, Discrimination, and Health***

This research program is a multi-year collaboration between CWW and the Kerr Ergonomics Institute (KEI) and now also includes the new Center for the Promotion of Health in the New England Workplace (CPH-NEW) at UML. It focuses on researching the links between work climate, discrimination, and harassment against women in the workplace, and the impact this has on levels of stress, adverse health outcomes, and increased business costs (due to higher absenteeism, increased turnover, lowered productivity, and higher worker healthcare costs). (Lead faculty: Laura Punnett & Meg Bond)

**Strategic Goal #2: Enhancing Understanding: To further intellectual inquiry about issues related to women and work among students and to support the professional development of a cohort of junior scholars able to generate their own scholarship on women and work.**

- 1) **Graduate Certificate on Diversity in the Workplace**

The CWW-sponsored interdisciplinary graduate certificate program on Diversity in the Workplace was formally approved in the Spring of 2008. The new certificate program includes courses in Psychology, RESD, Work Environment, and Education. The program will be launched in Fall 2008; the Program Coordinator is Michelle Haynes, Department of Psychology.

- 2) **Involvement of Students in CWW Projects**

We have been able to involve students in a wide range of projects relate to women and work. Some students are in paid positions – e.g., grant-funded; CFCI-sponsored RAs; Psychology Department-funded TA; workstudy students – and some contribute their time on a volunteer basis. Each year 10-15 students get involved with CWW-related projects. We also have a commitment to more generally support the professional development of women students at UML and have done so through workshops and open discussion times.

- 3) **Maintaining an Interdisciplinary Space**

CWW's office is frequented by graduate students from Psychology, RESD, and Work Environment. We have computers available for general student use, and keep our offices open all week with the help of TAs and work-study students so that the university community can use our space to gather informally. CWW has also made our conference room available for regular meetings of faculty and student groups such as Gender Studies and a support group for Junior Faculty. We have joined with Political Science/Model Leagues Program, Gender Studies, and Cultural Studies.

- 4) **On-going collaboration with the Laboratory for Interdisciplinary Design (LID)**

The LID, which is physically adjacent to CWW, is an unusual teaching and learning space, supporting interdisciplinary, collaborative, active learning, and service learning. The LID can support projects on issues of particular concern to women; it also supports improved pedagogy, which research shows can help retain women in technical fields.



As Coordinator of LID, Sarah Kuhn (also CWW Associate) has been spearheading the development of curriculum to support new teaching merging the technical and the social.

Strategic Goal #3: Challenging Inequalities: To seek remedies for gender-based inequality in the workforce through disseminating information and promoting institutional change, including within our own institution.

1) Annual “Gathering at the Well” Forum

CWW sponsors an annual forum entitled “Gathering at the Well” that is attended by many from the greater Lowell community as well as UML faculty, staff, and students. We selected this imagery because historically women gathered at the well to collect water and share common issues. They turned what is often an onerous task into a source of strength. The CWW Forum, “Gathering at the Well,” is designed to tap into that strength by promoting dialogue on issues of women and work and striving for awareness and solutions. The Forum is typically co-sponsored by the Psychology Department and Protestant Campus Ministry, and funded in part by the UML Council on Diversity and Pluralism. The Forum organizing committee is chaired by CWW Affiliate Imogene Stulken, Protestant Campus Ministry.

**2) Open Forums on Women and Work**

In addition to the annual forum, CWW works to enhance understanding of women and work issues through other types of educational programs. The Center sponsors several events open to the university and community each year on topics of relevance. We typically organize at least one event during Lowell Women’s Week, and we often sponsor other community forums in partnership with other organizations – both on campus (e.g., Gender Studies, CFWC, Dept of Work Environment, Center for Health Promotion) and off (e.g., American Association of University Women, Massachusetts Commission on the Status of Women, Local Chapters of the National Organization for Women).

**3) Publications and Outreach**

The Center for Women and Work produces and distributes two issues yearly of a newsletter, *Perspectives*. This publication includes articles about all aspects of the Center’s activities. The newsletter is mailed to about 1,300 individuals from all over the world.

**4) Support a Community of Equity at UMass Lowell**

In collaboration with the UMass Lowell Labor Extension Program (LEP), CWW has been advocating for a campus-wide gender equity study. The call for action grew out of discussions among women representing diverse departments of the University of Massachusetts Lowell. CWW and LEP also co-sponsored two events to bring together UMass women employees. The events address such issues as work/family balance, wage equity, availability of leadership roles for women, ergonomic issues, and also personal themes familiar to women such as the stress of constant multitasking,



invisibility of one's contributions, and expectations to perform work outside the scope of one's job description.

5) **Fostering Collaborations Locally, Regionally, Nationally and Internationally**

In terms of intra-university collaborations, we have had a particularly strong relationship and on-going collaboration with the Kerr Ergonomics Institute and now with the Center for the Promotion of Health in the New England Workplace (CPH-NEW). We also work closely with the Laboratory for Interdisciplinary Design (LID). In addition, we actively collaborate and co-sponsor programs with the Center for Family, Work, and Community (CFWC), the Council on Diversity and Pluralism, and the Departments of Psychology, Work Environment, Sociology, and Regional Economic & Social Development. We also coordinate our activities and co-sponsor events with the Gender Studies Program, the Lowell Center for Sustainable Production (LCSP), the Center for Public Health Research and Health Promotion (CPHRHP), and the Peace and Conflict Studies Institute (PACSI).

In addition, CWW extends our impact through strong relationships with national and international groups, including the National Institute for Occupational Safety and Health; Brandeis University Women's Studies Research Center; Massachusetts Commission on the Status of Women; National Society for the Psychological Study of Social Issues; National Society for Community Research and Action; University of Haifa International Conference on Social Responsibility; Boston Combined Jewish Philanthropies; PEACEWORK: American Friends Service Committee; European Association for Work and Organizational Psychology; and the International Congress on Women, Work, and Health. CWW is also a member of the National Center for Research on Women. Meg Bond serves on the Middlesex Regional Council of the Massachusetts Commission on the Status of Women.

**V. RESEARCH AND PROJECT SUPPORTS (2007-08)**

**The following summarizes the 2007-08 projects and research supported and/or leveraged as a results of CFCI funding.**

**A. Student Support**

⇒ Ekaterina Konovalova - half-time graduate research assistant on CFCI funds

**B. Advancing Knowledge about Women & Work**

- ◆ Supported a lively community of scholars through the CWW Associates Program
  - Sponsored regular working paper sessions with a productive group of 11 Associates who are scholars from diverse disciplines (psychology, sociology, economics, ergonomics, public health) – two of whom were new in 07-08; six were continuing.
  - Mentored junior faculty in development of their scholarship and grant writing
  - In addition to Associates, we also have 8 Affiliates, who work on CWW-sponsored projects, from UMass Lowell (Work Environment, Protestant Campus

Ministry, Labor Extension Program, Center for Family, Work & Community) and sister organizations (Middlesex Community College, UMass Boston, Germaine Lawrence Services)

- Recognition of Associates' Accomplishments – awarded in 2007-08:
  - Dr. Monica Galizzi awarded the Eckstein Prize for the best article in *Eastern Economic Journal* during 2005-2006.
  - Dr. Galizzi received the *Teaching Innovation Program (TIP) Certificate of Achievement* of the American Economics Association Committee on Economic Education, sponsored by NSF
  - Dr. Paula Rayman received a Fulbright Senior Scholar Award for her sabbatical work in Haifa, Israel.
  - Dr. Laura Punnett elected Chair (2007-2010) of the Scientific Committee on Musculoskeletal Disorders of the International Congress on Occupational Health
- During 2007-08, CWW Associates have:
  - Developed and expanded grant-funded projects (see also Section VI below)
  - Supervised graduate student projects on such topics as issues facing women in science and technology careers, caring for survivors of rape, redefining aging in the community
  - Published 3 authored or edited books and special journal issues
  - Published 18 journal articles and 13 book chapters, and made over 30 individual presentations to professional audiences
- ◆ Received continuation funding from the National Science Foundation for the *Working WISE Project: Follow-up to April 2007 Conference on “Intergenerational Voices on Women in Science and Engineering”* (Drs. Paula Rayman, Maria Brunette, & Meg Bond)
  - Focusing on dissemination efforts through web and print media
  - Editing compilation of papers outlining recommendations for future research directions to address barrier to women in STEM fields - anticipated completion October 2008
  - Presentations at regional, national and international conferences (National Science Foundation Joint Annual Meeting, American Society of Engineering Education, American Psychological Association, European Association for Work and Organizational Psychology, National Organization for Women Summit on Economic Justice for Women, Women in Engineering Programs & Advocates Network)
- ◆ Meg Bond invited to serve on a national advisory board for the American Association of University Women (AAUW) to guide their development of a proposal to the NSF Program *Gender in Science and Engineering* to develop a new research report highlighting key research findings on gender equity in STEM.
- ◆ Established the Massachusetts Care Policy Network (Dr. Mignon Duffy in collaboration with Drs. Randy Albelda from UMass Boston, & Nancy Folbre from UMass Amherst)
  - Received \$35,000 from the UMass President's Creative Economy Fund to support collaborative work with UMass Boston and Amherst
  - Convened the two meetings of the Care Network at CWW in October 2007 and May 2008, with scholars from several Massachusetts universities (including



UMass Lowell, Boston, and Amherst as well as Tufts, Brandeis, and Boston College)

- Critical goal is to generate scholarship to influence state-level policy
  - Identifying additional funding sources to support a report on the status of carework in Massachusetts
- ◆ Obtained funding of nearly \$100,000, including a two-and-a-half-year grant from the Massachusetts Department of Public Health, for *Lowell Seniors Count*, a large-scale university-community partnership to assess the needs and well-being of Lowell adults 60+ years of age (Dr. Andrew Hostetler)
  - ◆ Began work on an edited volume on carework (Drs. Andrew Hostetler, Mignon Duffy, & Meg Bond)
  - ◆ Received \$2,500 grant from UMass Boston Center for Women in Politics and Public Policy for research on work-family issues for politicians (Dr. Cheryl Najarian)
  - ◆ Forwarded a *Healthy Organizational Diversity Project* (lead: Dr. Meg Bond)
    - *Workplace Diversity: Promoting Diversity through Organizational Change* by Meg Bond published October 2007
    - Completed pilot studies of 4 community-based organizations in Fall 2007
    - Drafted proposal for a study of diversity within community-based organizations, now being developed for submission to targeted foundations
  - ◆ Advanced the idea of sponsoring a Public Radio *Story Corps* Outpost in Lowell (Drs. Michelle Haynes & Meg Bond) focused on collecting personal narratives about the role of work in the lives of women and immigrants
    - Developed a partnership with the Tsongas Industrial History Center, the National Park Service, and the UML Center for Family, Work and Community to advance this initiative
    - Submitted a two-year proposal to the Edson Parker Foundation – decision anticipated in September 2008
    - Submitted a proposal to the UMass President's Creative Economy Fund – not funded
    - Seeking additional foundation support to launch the project
  - ◆ Associates made presentations at local, regional, national and international meetings

### **C. Enhancing Understanding through Education and Training**

- ◆ Established a new Graduate Certificate Program on *Diversity in the Workplace* (Coordinator: Dr. Michelle Haynes)
  - Obtained participation and approval from the Departments of Psychology, Regional Economic and Social Development, and Work Environment
  - Received final approval from the Faculty Senate in March 2008
  - Will launch the certificate in Fall 2008 with a graduate course on Workplace Diversity in the Department of Psychology (taught by Dr. Meg Bond)
  - Developing a plan for marketing the program, including the design and distribution of a new brochure



- ◆ Hosted the 10<sup>th</sup> Annual *Gathering at the Well Forum* (April 3<sup>rd</sup>, 2008)
  - Designated as a part of Chancellor Meehan's Inauguration Week
  - Adopted the timely theme of: *Reframing Homeland Security: Building a CWW Agenda for Justice and Care at Home, at Work, & in the Community*
  - Featured as keynote speaker Dr. Cynthia Enloe, Professor of International Development & Women's Studies, Clark University
  - Produced an iMovie that highlights the scholarly work of CWW Associates
  - Attracted over 100 participants from both the University and the community
  
- ◆ Surveyed all students who have worked with the Center for Women and Work over the past 10 years
  - Inquired about their reflections on their experiences at CWW as well as how CWW helped to prepare them for their current work
  - Developed detailed profiles of eight alumnae
  - Publishing profiles and survey results in a special edition of the CWW newsletter, *Perspectives* (Fall 2008)
  - Featuring profiles on the CWW website
  - Plans underway to publish profiles in the UML Alum Magazine

#### **D. Advanced Systemic Change to Support Gender Equity**

- ◆ Launched a series of meetings with UML administration about a campus gender equity study for both staff and faculty
  - Submitted a proposal in collaboration with the UMass Lowell Labor Extension Program
  - Received a formal indication from Chancellor Meehan – at our fall Advisory Board meeting – that such a study is a priority for his administration
  - Followed up with several meetings with Executive Vice Chancellor Jacqueline Moloney
  
- ◆ Participating in university-wide team developing the NSF ADVANCE grant application to address gender equity issues in STEM fields at UML
  - Leadership role in the development of faculty survey on perceptions of the climate for diversity at UML (Drs. Meg Bond & Laura Punnett)
  
- ◆ Began a new partnership with the UML Labor Extension Program, called *Voices of Working Women UML (VOWW)*
  - Co-sponsored a staff-faculty breakfast to share issues faced by women employees all across the university (November 9, 2007)
  - Co-hosted a lunch on the theme of work-life balance for women employees during the Lowell Women's Week (March 6, 2008)
  - Both events were very well received and resulted in a list of priorities for improving the work climate for UML female employees
  
- ◆ Represented UMass Lowell, along with Oneida Blagg (Director, Equal Opportunity and Outreach) at the launch of the *Commonwealth Compact*, a statewide initiative to “to make Massachusetts a location of choice for people of color.” (May 23, 2008)



- ◆ Hosted the 2008 Annual meeting of the Massachusetts Chapter of the American Association of University Women (AAUW) on the theme of “Challenges in a New Land: Immigration, Women and their Families.” (February 2, 2008)
- ◆ Served as a *supporting organization* for the Fourth Annual State-wide Massachusetts Conference for Women, sponsored by the Massachusetts Commission on the Status of Women (Boston, December 11, 2007).
- ◆ Served as a *supporting organization* for a conference on “Women, Work and Wages sponsored by the UMass Boston Center for Women in Politics & Public Policy (June 9, 2008).

#### **E. Building an Extended Community of Support for CWW**

- ◆ Formed a New Advisory Board
  - Convened first meeting in September 2007
  - Held individual consultation meetings with Advisory Board members during Spring 2008
- ◆ Established a financial planning committee
  - Developed a new financial plan
  - Established close working relationship with University Advancement Office to coordinate development work
- ◆ Initiated a fund drive for our CWW 10<sup>th</sup> Anniversary Fund
  - Set a goal of \$25,000 in order to qualify for matching funds
  - Sent solicitation letters to our mailing list of 1,300 in December and February
  - Have 100% participation from the CWW Leadership Team
  - Have received donations and pledges of over \$10,000 thus far
- ◆ Kicked off the CWW 10<sup>th</sup> anniversary celebration with our first-ever “*Women’s Works*” on November 30, 2007. This was an event that:
  - Gathered together women from all corners of the university to celebrate UML women’s creative accomplishments from art to scholarship
  - Forged new relationships with many UML women not previously connected to CWW including a partnership with North Campus staff
  - Resulted in an invitation from Chancellor Meehan for artists from “*Women’s Works*” to display their art at the Allen House.
  - Raised funds to support our work (~\$1,600)
- ◆ Formed a planning committee for a 2008 special anniversary event
  - Established October 23, 2008 as the date for a celebrative breakfast event
  - Will feature Niki Tsongas
  - Established theme of “Everyday Advocates for Working Women”
  - Will honor a wide range of women who have made a difference in multiple arenas
- ◆ Invested in additional outreach



- Significantly revamped the CWW Web Site: <http://www.uml.edu/centers/women-work/>
- Created a new CWW poster display, to use at all upcoming events
- Published and distributed a biannual Newsletter, *Perspectives*
- Designing a new CWW brochure and marketing materials

## VI. Summary of 2007-08 Grants & Contracts

### **Funding received:**

\$40,000 Grant from the National Science Foundation for the Working WISE Project to fund dissemination of a 2007 Conference on “Intergenerational Voices on Women in Science and Engineering” (Drs. Paula Rayman, Meg Bond, & Maria Brunette)

\$35,000 Grant from the UMass President’s Creative Economy Fund to support collaborative work with UMass Boston and Amherst to generate a report on the status of carework in Massachusetts (Drs. Mignon Duffy, Randy Albelda, & Nancy Folbre)

\$87,500 Grant from the Massachusetts Department of Public Health (Office of Health Equity) & \$10,000 Grant from the Massachusetts Partnership for Healthy Communities to support a two and a half year project called *Lowell Seniors Count*, a large-scale university-community partnership to assess the needs and well-being of Lowell adults 60+ years of age (Dr. Andrew Hostetler)

\$2,500 grant from UMass Boston Center for Women in Politics and Public Policy for research on work-family issues for politicians (Dr. Cheryl Najarian)

\$6,440 Grant from the Committee of Federated Centers and Institutes to support a half-time Research Assistant.

\$1,000 Grant from the UML Council on Diversity and Pluralism to sponsor the Spring 2007 *Gathering at the Well Forum*

### Other proposals submitted:

1. Parker Foundation: to support a “StoryCorps” Project to collect stories from the greater Lowell community about women and immigrants’ experiences around work. The project is a collaboration between CWW, the Tsongas Industrial History Center and the Lowell National Park. Decision pending (should know in September 2008).
2. 2008-09 President’s Creative Economy Fund: To support the StoryCorps Project. Not funded.

## VII. PUBLICATIONS & PROFESSIONAL PRESENTATIONS (July 2007- June 08)

### CWW Working Papers

**Brunette, M. J., Rayman, P., Bond, M., & Yuan, L. (2007).** A Delphi study to structure a working conference on women’s success in science, technology, engineering, and mathematics (STEM) fields. *Center for Women & Work Working Paper Series, WP07-02.*



**Haynes, M. C.,** & Heilman, M E. (2007). Perceptions of Affirmative Action (AA): Implications for attitudes towards AA and its psychological consequences. *Center for Women & Work Working Paper Series*, WP07-03.

**Thomson, S.** (2007). The care tetrahedron: Portraits of elder care in the United States. *Center for Women & Work Working Paper Series*, WP07-04.

**Wasco, S. M.,** Knight, M. K., Fernández, M. C., Twarog, K. E., Norcross, H. L., Martin, K. C., de Laubenfels, M. J. (2007). Reactions to rape research: Examining upset and regret among ethnicity diverse college women. *Center for Women & Work Working Paper Series*, WP07-01.

### **Books, Monographs & Edited Journal Issues**

**Bond, M.A.** (2007). *Workplace Chemistry: Promoting Diversity through Organizational Change*. Hanover, NH: University Press of New England.

**Bond, M.A., Kalaja, A., Markkanen, P., Cazeca, D., Daniel, S., Tsurikova, L., & Punnett, L.** (2008). *Expanding Our Understanding of the Psychosocial Work Environment: A Compendium of Measures of Discrimination, Harassment & Work-Family Issues* National Institute for Occupational Safety and Health (NIOSH), US DHHS, Cincinnati OH, DHHS (NIOSH) Pub. No. 2008-104.

Dinh, K. & **Bond, M.A.** (Eds.) (in press). Special journal issue on “The Other Side of Acculturation; Changes among Host Individuals and Communities in their Adaptation to Immigrant Populations.” *American Journal of Community Psychology*.

### **Journal Articles**

Choi, B.K., Kawakami, N., Chang, S.J., Koh, S.B., Bjorner, J., **Punnett, L.**, & Karasek, R. (in press: Mar 2008) A cross-national study on the multidimensional characteristics of the five-item psychological demands scale of the Job Content Questionnaire. *International Journal of Behavioral Medicine* (MS# 054-06).

Cifuentes, M., Gore, R., Boyer, J., Tessler, J., d’Errico, A., Scollin, P., Lerner, D., Kriebel, D., **Punnett, L.**, & Phase in Healthcare Research Team. (2007). Inter-method agreement between O\*NET and survey measures of psychosocial exposure among healthcare employees. *American Journal of Industrial Medicine*, 50(7), 545-553, doi: 10.1002/ajim.20480.

Cifuentes, M., Boyer, J., Gore, R., d’Errico, A., Scollin, P., Tessler, J., Lerner, D., Kriebel, D., **Punnett, L.**, Slatin, C., & PHASE in Healthcare Research Team. (2008) Job strain predicts survey response in healthcare industry workers. *American Journal of Industrial Medicine*, 51(4), 281-9.

Cifuentes, M., Sembajwe, G., Tak, S.W., Gore, R., Kriebel, D., & **Punnett, L.** (2008) Association of major depressive episodes with income inequality and the human development index. *Social Science & Medicine* (accepted 14 Mar 2008).

**DeMotts, R.** (2008). Mitigating an elephantine epidemic: gendered space for HIV/AIDS outreach through Namibian conservancies, *Population and Environment*. Available online 11 April 2008; paper version forthcoming.



d'Errico, A., **Punnett, L.**, Cifuentes, M., Boyer, J., Tessler, J., Gore, R., Scollin, P.A., Slatin, C., Phase in Healthcare (2007). Hospital injury rates in relation to socioeconomic status and working conditions. *Occupational and Environmental Medicine*, 64, 325-333, doi: 10.1136/oem.2006.027839.

d'Errico, A., Gore, R., Gold, J.E., & **Punnett, L.** (2008) JCQ scale reliability and responsiveness to changes in manufacturing process. *American Journal of Industrial Medicine*, 51(2),138-47.

**Duffy, M.** (2007). Doing the dirty work: Gender, race, and reproductive labor in historical perspective. *Gender & Society*, 21 (3), 313-336.

**Hostetler, A. J.** (in press). Single by choice? Assessing and understanding voluntary singlehood among mature gay men. *Journal of Homosexuality*.

**Hostetler, A. J.** (2008). Educational careers, returning to school, and work-family concerns. *Sloan Work & Family Encyclopedia*, 23p. (peer-reviewed electronic encyclopedia).

**Hostetler, A. J.**, Sweet, S., & Moen, P. (2007). Gendered career paths: A life course perspective on returning to school. *Sex Roles*, 56(1/2).

**Galizzi, M.**, Zagorsky, J. (2008). How Do On-the-Job Injuries and Illnesses Impact Wealth? Forthcoming on *Labour Economics*

**Kuhn, S. & Rayman, P.** (forthcoming). Software and internet industry workers in Massachusetts: Findings and implications for the future of work. *The New England Journal of Public Policy*. (Reprinted from book chapter, see below)

MacDonald, L.A., Harenstam, A., Warren, N.D., & **Punnett, L.** (2008) Incorporating work organization into occupational health research: An invitation for dialogue. *Occupational and Environmental Medicine* 65:1-3..

Myers, D., Kriebel, D., Wegman, D.H., Karasek, R.A. **Punnett, L.** (2007). The social distribution of risk at work: Acute injuries and physical assaults among healthcare workers working in a long-term care facility. *Social Science & Medicine* 64, 794-806.

**Najarian, C. G.** (2008). Deaf women: Educational experiences and self identity. *Disability & Society* 23 (2): 117-128.

**Pyle, J. & Ward, K.** (2007). Recasting Our Understanding of Gender and Work During Global Restructuring. In Volume IV (*Globalizing Labour*) of *Globalization and Economy (I-IV)*, edited by Paul James and Robert O'Brien. London: Sage Publications, pp. 120-144. (Reprint of article originally published in *International Sociology*, 2003, special issue on Globalization, Gender, and Social Change in the 21<sup>st</sup> Century. 8(3), 461-489.)

Won E, Johnson PW, **Punnett L**, Dennerlein JT. (2007) Upper extremity biomechanics in computer tasks differ by gender. *Journal of Electromyography and Kinesiology* doi:10.1016/j.jelekin.2007.11.012.

### **Book Chapters, Technical Reports, & Conference Proceedings**



**Bond, M.A.** (2008). Gender, Race, and Class in Organizational Contexts. In Y. Altman, F. Bournois, & D. Bojie (Eds.), *Managerial Psychology*. London: Sage Publications. (Reprinted from an article originally published in the *American Journal of Community Psychology*, 1999, 27 (3).

**Bond, M.A. & Punnett, L.** (2007). Expanding our understanding of the psychosocial work environment. In M.A. Bond, et al. (Eds.), *Compendium of Diversity-Related Measures for Research in Occupational Health*. National Institute for Occupational Safety and Health (NIOSH), US DHHS, Cincinnati OH.

**Galizzi, M.** (2007, November). *On-The- Job Injuries: Employment History and Hidden Losses*. Final Report, Grant # K01 OH007999-03, National Institute of Occupational Safety and Health.

**Hostetler, A. J.** (in press). Generativity and time in the life-stories of gay men. In P. Hammack & B. J. Cohler (Eds.), *Life course and sexual identity: Narrative perspectives on gay and lesbian identities*. New York: Oxford University Press (forthcoming in 2008).

**Hostetler, A. J.** (in press). Homosexuality & bisexuality: Cultural and historical perspectives. In R. A. Shweder, T. R. Bidell, A. C. Dailey, S. D. Dixon, P. J. Miller, & J. Modell (Eds.), *The Chicago companion to the child*. Chicago: University of Chicago Press (forthcoming in 2009).

**Kuhn, S.** (2007). Evocative objects. In S. Turkle (Ed.), *Objects in mind: falling for science, technology, and design*. Cambridge, MA: MIT Press.

**Kuhn, S. & Rayman, P.** (2007). Women on the edge of change: Employees in United States information technology companies. In C. Burger (Ed.), *Reconfiguring the Firewall: A Cross-Cultural Context for Recruiting Women to IT*. A.K. Peters, Ltd.

**Kuhn, S. & Rayman, P.** (2007). Software and internet industry workers in Massachusetts: Findings and implications for the future of work. In T. Juravich (Ed.), *Future of Work in Massachusetts*. Amherst, MA: University of Massachusetts Press.

**Najarian, C. G.** (Forthcoming Spring, 2008). Feminist Disability Theory. In J. O'Brien, & E. Shapiro (Eds), *Encyclopedia of Gender and Society*. Sage Publications.

**Najarian, C. G.** (2008). Deaf Mothers: Communication, Activism, and the Family. In T. Jan, G. Llewellyn, & R. Traustadottir (Eds), *Disability and Family*.

**Najarian, C. G.** (2007). Book Review of *Not-So-Nuclear Families: Class, Gender, and Networks of Care* by Karen V. Hansen (2005). New Jersey: Rutgers University Press. Humanity & Society 31 (2-3), 291 – 293.

**Punnett L**, Cifuentes M, Sembajwe G, Tak SW, Gore R, Kriebel D. Global estimate of selected health conditions attributable to work: An analysis of the World Health Survey, 2002-2003. World Health Organization & U.S. National Institute of Occupational Safety and Health, 2008.

**Pyle, J.** (2007). Public policy and local economies: The phenomenon of secondary migration. In T. L. Pho, J. Gerson, & S. Cowan (Eds.), *Southeast Asian refugees and immigrants in the*



*mill city: Changing families, communities, institutions.* (pp. 19-38). Hanover, N.H: University Press of New England.

**Wasco, S. & Bond, M. A.** (forthcoming). Gender Issues in Community Psychology. In J. Chrisler & D. McCreary (Eds). *Handbook of Gender Research in Psychology*. London: Springer.



## **Professional Presentations**

**Bond, M.A.** (2008, June). *Building Participative, Empowering & Diverse Organizations: Challenges in Documenting Change*. Paper to be presented at the Second International Conference on Community Research and Action. Lisbon, Portugal.

Bond, M. (2008, June). *Diversity in Organizations*. Invited presentation to the Institute of Community Psychology Aotearoa. Hamilton, New Zealand.

**Bond, M.A.** & Maher, F. (2008, May). *Constructing Diversity: Cases from the Workplace and the University*. Brandeis University Women's Studies Research Center Lecture.

**Bond, M.A.** (2008, April). *Informal barriers for women in organizations*. Invited speaker on panel entitled "Women's Wage Puzzle" organized by the Acton/Concord Area Chapter of the National Organization for Women.

Boyer, J., Tessler, J., Cifuentes, M., **Punnett, L.**, & PHASE in Healthcare Team. (2007, August) *Development of an ergonomic job exposure matrix for the healthcare sector*. Sixth International Scientific Conference on Prevention of Work-related Musculoskeletal Disorders (PREMUS 2007), Boston MA.

**Brunette, M.** (2008, June). *An Intergenerational Working Conference to Define Research Questions for Future Work on Women's Success in STEM*. Women in Engineering Programs and Advocates Network (WEPAN) National Conference, Gateway to Diversity: Getting Results through Strategic Communications, St. Louis, Missouri.

Cifuentes, M., Sembajwe, G., Tak, S.W., Gore, R., Kriebel, D., & **Punnett, L.** (2008, March). *Country economic indicators and Major Depressive Episode by occupational position*. Seventh International Conference on Work, Stress and Health, American Psychological Association/National Institute for Occupational Safety and Health, Washington DC.

Cifuentes, M., Azaroff, L., & **Punnett, L.** (2008, March). *Facilitating inclusion of job strain issues by public health professionals*. Seventh International Conference on Work, Stress and Health, American Psychological Association/National Institute for Occupational Safety and Health, Washington DC.

**DeMotts, R.**, Magole, I., Haller, T., Hoon, P. & Saum, R. (2008, July). *Situating CBRNM: Successes and Shortcomings in Botswana's Community Trusts*. Paper to be presented at the Annual Meeting of the International Association for the Study of the Commons (IASC), Cheltenham, England.

**DeMotts, R.** (2008, April) *Human-Wildlife Conflict*. Invited panel speaker at the Association of American Geographers Annual Meeting, Boston, MA.

**DeMotts, R.** & Hoon, P. (2008, April) *Whose Elephants? Conserving, Compensating, and Competing in Northern Botswana*. Paper presented to the Association of American Geographers Annual Meeting, Boston, MA.

**DeMotts, R. (2008, April). The Impacts of Globalization in Africa. Presentation at the Lowell Film Festival, Lowell, MA.**



**DeMotts, R.** (2008, February). *HIV and Conservation in the Caprivi: Roles for Conservancies*. Invited talk at the University of Florida Natural Resource Management Group, Center for African Studies, Gainesville, FL.

**DeMotts, R.** (2007, November). *HIV/AIDS and Conservation in Namibia*. UML-RESO Fall Seminar Series, Lowell, MA.

**DeMotts, R.** (2007, October). Invited Junior Faculty Representative, meeting on Emerging Scholar Participation in African Studies, Annual Meeting of the African Studies Association, New York, NY, 18-21.

**DeMotts, R.** (2007, October). *A Park the Size of Italy: Room for Residents in KAZA?* Paper presented at the Annual Meeting of the African Studies Association, New York, NY. [also panel chair]

**DeMotts, R.** (2007, July). *Examining HIV: An Elephantine Epidemic in the Caprivi,* World Wildlife Fund (WWF). Invited talk as part of a symposium on HIV and Conservation, Annual Meeting of the Society for Conservation Biology, Port Elizabeth, South Africa.

**Duffy, M.** (2008, August). Invited presenter at annual meetings of American Sociological Association, thematic session on Racial Ideologies, Reflexivity, and Care Work. Boston, MA.

**Duffy, M.** (2007, August). *Building a Care Movement: Three Frames for Change*. Paper presented at Eastern Sociological Society's annual meetings. Philadelphia, PA.

Halpin, J., Buchanan, S., Orris, P., Frumin, E., Moriarty, J., Vossen, P., **Punnett, L.**, & Krause N. (2007, August) *Race/ethnicity and gender-based disparities in injury rates among U.S. hotel workers*. Sixth International Scientific Conference on Prevention of Work-related Musculoskeletal Disorders (PREMUS 2007), Boston MA.

**Hargis, S., Lally, J., Konovalova, E & the Working WISE Team.** (2008, April). *Intergenerational Voices on Women in Science and Engineering: A Working Conference to Design Research for Women's Success in STEM*. Poster presentation. Summit for Economic Justice for Women: Bringing Together Research and Advocacy – from Local to Global – to Advance Economic Justice and Empowerment for Women. Atlanta, Georgia.

**Hostetler, A. J.** (2007, August). *Choosing care, sacrificing community? Older adults and the prospects for building multicultural, intergenerational caring communities*. Paper presented at the Fifth Annual Carework Conference, New York, N.Y.

Kang, D.M., Kim, I., Kim, J., Kim, E., Koh, S.B., & **Punnett, L.** (2007, August) *Reliability and validity of questionnaire to assess labor intensification*. Sixth International Scientific Conference on Prevention of Work-related Musculoskeletal Disorders (PREMUS 2007), Boston MA.

Kurowski, A., Boyer, J., Fulmer, S., & **Punnett, L.** (2007, August) *Changes in manual handling across job titles before and after the introduction of a no-lift program in nursing homes*. Sixth International Scientific Conference on Prevention of Work-related Musculoskeletal Disorders (PREMUS 2007), Boston MA.



**Lally, J., Konovalova, E & the Working WISE Team.** (2007, August). *Intergenerational Voices on Women in Science and Engineering: A Working Conference*. Poster presentation. National Science Foundation Division of Human Resources Development 2007 Joint Annual Meeting and Poster Exhibition, Washington D.C.

**Lally, J., Konovalova, E., & the Working WISE Team** (2008, June). *Creating Institutional Change: Intergenerational Voices from Women in STEM Fields*. Poster presentation. National Science Foundation Division of Human Resources Development 2008 Joint Annual Meeting Research on Gender in Science and Engineering, Washington D.C.

MacDonald, L., Härenstam, A., Warren, N., & **Punnett, L.** (2007, August) *Work organization and risk factors for musculoskeletal disorders*. Invited keynote: Sixth International Scientific Conference on Prevention of Work-related Musculoskeletal Disorders (PREMUS 2007), Boston MA.

**Najarian, C. G.** (2008). *Deaf Women Workers: Stories of Struggle as a Linguistic Minority*. Poster presentation at the Inaugural Luncheon, University of Massachusetts Lowell, Lowell, MA.

**Najarian, C. G.** (2007, August). *Deaf Women's Work Experiences: Negotiating Gender, Ability and Theories of Resistance*. Paper presented at the Society for The Study of Social Problems Meetings, New York, NY.

**Najarian, C. G.** (2007, August). *The public and private lives of politicians: Negotiating work, family, and public policies*. Paper presented at the Fifth Annual Carework Conference, New York, N.Y.

**Punnett, L.** (2007) *Inequitable Distribution of Workplace Risks: Insights from Studying Musculoskeletal Disorders*. C. O. Sappington Memorial Lecture (Invited Keynote). American College of Occupational and Environmental Medicine, American Occupational Health Conference, New Orleans LA.

**Punnett, L.** (2007) *Socioeconomic disparities in health and in occupational exposures: Relevance for workplace health promotion and protection programs*. NORA Symposium, Midwest Center for Occupational Health and Safety, University of Minnesota, Minneapolis MN.

**Punnett L,** Cherniack MG, Henning RA, Faghri PD, Azaroff LS, Flum MR. (2007) Evidence-based strategy for integrating occupational ergonomics with workplace health promotion: The Center for the Promotion of Health in the New England Workplace. Annual Meeting, American Public Health Association.

**Punnett, L.,** Cherniack, M.G., Henning, R.A., Faghri, P.D., Flum, M.R., Lahiri, S., & Nobrega, S. (2008, March) A scientific rationale for combining workplace health promotion with occupational ergonomics. Seventh International Conference on Occupational Stress and Health, American Psychological Association/National Institute for Occupational Safety and Health, Washington DC.

**Pyle, J.** (2007, August). *Globalization and the Increase in Transnational Care Work: The Flip Side*. Paper presented at the Fifth Annual Carework Conference, New York, N.Y.

**Pyle, J.** (2007). *Human Trafficking: What Are the Issues?* University of North Florida. (Human Trafficking Awareness Week Lecture).



**Pyle, J.** (2007). *Human Trafficking: What Are the Issues?* Northeast Florida Human Trafficking Task Force, Jacksonville, FL.

**Rayman, P.** (2008, June). *Research on Gender Citation Analysis: Results and Process.* Citation Presentation. National Science Foundation Division of Human Resources Development 2008 Joint Annual Meeting Research on Gender in Science and Engineering, Washington D.C.

**Rayman, P.** (2008, June). *Beyond Coexistence: Israeli Arab-Jewish Relations.* Presentation to the Combined Jewish Philanthropies, Boston, June 20, 2008

Tak, S.W., **Punnett, L.**, Sembajwe, G., Cifuentes, M., Gore, R., & Kriebel, D. (2007, August) *Global estimate of arthritis attributable to work by occupations: An analysis of the World Health Survey, 2002-2003.* Sixth International Scientific Conference on Prevention of Work-related Musculoskeletal Disorders (PREMUS 2007), Boston MA.



22. CENTER FOR THE PROMOTION OF HEALTH IN THE NEW ENGLAND WORKPLACE  
UNIVERSITY OF MASSACHUSETTS LOWELL

**Annual Report to CFCI  
July 17, 2008**

**1. Mission Statement**

The mission of the Center for the Promotion of Health in the New England Workplace (CPH-NEW) is to integrate health protection, or occupational health and safety, and health promotion programs in the workplace. The Center will conduct several trans-disciplinary research, education and translation projects with complementary models and evaluate their health and economic benefits as well as assess the opportunities for and obstacles to this integrated approach. All CPH-NEW projects feature systematic approaches to enhancing workplace support of health-promoting behaviors and employee involvement in program development. Thus CPH-NEW seeks to advance public health by integrating two core public health areas, linking primary prevention to the workplace and the workplace to primary prevention.

**2. Description and Goals**

The Center for the Promotion of Health in the New England Workplace is a research-to-practice initiative funded for an initial five-year period (2006-2011) as a *Center for Excellence to Promote a Healthier Workforce* by the National Institute for Occupational Safety and Health (NIOSH). CPH-NEW is a cooperative initiative by investigators from the University of Massachusetts Lowell (UML) and the University of Connecticut (UC), both Storrs and Farmington campuses, along with the private sector, labor, and state government, especially the Massachusetts and Connecticut Departments of Public Health. The key academic departments are Work Environment at UML and Occupational and Environmental Medicine, Occupational Health Psychology, and Health Promotion at UC. Strengths of CPH-NEW lie in extensive collective experience in occupational health and safety, psychology, and health promotion and education; technical expertise in survey research and biostatistics; and educational and outreach infrastructure. Cross-disciplinary collaboration rests on both project- and methodology-oriented teams as well as on the investigators' strongly established relationships, with more than a decade of collaborative work across multiple academic departments and research units.

**3. Research Focus Areas**

The key topics of study within CPH-NEW are:

- a. The interaction of occupational and non-occupational risk factors in the etiology of musculoskeletal, cardiovascular, and mental health in working populations.
- b. The influence of the physical, psychosocial and organizational work environment on individual health behaviors.
- c. The importance of participatory processes in implementation of effective workplace health programs.



- d. Relative effectiveness and cost-effectiveness of separate versus integrated workplace health programs (health protection and health promotion).

#### **4. Associated Key Personnel (Faculty and Research Staff)**

##### At UML:

Dr. Laura Punnett, Center Co-Director & Professor, Dept. of Work Environment  
Dr. Nicole Champagne, Associate Professor, Dept. of Community Health and Sustainability  
Dr. Marian Flum, Project Director, Dept. of Work Environment  
Dr. Rebecca Gore, Senior Applied Statistician, Dept. of Work Environment  
Dr. Supriya Lahiri, Professor, Dept. of Economics  
Ms. Suzanne Nobrega, Project Manager, CPH-NEW

##### At UC:

Dr. Martin Cherniack, Center Co-Director & Professor, Occupational Medicine (Farmington)  
Dr. Poursan Faghri, Professor, Health Promotion (Storrs)  
Dr. Rob Henning, Professor, Occupational Psychology (Storrs)  
Dr. Tim Morse, Occupational Ergonomics (Farmington)  
Dr. Susan Reisine, Professor & Chair, Community Sciences & Community Health (Farmington)  
Dr. Nick Warren, Occupational Ergonomics (Farmington)

#### **5. New and temporary faculty affiliations (2007-08)**

None

#### **6. Students Supported (2007-08)**

- a. Alicia Kurowski, doctoral student in occupational ergonomics, Department of Work Environment: Research Assistant, Project A. She conducts observational analyses of changes in physical work load of clinical staff following implementation of an ergonomics program. Her thesis research characterizes the physical demands of nursing home clinical jobs before and after implementation of a health protection program.
- b. Kendra Richardson, Masters student in occupational ergonomics, Department of Work Environment: Research Assistant, Project A. She assisted with job observations and other field data collection; her masters capstone project analyzed workers compensation claim data on occupational injuries before and after implementation of a health protection program.
- c. Gabrielle Kernan, doctoral student in occupational epidemiology, Department of Work Environment: Research Assistant, Project A. She assists with questionnaire distribution, data management and analysis. Her thesis will address occupational and non-occupational risk factors for obesity, mental health, and other health outcomes among nursing home employees.
- d. Shpend Qamili, masters student, Department of Psychology: Research Assistant, Project A. He assists in conducting the participatory health promotion/protection teams in the nursing homes.



- e. Yuan Zhang, doctoral student, Department of Nursing: Research Assistant, Project A. She assists in conducting the participatory health promotion/protection teams in the nursing homes.
- f. Ramona Bryan, masters student, Department of Psychology: Research Assistant, Project C. She conducts key informant interviews and literature reviews.
- g. Kim Winchester, undergraduate student in Management Science: hourly employee, Project A.
- h. Other doctoral students supported in 2007-08 by CPH-NEW were Jon Boyer and Jamie Tessler. Both of them were employed on an hourly basis for field data collection on Project A while completing their thesis research on other projects.

## 7. Current Research Projects

The Center's initial funding supports three projects. Two are Trans-Disciplinary "Exploratory, Efficacy, and Effectiveness" Research Projects and one is an "Education, Translation, Communication and Dissemination" Project. Both research projects entail combining workplace health promotion with occupational ergonomic and mental health interventions, with a strong emphasis on employee involvement. The translation project seeks to identify opportunities to integrate occupational health into more mainstream public health activities.

Project A: "Promoting Physical & Mental Health of Caregivers through Transdisciplinary Intervention (Pro-Care)." P.I.: Laura Punnett (UML)

This study is conducted within a single company, a major East Coast provider of nursing home and assisted living care. An ergonomics ("injury reduction") program in 217 facilities is paired with two types of health promotion programs to compare worker health outcomes in sites with: 1) workplace intervention only; 2) both workplace intervention and HPE; and 3) workplace intervention plus a participatory health promotion program.

Project B: "Health Improvement through Training and Employee Control (HITEC)." P.I.: Martin Cherniack (UHC)

This study involves comparison of traditional HPE/workplace intervention with an experimental program featuring employee control. The sites are recruited in pairs within economic sector to provide a contrast on the basis of intervention type that is independent of broad type of physical work and work organization features

Project C: "Workplace Stress and Cardiovascular Diseases: Education and Outreach to Health Professionals." P.I.: Nicole Champagne (UML)

This project builds on Heart and Stroke Partnership plans developed by the MA and CT Departments of Health. The Center personnel are interviewing DPH and other health or "wellness" professionals regarding their knowledge of occupational stress and will develop curriculum and offer training sessions primarily on the relationship between work-related stress and the development of heart disease and stroke.



In addition to the formal projects, which are largely organized by campus, a set of Cross-Disciplinary Methods Teams facilitates cross-campus communication on common issues and methodologies for all 3 projects:

Team	Convenor	Purpose
Health promotion	Pouran Faghri (UC)	Discuss methods for integration of health promotion with workplace hazard prevention
Qualitative research & participatory interventions	Marian Flum (UML)	Compile repertoire of methods; compare approaches across studies & facilitate process evaluation
Economic analysis	Supriya Lahiri (UML)	Evaluate cost-effectiveness of intervention programs with common metrics
Survey measures & biometrics	Susan Reisine (UCHC) & Rebecca Gore (UML)	Compile common pool of measures; provide expertise in advanced statistical techniques (e.g., multi-level modeling)

## 8. Publications (2007-08)

### a. Published or in press

Bond MA, Kalaja A, Markkanen P, Cazeca D, Daniel S, Tsurikova L, Punnett L. Expanding our understanding of the psychosocial work environment: A compendium of measures of discrimination, harassment & work-family issues. National Institute for Occupational Safety and Health, Cincinnati OH, DHHS (NIOSH) Pub. No. 2008-104.

MacDonald LA, Hørenstam A, Warren ND, Punnett L. Incorporating work organization into occupational health research: An invitation for dialogue. *Occup Environ Med* 2008; 65:1-3.

Miranda H, Heliövaara M, Viikari-Juntura E, Knekt P, Punnett L. Physical work and chronic shoulder disorder. Results of a prospective population-based study. *Annals Rheumatic Diseases* 2008 Feb;67(2):218-223.

Punnett L, Cifuentes M, Sembajwe G, Tak SW, Gore R, Kriebel D. Global estimate of selected health conditions attributable to work: An analysis of the World Health Survey, 2002-2003. Technical report to World Health Organization & National Institute of Occupational Safety and Health, 2008.

Punnett L. Integrating health protection and health promotion at the workplace. Pages 22-24 in: *To protect and promote health at the workplace*, GOHNET (Global Occupational Health Network) newsletter no. 14, Geneva: World Health Organisation, 2008.

### b. Manuscripts under review by scientific journals

Cherniack M, Warren N, Dussetschleger J, Cifuentes M, Punnett L. Workplace interventions and changing patterns of cardiovascular disease.

Henning R, Warren N, Robertson M, Faghri P, Cherniack M. Workplace health promotion through participatory ergonomics: An integrated approach for greater effectiveness and sustainability.

Punnett L, Cherniack M, Henning R, Morse T, Faghri P. A conceptual framework for the integration of workplace health promotion and occupational ergonomics programs.





### c. Manuscripts in preparation

- Cherniack M, Morse T, Dussetschleger J, Seidner A. Assessing management readiness for integrated workplace health programs.
- Cifuentes M, Gore R, Nobrega S, Punnett L. Working conditions and health behaviors of nursing home employees: Need for an integrated approach to workplace health.
- Obidekwu C, Reisine S, Faghri P, Punnett L. Comparing reliability and validity of two versions of health self-efficacy questionnaire items.
- Kotejoshyer R, Reeves D, Henning RA, Faghri P. A worksite readiness checklist for participatory worksite ergonomics and health promotion programs.

### 9. Conference Presentations (2007-08)

- Cifuentes M, Tak SW, Sembajwe G, Gore R, Punnett L, Kriebel D. International co-morbidity of low back pain and major depressive episode. Sixth International Scientific Conference on Prevention of Work-related Musculoskeletal Disorders (PREMUS 2007), Boston MA, Aug 2007.
- Faghri P. A worksite readiness checklist for participatory worksite ergonomics and health promotion programs. WorkLife 2007: Protecting and Promoting Worker Health. National Institute for Occupational Safety and Health, Bethesda MD, Sept 2007.
- Halpin J, Buchanan S, Orris P, Frumin E, Moriarty J, Vossen P, Punnett L, Krause N. Race/ethnicity and gender-based disparities in injury rates among U.S. hotel workers. PREMUS 2007, Boston MA, Aug 2007.
- Henning RA, Robertson M, Warren N. A Participatory Approach to Worksite Health Promotion Program (Pre-conference Workshop). WorkLife 2007: Protecting and Promoting Worker Health. National Institute for Occupational Safety and Health, Bethesda MD, Sept 2007.
- Henning RA. Adaptation of a participatory ergonomics framework for actively engaging workers in the design of health promotion programs. WorkLife 2007: Protecting and Promoting Worker Health. National Institute for Occupational Safety and Health, Bethesda MD, Sept 2007.
- Kurowski A, Boyer J, Fulmer S, Punnett L. Changes in manual handling across job titles before and after the introduction of a no-lift program in nursing homes. PREMUS 2007, Boston MA, Aug 2007. \* *Honorable Mention, Best Student Abstract Competition*
- Kurowski A. Changes in manual handling across job titles after the introduction of a no-lift program in nursing homes. Fourth Annual Student Research Conference, New England Chapter, Human Factors and Ergonomics Society, Cambridge MA, Nov 2007.  
\* *Aptima Award for Best Student Presentation*
- Lahiri S. Cost utility models for supporting prevention through new reimbursement methods: A framework. WorkLife 2007: Protecting and Promoting Worker Health. National Institute for Occupational Safety and Health, Bethesda MD, Sept 2007.
- Lahiri S. Economic evaluation of occupational health interventions: Results from macro and micro level studies. WorkLife 2007: Protecting and Promoting Worker Health. National Institute for Occupational Safety and Health, Bethesda MD, Sept 2007.
- Miranda H, Heli väara M, Viikari-Juntura E, Knekt P, Punnett L. Physical work and chronic shoulder disorder: Results of a prospective population-based study. PREMUS 2007, Boston MA, Aug 2007.



## 9. Conference Presentations, continued

- Miranda H, Viikari-Juntura E, Punnett L, Riihimäki H. Age modifies the risk of low back pain related to occupational loading, health behaviors, sleep disturbance and mental stress. European Congress Public Health, Helsinki Finland, Oct 2007.
- Punnett L, Faghri P. Evidence-based strategies for integrating occupational health and safety with workplace health promotion. WorkLife 2007: Protecting and Promoting Worker Health. National Institute for Occupational Safety and Health, Bethesda MD, Sept 2007.
- Punnett L, Cherniack MG, Henning RA, Faghri PD, Azaroff LS, Flum MR. Evidence-based strategy for integrating occupational ergonomics with workplace health promotion: The Center for the Promotion of Health in the New England Workplace. American Public Health Association Annual Meeting, Nov 2007.
- Punnett L. The Scientific Rationale for Combining Workplace Health Promotion with Occupational Ergonomics. From Both Sides of the Atlantic: Exploring the Complexities of Health Promotion in the Workplace, Harvard School of Public Health, Boston MA Dec 2007.
- CPH-NEW Symposium: “Three Interventions for Workplace Health: Research-to-Practice Strategies and Participatory Methodologies,” chaired by R A Henning. Seventh International Conference on Occupational Stress and Health, American Psychological Association/National Institute for Occupational Safety and Health, Washington DC, March 2008. Comprised of 6 oral presentations:
- Cherniack M.:Evaluating management readiness.
  - Cifuentes M: Facilitating inclusion of job strain issues by public health professionals.
  - Flum M: Site evaluations for participatory nursing home clinical staff wellness programs.
  - Punnett L: CPH-NEW: Evidence-based strategies for integrating OHS with workplace health promotion.
  - Reeves D:: Worksite measurement of organizational readiness for a participatory ergonomics intervention.
  - Warren N.: Integrating participatory ergonomics with health promotion in the workplace.

## 10. Collaboration with Other UML Centers, Institutes, and Departments

CPH-NEW interfaces with other centers and departments at UML on activities related to workplace, community, gender and social inequality issues. Participating faculty members and Research Assistants are drawn from several departments: Economics, Community Health and Sustainability, Nursing, and Psychology. Project A was a direct outgrowth of a prior NIOSH-funded research project, Socioeconomic Disparities in Health (“PHASE in Healthcare”), of which the co-P.I.’s were Dr. Punnett and Dr. Slatin of the Center for Public Health and Health Promotion. A former member of the PHASE team, Dr. LeeAnn Hoff, Professor Emerita of Nursing, has been recruited to serve as a project resource on issues related to workplace violence in nursing homes.

Collaboration with the UML Center for Women and Work (CWW) supports our study of the relationships between workplace climate and employee stress, health and work outcomes (absenteeism, turnover, lowered productivity, and costs). CWW provided invaluable input for development of the survey instruments in CPH-NEW projects A and B; and a CWW Associate



(Dr. Michelle Haynes, Psychology Department) has been recruited to assist with training on supervisory practices at the Project A intervention sites. Suzanne Nobrega and Laura Punnett made a presentation on Project A work in progress for peer feedback (“Effectiveness of an Ergonomics Program and Need for Health Promotion”) in the research seminar series for Associates of the UML Center for Women and Work in March 2008.

The Kerr Ergonomics Institute (KEI) has important expertise on some of our key topic areas, especially the impact of job stress on cardiovascular health, and plans for additional grant-writing are underway with Dr. Sean Collins, Department of Physical Therapy, who is also a key member of KEI.

## 11. Local, Regional and International Outreach

Collaboration with entities outside UML is inherent in CPH-NEW activities, as described above, including especially with the University of Connecticut and the Massachusetts Department of Public Health (MDPH). The entire Project C entails working closely with MDPH.

Collaborations with UC pre-date the formation of CPH-NEW: a regular semi-annual joint UML/UC research retreat provides an opportunity for exchange among students, research staff and faculty members from all three university campuses. This year’s “Sturbridge Retreats” were held in January, 2008, and May, 2008. CPH-NEW investigators have presented work in progress at each of these meetings.

During the past year, we have also engaged colleagues in research and outreach activities from the Massachusetts Nurses Association, the Mt. Sinai School of Medicine, and UNITE-HERE (Union of Needletrades, Industrial and Textile Employees merged with Hotel Employees and Restaurant Employees International Union). Some of these dialogues have led to formal presentations to CPH-NEW at the Department of Work Environment, UML, by outside colleagues:

“An Australian Case Study in the Assessment of Research Impact—Workplace Stress in Victoria: Developing a Systems Approach.” Tony LaMontagne, Associate Professor, Monash University (Australia), Dec 2007.

“Psycho-social Risk Prevention: ANACT, The French Proactive and ‘Social Dialogue Oriented’ Approach.” Benjamin Sahler, Director, Limousine regional branch of ANACT (French National Agency for the Improvement of Working Conditions). March 2008.

“Si Se Puede! Union struggles and victories on the workload of hotel room attendants.” Brian Lang, Vice President, UNITE HERE! Local 26, Boston, MA. March 2008.

CPH-NEW personnel participate very actively in the NIOSH Worklife Initiative, as evidenced by our multiple presentations and workshops at the WLI conference in Sept, 2007 (see **9. Conference Presentations**, above). The smaller network of the three funded WLI centers plus key NIOSH researchers met in February, 2008, in Boston. At that meeting we presented the center’s research framework and results to date of each project; we also contributed to all three working groups through input on the discussion questions and on the post-meeting drafts of the white paper in preparation. Several CPH-NEW researchers also submitted comments on the new



NIOSH resource document, “The Essential Elements of Effective Workplace Programs and Policies for Improving Worker Health and Wellbeing.”

In her role as P.I. of CPH-NEW, Dr. Punnett has received several invitations to present the work of the Center, including from the University of Minnesota, the University of California, and the Director’s Office of the U.S. National Institute for Occupational Safety and Health. Internationally, our research led to an invitation to serve on the International Scientific Board of FINALE (Frame for INterventions for preserved work Ability: Long term Effect), a multi-project research program underway at the Danish National Research Centre for the Working Environment (Copenhagen). FINALE consists of 6 interlinked research projects that address musculoskeletal health and disability prevention through health promotion and work organization, so there is direct overlap of interest areas. The first annual Board meeting took place on 15-16 January, 2008.

Dr. Punnett was also chair of the Local Organizing Committee of PREMUS 2007, the Sixth International Scientific Conference on Prevention of Work-Related Musculoskeletal Disorders, which took place in Boston on 26–30 August 2007. This is the pre-eminent international meeting of researchers on causes and prevention of work-related musculoskeletal disorders, hosted triennially by the Scientific Committee on Musculoskeletal Disorders of the International Congress on Occupational Health (ICOH). Dr. Nick Warren and Ms. Jamie Tessler, two other members of CPH-NEW, also served on the PREMUS Local Organizing Committee. The conference brought together over 400 researchers and practitioners from numerous countries representing occupational ergonomists, health and safety specialists, economists, industrial engineers, kinesiologists, social scientists and policy analysts.

Another important outreach effort began when the CPH-NEW website went live in June 2007 ([www.uml.edu/centers/CPH-NEW](http://www.uml.edu/centers/CPH-NEW)). A feature entitled “CPH-News and Views” was initiated on the website in September, 2007, that showcases short factsheets from individual Center researchers on relevant topics, with a new one posted every two months. A mailing list sign-up form was also activated on the CPH-NEW website.

## **12. Research Proposals Submitted (2007-08)**

- a. “Intervention Effectiveness of Participatory Health Promotion Among Long Term Care Workers”  
P.I.: Laura Punnett on behalf of Marian Flum, Sc.D., UML. Submitted 12/17/07 to The Charles A. King Trust Postdoctoral Fellowship Program.
- b. “A participatory approach to an incentivized worksite health promotion program for workers at high risk for type 2 diabetes”  
P.I.: Pouran Faghri, M.D., UC Storrs. Submitted 02/26/2008 to National Center for Chronic Disease Prevention and Health Promotion, Division of Diabetes Translation. UML subcontract, P.I.: Laura Punnett.



## 23. COMBUSTION LAB YEAR-END REPORT TO CFCI, UML: TIME PERIOD 2007-2008

### I. Mission Statement

This Center is engaged in activities in fire research (chemistry and physics of fire; initiation mechanisms; fire prevention and extinguishment). These activities are in support of current and pending cooperative efforts with such federal and other agencies as the Transportation Security Administration, Department of Energy, NASA, and NIST.

### II. General Description

We have been working with UML colleagues in Plastics Engineering, Mechanical Engineering, Civil and Environmental Engineering, Chemistry, and Physics Departments. Our past and ongoing activities include the following areas of research:

- Mechanisms for initiation of fire.
- Facilitation of combustion by application of electrostatic field effects.
- Improvement of environmentally friendly industrially important combustion reactions
- Fire initiation and mitigation.
- Explosives Detection

III. Surface Catalyzed Combustions. (This area will be discussed in Section VII.)

### IV. Associated Personnel

Our activities this past year have been interdisciplinary within this University with the following personnel:

- UML Dep't of Chemistry: Professors William Bannister (Center Director)
- UML Dep't of Physics: Professor James Egan
- UML Dept of Plastics Engineering: Prof's Francis Lai, Ramaswami Nagarajan
- UML Dep't of Civil & Environmental Engineering: Dr. Pradeep Kurup

V. New faculty affiliations within the past three years: None.

### VI. Student Research Support

Financial and technical support was provided to one undergrad student (Joshua Infantine) and eight grad students (Pitaya Tangarrayasab, Weera Paramasawat, Leng Chaosukhum, Adisak Jaseekulkit, Nuthatthai Warasitthhinon, Wipoo Sriseubsai, Pongphisanu Muangchareon, Apisak Meesrisom) in the last year.

## VII. Current Research: Electrostatic (Anionic) Effects in Hot Surface Combustions

We have confirmed our previous findings that:

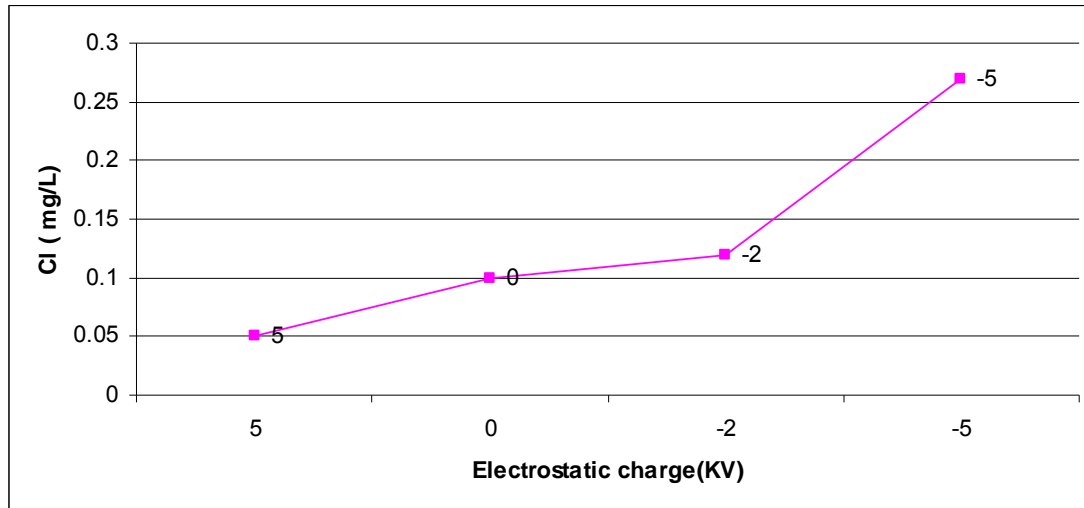
- Initial phase of hot surface catalyzed oxidation is anionic, not free radical.
- Oxygen radical anions abstract protons in an initial rapid ionic (acid/base) step to form a carbanion and hydroxyl free radical. In a second slow rate determining step, electron transfer from the carbanion to the hydroxyl radical forms an alkyl free radical, which only then proceeds in free radical oxidation sequences. Carbanion intermediacy provides lowered energy path. Free radical character determines ultimate product identity.
- Seebeck effects govern generation of oxygen radical anions at the hot surface. Negative charge effects facilitate oxidations. Inverse relationships exist between hydrocarbon hot surface ignitability and combustibility.
- Surfaces with negative Seebeck effects facilitate selective oxidations, but require higher temperatures to effect ignition of fuels than for positive Seebeck surfaces.
- The Fischer-Tropsch (F-T) reaction is the basis of a multi-billion dollar industry whereby coal, charcoal, biomass and other carbonaceous materials can be oxidized using super-heated steam (at very high temperatures) to form carbon monoxide and hydrogen:  $C + H_2O \rightarrow CO + H_2$ . carbon monoxide (CO) is used in the "Oxo" process to form industrially important aldehydes; hydrogen is an increasingly important fuel for use in emission free automobiles. Both the CO and hydrogen can be combined in an extension of the F-T process to form clean burning low-soot forming Diesel fuel with no sulfur or other polluting contaminants. This synthetic fuel is more expensive than conventional Diesel, but with dwindling petroleum resources and concomitant increasing fuel prices, the F-T process is becoming an ever more popular industrial route. There are now several million barrels a year in current production and use. The F-T process is typically conducted at high temperatures. Our findings are that the F/T process can be performed at much lower temperatures when large negative electrostatic charges are applied, which would considerably cheapen the reaction system.
- The burning of hydrocarbon fuel (particularly Diesel) mixtures with air occurs at high temperatures, with accompanying combustion of nitrogen to form highly toxic nitrogen oxides ("NO<sub>x</sub>") which present serious environmental problems in automotive engine performance. We are examining the application of electrostatic charges with a view toward decreasing engine temperatures and NO<sub>x</sub> emissions.

In addition, we have made discoveries in the following new areas:

- The principle of electrostatic facilitation applies not only to hydrocarbon combustion chemistry; rather, *all* combustion reactions, inorganic and organic, appear to be susceptible to this effect. Thus, both industrially important organic substrate oxidations (e.g., Fischer-Tropsch, and oxychlorinations and nitrous oxide oxidations, and inorganic oxidations such as the "Contact" preparation of sulfuric acid from sulfur, and nitric acid preparation from ammonia, proceed at cur with

higher rates and yields at lower temperatures upon application of electrostatic fields.

- An example of this can be seen in our work on the Deacon oxidation of hydrogen chloride, and the reverse Deacon reaction utilized in dechlorination of toxic waste materials.:  $2 \text{HCl} + \text{O}_2 \rightarrow \text{Cl}_2 + \text{H}_2\text{O}$   
heat., cat.



#### Increase in chlorine production using negative field applications.

- Successive positive/negative electrostatic field pulsings facilitate oxygen radical anion formation from air by Seebeck electron transfer to the hot surface during positive phases. Higher reaction rates result from radical anion repulsion from surfaces during the negative phase.
- Injection of small amounts of water into internal combustion engines has been shown to enhance engine performance (decreased fuel consumption, engine temperatures and soot and  $\text{NO}_x$  emissions). We believe that the underlying principle in these salutary effects is the Fischer-Tropsch oxidation of soot particles by the injected water, and that water may also cause greater oxidation of soot by  $\text{NO}_x$  emissions (with corresponding decreases in  $\text{NO}_x$ ).
- Hydrogen peroxide should serve equally well in this respect, with the added advantage of overcoming rich fuel constrictions for more complete combustion.
- Building upon these principles, the incorporation of pulsed +/- electrostatic fields into engine operations is expected to further reduce internal combustion engine temperatures, fuel requirements, and  $\text{NO}_x$  and soot emissions, with even higher increases in engine horsepower.
- Better Seebeck catalysts should result in optimized performance for commercial oxidations, and for engine performance.

#### VIII. Most recent publications:



Anionic/Electrostatic Field Effects In Hot Surface Catalyzed Combustions". Paramasawat, W.; Chaosukhum, J.; Meesrisom, A.; Sriseubsai, W.; Nagarajan, R.; Egan, J.; Jahngen, E.; Euaphantasate, , N.; Lai, F.; Kuo, C-S.' Muangchareon, P.; Tangarrayasap, P.; Bannister, W. *2007 Fall Meeting, Western States Section, Combustion Ins., Sandia Nat'l Laboratories, Livermore, CA Oct. 2007)*

Invention Disclosure: "Anionic and Electrostatic Field Effects in Hot Surface Catalyzed Combustions", to UML; August 2007

IX. Conferences: (Please see IX above)

X. Intra-University Collaboration

As cited previously in this report, there have been extensive activities within the University involving the Departments of Plastics Engineering, Civil and Environmental Engineering, Mechanical Engineering: Chemistry, and Physics.

Our group has provided technical support (including more than 20 samples of explosives of interest in terrorist activities, and extensive literature resources) to the Explosives Detection group headed by Drs. Kurup, Ramaswamy and Kumar.

XI. Regional/Local Community Technical Outreach

We have initiated a working partnership with engineering staff at the University of Massachusetts (Amherst).

XII. Proposals Submitted:

Boeing. Chevron Corp.; GE.,GM, USAF; Department of Energy, Toyota, Detroit Diesel

Submitted By:

---

William Bannister, Center Director

25 July 2008.



## 24. INSTITUTE FOR NANOSCIENCE AND ENGINEERING TECHNOLOGY

(INSET)

**Arthur C. Watterson, Director**

### **Annual Report 2007-2008**

#### **1. Mission**

The Institute for NanoScience and Engineering Technology is a collaborative University wide interdisciplinary research and development center that focuses on research, education and training regarding nanoscience and engineering technology that will advance our knowledge and improve the lives of the people of the Commonwealth.

#### **2. General Description and Goals**

Nano research includes control of materials structures from the atomic level to intricate structures by methods such as self assembly of supramolecular as well as enzyme reactions. New materials with new properties will be generated by these techniques. These new materials will be of interest to the Commonwealth as they can generate new start up companies to benefit the state economy.

##### Goals:

Develop collaborative research with other Centers, Departments and Colleges within the University.

Develop collaborative research with industry

Develop research projects funded by government agencies

Provide education and training in nanoscience and nanoengineering for UMass Lowell students and postdoctoral research students

Provide education and training for the regional community

#### **3. Research Focus**

The research focus within INSET is directed at novel materials which includes: materials research as illustrated by the following areas

Nano chemistry of substituted fullerenes that show promise for drug delivery and also as efficient conducting polymers.

New nanostructures formed from the synthesis of triblock copolymers

New self assembled polymeric drug delivery systems which include nanosized particles to promote rapid delivery and uptake of drugs. Dual drug delivery systems have also been developed

Enzyme synthesis of new polymeric materials that show potential applications in both the medical field, the electronics industry and the cosmetics field. These materials and their applications are the current focus:



- New MRI imaging contrast agents
- Dual nano carriers for cosmetics and drug delivery
- Polyelectrolytes
- Fire retardant polymers
- Sequestration of Lead with Nano Particles
- Antimicrobial activity
- Encapsulation of Botulinum inhibitors

#### Analytical research

- Analysis and oxidation/reduction studies on alpha-tocopherol as well as organic compounds in storm drain water in Massachusetts
- Selective recognition of Calcium ions by polymeric phenols

#### **4. Faculty and Staff Associated with INSET**

Arthur C. Watterson, Professor Emeritus, Director, Department of Chemistry, University of Massachusetts Lowell

Long Chiang, Professor, Dept of Chemistry, University of Massachusetts Lowell

Virinder Parmar, Visiting Professor, Dept of Chemistry, University of Massachusetts Lowell

Rudy Faust, Professor, Dept of Chemistry, University of Massachusetts Lowell

David Ryan, Professor, Dept of Chemistry, University of Massachusetts Lowell, U.S. Army, Natick Labs

Lynne Samuelson, Dept of Chemistry, University of Massachusetts Lowell

Eugene Barry, Professor, Dept of Chemistry, University of Massachusetts, Lowell

Marina Ruths, Assistant Professor, Department of Chemistry, University of Massachusetts Lowell

Jayant Kumar, Professor, Dept of Physics, University of Massachusetts Lowell

Jackie Zhang, Associate Professor, Dept of Environmental Engineering, University of Massachusetts Lowell

Bal Ram Singh, Professor, University of Massachusetts, Dartmouth

Charlene Mello, University of Massachusetts, Dartmouth, U.S. Army, Natick Labs

Robert Fisher, Research Professor, Dept of Chemical Engineering, MIT

Clark Colton, Professor, Dept of Chemical Engineering, MIT

Anna Moore, Assistant Professor of Radiology, Mass General Hospital

Ashok Prasad, Visiting Professor, Dept of Chemistry, University of Massachusetts Lowell

Sunil Sharma, Visiting Professor, Department of Chemistry, University of Massachusetts Lowell

Throughout the following sections the activities linked to CFCI funding are indicated by a double asterisk and bold face type



## 5. Students Supported

### Undergraduate students

Thomas Farrell

### Graduate Students

Rahul Tyagi

Vincent Tucci

### Postdoctoral Research Associates

Mukesh Pandey

Ravi Mosurkal

Vijayendra Kumar

Bhavna Gupta

### **Student awards**

American Institute of Chemists Award – Thomas Farrell

Tripathy Memorial Summer Graduate Fellowship \_ Rahul Tyagi

### **Tripathy Memorial Summer Graduate Fellowship**

An endowed memorial fund that will lead to graduate research fellowships for outstanding graduate students in the last year of a Ph.D. program has been established in Dr. Tripathy's name. This fund, to date, has led to the award of eight fellowships for summer support.

## 6. Current Research Programs

The research projects in INSET are predominantly synthesis and characterization of new materials.

Drug Delivery Materials – research continues on the modification and testing of polyethylene glycol (PEG) based nanospheres. NIH supported funding for the testing of delivery of an antioxidant formulation as well as other anticancer materials in mice. The work has produced encouraging results.

Fire Retardant Materials – Research continues on modification of polymers with cross-linking and formation of inverse micelles for encapsulation of known fire retardant compounds such as metal hydroxides to make them more compatible with commercial polymers. A grant from MTTC was obtained for scaling up the reactions

Magnetic Resonance imaging (MRI) – Research continues in this project as several fluorinated nanospheres with fluorescent dyes attached have been prepared and are being tested at MIT. Targeting peptides have been attached and are being tested for selectivity.



Fullerene Chemistry – Research continues on the functionalization and subsequent chemistry of C60 fullerenes. Two Photon phenomena are an exciting new discovery in this area. It can have important applications in the medical field.

Multiblock and Amphiphilic Polymers – Research continues on the synthesis and characterization of new multiblock polymers and their applications, particularly in the medical field, namely stent coating materials.

## 7. Peer reviewed publications of INSET 2007 – 2008

(\*\* means graduate student supported by Institute funding)

### Book Chapters

**\*\*Enzymatically synthesized pegylated polymers as nanomicellar drug delivery systems.**

Kumar, Rajesh; Pandey, Mukesh K.; Tyagi, Rahul; Parmar, Virinder S.; Watterson, Arthur C.; Kumar, Jayant. ACS Symposium Series (2008), 977(Polymers for Biomedical Applications), 204-224. Publisher: American Chemical Society,

**\*\*Synthesis and characterization of dual nanodelivery systems containing vitamin E for cosmetics and pharmaceuticals.**

Kumar, Rajesh; Tyagi, Rahul; Watterson, Arthur C.; Parmar, Virinder S.; Kumar, Jayant. ACS Symposium Series (2007), 961(Cosmetic Nanotechnology: Polymers and Colloids in Cosmetics), 139-148. Publisher: American Chemical Society,

### Publications

**\*\*Design and Synthesis of Novel Pegylated 4-Methylcoumarins.** Pandey, Mukesh K.; Tyagi, Rahul; Tomar, Shilpi; Kumar, Jayant; Parmar, Virinder S.; Watterson, Arthur C. Journal of Macromolecular Science, Part A: Pure and Applied Chemistry (2007), 44(12), 1293-1298.

**\*\*Controlled Release of Covalently Bound Organic Molecules by Slow Hydrolysis for Potential Biocide Applications.** Mosurkal, Ravi; Kumar, Jayant; Parmar, Virinder S.; Watterson, Arthur C. Journal of Macromolecular Science, Part A: Pure and Applied Chemistry (2007), 44(12), 1289-1292.

**\*\*Synthesis and Characterization of Photoactive Amphiphilic Polymers.** Tyagi, Rahul; Pandey, Mukesh K.; Malhotra, Shashwat; Kumar, Rajesh; Kumar, Jayant; Parmar, Virinder S.; Watterson, Arthur C. Journal of Macromolecular Science, Part A: Pure and Applied Chemistry (2007), 44(12), 1283-1287.

**Biocatalytic Synthesis of Organosiloxane Copolyimide.** Mosurkal, Ravi; Samuelson, Lynne A.; Parmar, Virinder S.; Kumar, Jayant; Watterson, Arthur C.. Macromolecules (2007), 40(22), 7742-7744.

**\*\*Synthesis and characterization of nano carrier containing antioxidant 4-methylcoumarin.** Pandey, Mukesh K.; Tyagi, Rahul; Parmar, Virinder S.; Tucci, Vincent; Kumar, Jayant; Shea, Thomas; Watterson, Arthur C. *Polymer Preprints (American Chemical Society, Division of Polymer Chemistry)* (2007), 48(2), 958-959.

**\*\*Design and synthesis of novel crosslinked polydimethylsiloxanes for use in flame retardant applications.** Tucci, Vincent B.; Pandey, Mukesh K.; Tyagi, Rahul; Parmar, Virinder S.; Kumar, Jayant; Watterson, Arthur C. *Polymer Preprints (American Chemical Society, Division of Polymer Chemistry)* (2007), 48(2), 276-277.

**\*\*Lipase (Novozyme 435) catalyzed chemo selective one pot synthesis of surfactants.** Farrell, Tom; Tyagi, Rahul; Pandey, Mukesh K.; Parmar, Virinder S.; Watterson, Arthur C. *Polymer Preprints (American Chemical Society, Division of Polymer Chemistry)* (2007), 48(2), 244.

**\*\*Selectivity of lipase (Novozyme 435) in pegylated and siloxane polymers.** Tyagi, Rahul; Pandey, Mukesh K.; Kumar, Rajesh; Tucci, Vincent; Kumar, Jayant; Parmar, Virinder S.; Watterson, Arthur C.. *Polymer Preprints (American Chemical Society, Division of Polymer Chemistry)* (2007), 48(2), 219-220.

**Specificities of acetoxy derivatives of coumarins, biscoumarins, chromones, flavones, isoflavones and xanthenes for acetoxy drug: Protein transacetylase.** Kumar, Ajit; Singh, Brajendra K.; Sharma, Nawal K.; Gyanda, Kapil; Jain, Sapan K.; Tyagi, Yogesh K.; Baghel, Anil S.; Pandey, Mukesh; Sharma, Sunil K.; Prasad, Ashok K.; Jain, Subhash C.; Rastogi, Ramesh C.; Raj, Hanumantharao G.; Watterson, Arthur C.; Van der Eycken, Erik; Parmar, Virinder S. *European Journal of Medicinal Chemistry* (2007), 42(4), 447-455.

**\*\*Design and synthesis of novel amphiphilic polymers for MRI and selective targeting in cancer diagnosis/therapy.** Pandey, Mukesh K.; Tyagi, Rahul; Kumar, Rajesh; Parmar, Virinder S.; Watterson, Arthur C.; Kumar, Jayant; Hardiman, Michelle T.; Zhou, Jin; Brower, Kevin P.; Fisher, Robert J.; Colton, Clark K. *PMSE Preprints* (2007), 96 855-856.

**Laboratory modules on environmental impacts of nanotechnology.** Zhang, Xiaoqi; Bruell, Cliff; Hines, Mark; Watterson, Arthur C.; Barry, Carol MF. , 233rd ACS National Meeting, Chicago, IL, United States, March 25-29, 2007 (2007),

**Large Concentration-dependent Nonlinear Optical Responses of Starburst Diphenylaminofluorencarbonyl methano[60]fullerene Pentaads** Elim, H. I.; Anandakathir, R.; Jakubiak, R.; Chiang, L. Y.; Ji, W.; Tan, L. S. , *J. Mater. Chem.* **2007**, 17, 1826-1838,

**Starburst Encapsulation of C<sub>60</sub> by Multiple Hindered Two-Photon Absorptive Diphenylaminodialkylfluorene Arms**, *J. Macromol. Sci. A, Pure Appl. Chem.* **2007**, Anandakathir, R.; Tan, L.-S.; Chiang, L. Y. (accepted)



**Prolong Photoinduced Charge-Separated States in Starburst Tetra(Diphenylaminofluoreno)[60]Fullerene Adducts**, El-Khouly, M. E.; Anandakathir, R.; Ito, O.; Chiang, L. Y. *J. Phys. Chem. A* **2007**. (accepted, in press)

**Alternative Synthesis of C<sub>60</sub>-diphenylaminofluorene Derivatives for Nonlinear Photonic Applications: Method of Preparation and Characterization**, *J. Macromol. Sci. A, Pure Appl. Chem.* **2007**, Jeon, S. H.; Anandakathir, R.; Chiang, J.; Chiang, L. Y. (accepted)

Amino Acid and Poly(ethylene glycol) Based Self-Organizing Polymeric Systems: Chemo-enzymatic Synthesis and Characterization. *Journal of Macromolecular Science Part A*, in press

Synthesis and Characterization of Novel Amphiphilic Polymers as Drug Delivery Nano Carriers . *Journal of Macromolecular Science Part A*, in press

Design and Lipase Catalyzed Synthesis of 4-Methylcoumarin-siloxane Hybrid Copolymers . *Journal of Macromolecular Science Part A*, in press

### **Conference Presentations**

**\*\*Synthesis and characterization of nanocarrier containing antioxidant 4-methylcoumarin.** Pandey, Mukesh K.; Tyagi, Rahul; Parmar, Virinder S.; Tucci, Vincent B.; Kumar, Jayant; Shea, Thomas; Watterson, Arthur C.. 234th ACS National Meeting, Boston, MA, United States, August 19-23, 2007

**\*\*Design and synthesis of novel crosslinked polydimethylsiloxanes for use in flame retardant applications.** Tucci, Vincent B.; Pandey, Mukesh K.; Tyagi, Rahul; Parmar, Virinder S.; Kumar, Jayant; Watterson, Arthur C 234th ACS National Meeting, Boston, MA, United States, August 19-23

**\*\*Design and synthesis of novel crosslinked polydimethylsiloxanes for use in flame retardant applications.** Tucci, Vincent B.; Pandey, Mukesh K.; Tyagi, Rahul; Parmar, Virinder S.; Kumar, Jayant; Watterson, Arthur C 234th ACS National Meeting, Boston, MA, United States, August 19-23, 2007

**\*\*Lipase (Novozyme 435) catalyzed chemoselective one pot synthesis of surfactants.** Farrell, Tom; Tyagi, Rahul; Pandey, Mukesh K.; Parmar, Virinder S.; Watterson, Arthur C., 234th ACS National Meeting, Boston, MA, United States, August 19-23, 2007

**\*\*Selectivity of lipase (Novozyme 435) in pegylated and siloxane polymers.** Tyagi, Rahul; Pandey, Mukesh K.; Tucci, Vincent B.; Kumar, Rajesh; Kumar, Jayant; Parmar, Virinder S.; Watterson, Arthur C, 234th ACS National Meeting, Boston, MA, United States, August 19-23, 2007



**\*\*Design and synthesis of novel amphiphilic polymers for MRI and selective targeting in cancer diagnosis/therapy.** Pandey, Mukesh K.; Tyagi, Rahul; Kumar, Rajesh; Parmar, Virinder S.; Watterson, Arthur C.; Kumar, Jayant; Hardiman, Michelle T.; Zhou, Jin; Brower, Kevin P.; Fisher, Robert J.; Colton, Clark K. 233rd ACS National Meeting, Chicago, IL, United States, March 25-29, 2007 (2007),

**\*\*Biocatalytic modification of naturally occurring Iron porphyrin as a renewable catalyst.** Nagarajan, Subhalakshmi; Tyagi, Rahul; Nagarajan, Ramaswamy; Kumar, Jayant; Watterson, Arthur C.; Bruno, Ferdinando; Samuelson, Lynne A. 233rd ACS National Meeting, Chicago, IL, United States, March 25-29, 2007

## 9. Collaborations with other Centers and /or Departments

There are many collaborations with the Center for advanced Materials (CAM) which includes collaboration with the Chemistry and Physics Departments

We have a collaboration with the Department of Civil and Environmental Engineering.

## 10. Regional/Local Outreach

We have a continuing collaboration with Dr. Philip Westmoreland in the Chemical Engineering Department at UMass Amherst on the Fire Retardant Materials Project.

We have a continuing collaboration with Dr. Clark Colton and Dr. Robert Fisher in the Chemical Engineering Department at MIT and with Anna Moore at Mass General Hospital on the MRI imaging project. Colton and Fisher have three graduate students on the project which has been supported by the Deshpande Foundation for \$170,000 and is now supported by AXLE Corporation

We have developed a recent collaboration with Dr. Charlene Mello, U.S. Army Natick Laboratories, located at University of Massachusetts Dartmouth on developing antimicrobial polymers

We have developed a recent collaboration with Dr. La Colla, Universita Degli Studi di Cagliari, Cagliari, Italy on HIV active drugs

We are starting to develop a collaboration with Dr. Shyam Biswal, Johns Hopkins University School of Public Health on antioxidant pathways related to disease.

We are starting to develop a collaboration with Dr. Anthony DePass, Long Island University, Brooklyn Campus on reversing mechanisms for growth of cancer.

We are starting to develop a collaboration with Dr. Sanjay Malhotra, National Cancer Institute, Fort Dietrich. On using our technology for anti-cancer drug encapsulation.



## 11. Proposals submitted/awarded

### Proposals submitted

- National Science Foundation, A. Watterson, J. Kumar (not funded)
- American Chemical Society, A. Watterson, J. Kumar(not funded)
- MTTC Technology Initiative, Arthur Watterson. Jayant Kumar (funded)
- NineSigma, A. Watterson (Funding Pending)

### Proposals submitted and funded

- 02/15/05 to 02/14/08** Starburst Fullerene-chromophore Conjugates for Multi-photon Absorption and Photovoltaic Applications  
Source of Support: Air Force Office of Scientific Research (AFOSR)  
Total Award Amount: **\$360,000**
- 9/1/05 to 8/31/08** J. Zhang, C. Brule, M. Hines, A. Watterson Introduction of Nanotechnology in Engineering Curriculum  
Source of Support: National Science Foundation  
Total Award Amount: **\$ 200,000**
- 7/1/06 to 8/31/07** A. Watterson. Use of Microfluidics Technology to Examine the Behavior of Nanoparticle Drug Delivery Systems  
Source of Support: Microfluidics Corporation  
Total Award Amount: **\$12,000**
- 3/1/07 to 2/28/08** A. Watterson, J. Kumar Biocatalytic Synthesis of Novel Polysiloxanes for Flame Retardant Applications:  
Massachusetts Technology Transfer Corporation  
Total Award Amount: **\$40,000**
- 4/1/07 to 9/30/09** A. Watterson Enhanced Imaging and Therapy for Cancer  
Source of support: AXLE Corporation (Through MIT)  
Total Award Amount **\$440,000**



## 25. INSTITUTE FOR PLASTICS INNOVATION At The University Of Massachusetts Lowell

### **Mission Statement**

The Institute for Plastics Innovation's central mission is to address industry-wide concerns in a multi-disciplinary manner in order to develop new plastics manufacturing technologies and standards. The IPI assists in sustainable regional economic and social development.

The mission and major purpose of the University of Massachusetts Lowell are to provide to students an affordable education of high quality and to focus some of its scholarship and public service on assisting sustainable regional and economic and social development.

### **Description and Goals**

The Institute for Plastics Innovation at the University of Massachusetts Lowell develops and provides knowledge-based plastics manufacturing expertise to partners. The IPI provides an environment where start-up companies will develop into technology and manufacturing employers in Massachusetts.

- To partner with companies to develop economically significant intellectual property.
- To transfer, license, and support current patents and intellectual property companies.
- To provide an incubation space for companies which are synergistic with the expertise of the Institute for Plastics Innovation.

The Institute for Plastics Innovation's central mission is to address industry-wide concerns in a multi-disciplinary manner in order to develop new plastics manufacturing technologies and standards.

### **Research Focus Area**

The Institute for Plastics Innovation has been transformed over the past few years to a focus on industrial partnerships. These partnerships have enabled the IPI to better serve the companies individual needs, while protecting the intellectual property that is developed at the IPI. These partnerships are developed around novel technologies which are either developed or enhanced at the Institute. The Institute's University personnel presents a review of the research progress to each of the sponsors individually. These review meetings include oral presentations and written reports. Review meetings are held at the University of Massachusetts Lowell and are attended by member companies, student affiliates, and Institute professional staff.

Faculty members recognize the need to assist industry in developing techniques and teaching skills required to keep the American plastics industry competitive in future decades. To meet



this challenge the department has been active in soliciting research projects from industry and from the state. Since 1984, the department has had a seven-fold increase in its support from these sectors.

The University of Massachusetts Lowell is uniquely qualified to produce research results for an integrated plastics manufacturing system, helping member companies gain a competitive edge.

## **Associated Personnel**

Dr. Stephen P. McCarthy, Director  
Professor  
Plastics Engineering Dept.  
University of Massachusetts Lowell  
(978) 934-3417  
(978) 934-3065 FAX  
[stephen\\_mccarthy@uml.edu](mailto:stephen_mccarthy@uml.edu) EMAIL

## **Other Faculty**

Thomas Shea, Biology Department, University of Massachusetts  
Robert Nicolosi, Clinical Life Sciences, University of Mass. Lowell  
Bryan Buchholz, professor, Work Environment & Director, BioEngineering  
Aldo Crugnola, Professor, Plastics Engineering  
Kathleen Doyle, Professor & Chair, Clinical Laboratory and Nutritional Sciences  
Carl Lawton, Professor, Chemical Engineering  
Catherine Galligan, Project Manager, Sustainable Hospitals Project  
Jerry Hojnacki, Professor (former Dean of Graduate School)  
David Kazmer, Professor, Plastics Engineering  
Christopher Nazarecki, Professor, Mechanical Engineering  
Thomas Shea, Professor, Biology Department  
Hongwei Sun, Professor, Mechanical Engineering  
Daniel Schmit, Professor, Plastics Engineering  
Steven Tello, Professor, Management Department  
Gerard Dybel: Gate Working Lab, hand biomechanics and ergonomics  
Alan Rux, Technician, Electrical Engineering  
Sheila Noone, Professor, UMass Medical Center, Worcester

## Student Interaction

The Department of Plastics Engineering has about 200 undergraduate students and 325 full and part-time graduate students. Many of these students have performed their research in conjunction with the IPI within the past year. All were graduate students.

### **Graduate Student Researchers**

Anshuman Shrivastava  
Sameer Huprikar



Dr. Muhammad Azam  
Scott Wharram  
Kiran Karve

### **Research of the Institute**

The Institute for Plastics Innovation advances the state of current **plastics manufacturing technology** by performing research programs that focus on the key issues facing the plastics industry today. The institute pools the resources of multi-disciplinary U.S. university and industry experts, where necessary collaborative research is utilized to solve current challenges impeding the advanced of plastics manufacturing technology. New manufacturing technologies are expected to be developed with many of these new technologies being a direct result of multi-disciplinary interactions between university and industry personnel. The results of the research will be used directly by participating companies, thus ensuring that laboratory research is adaptable to the true manufacturing setting.

### **Current Research**

Life Sciences Initiative, Commonwealth of Massachusetts, 4,000,000.00  
Massachusetts Medical Device Development Center, Proposal for a New Business Formation Catalyst Project, \$500,000.00  
Massachusetts Medical Device Development Center, John Adams Grant, \$150,000  
Nanospheres for Ophthalmic Drug Delivery, \$70,428  
Development of an Electrical Stimulation Dish for Cell Culture that Can Overcome Shortcomings & Improve Gene Introduction, \$60,000  
Massachusetts Institute of Technology, Exploring the Application of Functionalized Nanospheres for Pb Removal \$ 9,901.00  
Xenith Corporation, Development Project for Impact Protection Equipment, \$70,428  
UMass Presidents Office CVIP Technology Award, \$15,000.00  
Zeeland Chemical Corporation, "Evaluate DOE of EMA vs. Fusabond, \$10,000

### **Publications**

#### **Conference Presentations**

EASTEC 2008, West Springfield, MA, May 2008  
MDM East, New York, NY, May 2008  
MDM West, January 2008  
Medica 2008, Dusseldorf, Germany, December 2007  
MassMEDIC's 9th Annual MedTech Investors Conference, Boston, MA, November 2007  
MassMEDIC's 11th Annual Conference, May 2007



## **Collaboration with other Centers/Institutes/and or Departments**

### *Other Centers/Institutes*

UMass NanoMedicine Institute  
Massachusetts BioManufacturing Center, UML  
Continuing Studies, Industrial Seminar at Clariant Corp.  
Nanomanufacturing Center of Excellence  
Plastics Institute of America  
University of Massachusetts Medical Center, Worcester  
University of Massachusetts, Dartmouth

### *Other Departments*

Electrical and Computer Engineering, UML  
Mechanical Engineering, UML  
Chemical Engineering, UML

### Regional/Local Outreach

MassMedic  
Medical Development Group  
National Collegiate Inventors & Innovators Alliance  
Massachusetts Biomedical Initiatives (MBI)  
WPI Bioengineering Institute (BEI)

### Proposals submitted

KaZak Composites Inc., “Innovative, Low Cost Hydraulic Spreader with Portable Compressed Gas Power and Manual Override”  
Sustainable Extraction of Bioplastics



## 26. INSTITUTE FOR VISUALIZATION AND PERCEPTION RESEARCH

# Annual Report 2007-2008

**Georges Grinstein  
Haim Levkowitz  
Co-Directors**

### **Mission Statement**

The Institute for Visualization and Perception Research (IVPR) is an interdisciplinary group whose research and contract activities focus on the development of systems, displays and interaction techniques that enable scientists to explore multidimensional databases by analytic and visual means. We seek to facilitate and improve the exploration of various types of data, including large and complex datasets, such as those obtained from studies of health and crime statistics, as well as multi-parameter image data like that obtained by earth resource satellites and medical imaging systems. Our work—which is both theoretical and applied—draws from the fields of computer science, computer engineering, mathematics and psychology. Most recently our focus has been on applying our visualization and data mining techniques to bioinformatics.

### **General Description and Goals**

The specific goals of the IVPR are to:

- Apply knowledge of perception to the development of visualization technologies;
- Integrate analytic approaches with visual ones in the development of tools;
- Train visualization scientists;
- Disseminate visualization technology via presentations and papers as well as technology transfer;
- Provide consultation in visualization to industry and government.

With its expertise in the areas of interactive visualization of complex data, the IVPR can support information engineering activities, including management, analysis, exploration, and development.

### **Research Focus Areas**

The research areas we focus on include:

- visual and analytic data mining of databases
- visualization of imagery data (e.g., earth satellite, medical)
- visualization applied to information retrieval and web searching
- multispectral data fusion
- integration of visualization and supercomputing
- color models and imaging
- image registration and analysis
- human computer interface



- system issues (graphics, visualization, virtual reality)
- software design and development

### **Associated Personnel**

Co-Directors

Dr. Georges Grinstein

Dr. Haim Levkowitz

Faculty members from various departments in the University, along with external collaborators, are involved in research problems at the Institute.

Currently, the list includes the following personnel

- Dr. Karen Daniels (computational geometry, data mining)
- Dr. Georges Grinstein (visualization, data mining)
- Dr. Haim Levkowitz (visualization, data and text mining, internet and web, color theory, imaging)
- Dr. Gary Livingston (data mining, databases)
- Dr. Lee Jones (mathematical modeling, statistics)
- Dr. Alex Gee (visualization and user interfaces)
- Dr. Patrick Hoffman (Data mining and visualization, at InforSense)
- Dr. R..Daniel Bergeron (Visualization, at UNH)
- Dr. Maria Cristina Ferreira de Oliveira (Visualization and Perception, at the University of Sao Paulo, Brazil)
- Dr. Rosane Minghim (Visualization and Perception, at the University of Sao Paulo, Brazil)
- Dr. William Mass (visualization and national indicators, at RESDI)
- Dr, Catherine Plaisant (Visual Analytics, at UMaryland)
- Dr. Jean Scholtz (Visual Analytics, at Pacific Northwest National Laboratories)
- Dr. Marjan Trutschl (visualization and bioinformatics, at LSUS)
- Dr. Urska Cvek (visualization and bioinformatics, at LSUS)

### **Students Supported**

- Jianping Zhou (Sc.D. August 2007) Bioinformatics Visualization and Data Mining (Dr. Zhou has worked with the SensAble project, the UVP platform, and microarray data)
- Hongli Li (Sc.D. expected 2008) Large graphs and pathways (Ms. Li has worked on various large graph projects and has accepted a position at Pfizer)
- Shaun Morrissey (Sc.D. expected 2009) Real time visual representation of Firewall/Security Rules sets (Mr. Morrissey is working at MITRE on security related issues)
- Alex Baumann (Sc.D. expected 2009) The Haptics and Sound API (Mr. Baumann has worked on haptics and sound projects for SensAble).
- Damon Berry (Sc.D. Expected 2009) Force points, a mathematics theory of visualization (Mr. Berry is working on the Indicator project)



- Henry Kostowski (Sc.D. expected 2009) A mathematical theory of visualization (Mr. Kostowski is building a theory based visualization system)
- Vivek Gupta (Sc.D. expected 2009) A new desktop metaphor (Mr. Gupta has been working on a new desktop metaphor, for which the University has applied for a patent)
- Brian Drohan (Ph.D. expected 2009), Architectures for Electronic Health Records. (Mr. Drohan has been working on the MGH project and focused on risk analysis for breast cancer and visualizations for physicians)
- Laura Costello (Sc.D. expected 2010), Data Analysis for Breast Cancer Risk Assessment (Ms. Costello has been working on using AI and mathematical tools on the MGH project).
- Amr Elbasiony (Sc.D, 2009) Human tissue characterization using imaging, visualization and vision.
- Chandana Ariyawansa (Sc.D., 2010) Non-text information retrieval.

Two juniors from CS have worked in the lab.

### **Current Research Projects**

**VAST Contest:** We are working with the University of Maryland and Pacific Northwest National Laboratories to continue to manage and evolve the Visual Analytics Science and Technology contests and conferences. We are also working to establishing an infrastructure for the scientific evaluation of visual analytics science and technology software systems

**Measures and Indicators Consortium:** We are working with Dr. Mass on the development of collaborative and web based interactive visualizations in the area of public planning and policy for New England indicators. We are developing a consortium to consist of about 10 members each paying \$75,000.

### **Publications**

Sharko, J., Grinstein G., and K. Marx, Vectorized RadViz and Its Application to Multiple Cluster Datasets, accepted for the IEEE 2008 Visualization Conference.

F. V. Paulovich, L. G. Nonato, R. Minghim, and H. Levkowitz. "Least Square Projection: a fast high precision multidimensional projection technique and its application to document mapping." IEEE Transactions on Visualization and Computer Graphics, May/June 2008 (Vol. 14, No. 3) pp. 564-575.

Plaisant C., G. Grinstein, J. Scholtz, M. Whiting, T. O'Connell, S. Laskowski, L. Chien, A. Tat, W. Wright, C. Görg, Z. Liu, N. Parekh, K. Singhal, and J. Stasko, Evaluating Visual Analytics: Lessons learned from the 2007 Visual Analytics Science and



Technology Symposium Contest, IEEE Computer Graphics and Applications, 2, March-April, Vol 14, pp 12-21 (2008).

Plaisant C., Fekete JD, and G. Grinstein (2008), Promoting Insight Based Evaluation of Visualizations: From Contest to Benchmark Repository, in IEEE Transactions on Visualization and Computer Graphics, Vol 14, No 1, 2008.

Martin F., Grinstein G., and S. Kuhn (2007), A Radical Design Course: Leveraging APIS for Creativity and Innovation in Software, Proceedings of the Software Engineering and Applications 2007 Conference (Cambridge MA)

Scholtz J., Grinstein G., and C. Plaisant, Metrics for the Evaluation of Visual Analytics, Proceedings of the IEEE Information Visualization Conference, Baltimore, October 2007

Grinstein G., T. O'Connell, S. Laskowski, C. Plaisant, J. Scholtz and M. Whiting, The VAST 2007 Contest – Blue Iguanodon, Proceedings of the IEEE Visual Analytics Systems and Technology Symposium, Baltimore, October 2007

Marx, K., Sharko, J., Grinstein, G., Odelberg, S., Simon, H. (2007), Evidence for Proximal to Distal Appendage Amputation Site Effects from Global Gene Expression Correlations Found in Newt Microarrays, Proceedings of the IEEE 7th International Symposium on Bioinformatics and BioEngineering, Harvard Medical School, Boston MA, pp 131-136, October 14-17, 2007

Sharko, J., Grinstein, G., Marx, K. A., Zhou, J., Cheng, C., Odelberg, S., and H. Simon (2007), Heat Map Visualizations Allow Comparison of Multiple Clustering Results and Evaluation of Dataset Quality: Application to Microarray Data, Proceedings of the 11th international Conference Information Visualization (July 04 - 06, 2007). IV. IEEE Computer Society, Washington, DC

For other CS related publications see the CBMI 2007-2008 report

## **Conference Presentations**

Numerous presentations at meetings of the IEEE, CBSE, ICDE, CHI, IBC, DDT, BioIT, and at Universities and Labs, including a keynote talk at the Pfizer Global Summit in the UK and keynote at Information Visualization 2008 in London this July.

### **Tutorials and Workshops:**

- R. Minghim and H. Levkowitz. Visual Text Mining. Eurographics 2007, Prague, Czech Republic, September 4, 2007.
- G. Grinstein. Information Visualization, a Modern Perspective for Visualization, Information Visualization 2008, London, U. K., July 2008.
- G. Grinstein, J. Scholtz, C. Plaisant. Benchmark Data Sets, VAST 2007, Sacramento CA, October 2007.



## Collaborations

Center for Biomolecular and Medical Informatics  
Center for Industrial Competitiveness  
Center for Intelligent Materials  
Department of Biological Sciences  
Department of Chemistry  
BBN

University of Maryland  
Pacific Northwest National Laboratories  
University of Sao Paulo, Sao Carlos, SP, Brazil

### Regional/Local Outreach

We made numerous presentations to high schools and community colleges on the computer science and of course the bioinformatics programs to help increase the number of students and minorities joining our programs.

### Proposals Submitted/Awarded

#### Awarded

**NSF with UMD and PNNL, 09/07 – 08/09, \$408,689 + \$12,000 REU**

PI: Dr. Georges Grinstein

Collaborative Research: Scientific Evaluation Methods for Visual Analytics Science and technology (SEMAST) Research on Visual Analytics

**Boston Foundation, 07/07-12/07, \$5,000**

PI: Dr. Bill Mass and Dr. Georges Grinstein

NE Measures & Indicators: Regional System Tools to Advance a National Model

**National Academy of Sciences, 07/07-12/07, \$10,000**

PI: Dr. Bill Mass and Dr. Georges Grinstein

NE Measures & Indicators Prototype

**NIST, 7/06-12/08, additional \$25,000, then \$20,000**

We are working with the University of Maryland and Pacific Northwest National Laboratories to continue to manage and evolve the Visual Analytics Science and Technology contests and conferences.

**Vital Solutions, 3/08-6/08, \$9,000**

HL7 message translators for Walter Reed Hospital

#### Submitted

NSF, \$280,000: Ultra High Dimensional Mapping for Visual Data Analytics, with Dr. Daniels and Dr. Rybnikov (**not awarded**)

DHS, \$700,000 (6 year): Center of Excellence for Command Control and Interoperability, with Rutgers as lead institution. (**Decision to be made August 31**)



MICo-Viz Consortium is moving forward with Arizona having committed and several others about to (\$75,000 per year for 2 years per member), with Bill Mass and Charlotte Kahn.



27. THE KERR ERGONOMICS INSTITUTE  
UNIVERSITY OF MASSACHUSETTS LOWELL

**Annual Report to CFCI 2007-2008**

**1. Mission Statement**

The mission of the Kerr Ergonomics Institute (KEI) is to conduct research and provide technical assistance to industry, labor, and the public sector on the health, safety, and productivity consequences of designing (or failing to design) jobs to fit human needs. KEI seeks specifically to evaluate the physical, psychosocial and organizational causes of workplace injury and disease, their associated costs, and the effectiveness of potential prevention measures.

**2. Description and Goals**

The Kerr Ergonomics Institute is the region's only comprehensive, university-based ergonomics research center to examine the relationship among occupational ergonomic hazards, psychosocial stress, and work organization, and their effects on worker health and safety. KEI takes a multi-disciplinary approach to the study and prevention of occupational injuries, musculoskeletal disorders, and stress-related illness. Their impact on employers, workers, and society threatens sustainable economic development through lost productivity and earnings, increased costs to employers, and impairment and reduced quality of life for affected workers. KEI's goal is to develop long-term solutions to the occupational health and injury crisis, promoting injury and disease prevention strategies as an essential component of industrial and public policy.

The KEI contains the Job Content Questionnaire (JCQ) Center, which administers the international network and database of JCQ users. A related area of expertise is development of new forms of healthy work organization that both maintain productivity and reduce stress risks in the workplace. Work organization improvements that can reduce stress (increased employee skill development and participation in decision-making) also can lead to improved productivity in general. The new wave of industrial development requires skill-based forms of production, which in turn requires participatory methods of work organization change.

**3. Research Focus Areas**

The key areas of scholarship within KEI are:

- a. Measurement and evaluation of occupational ergonomic (physical) exposures
- b. Measurement and evaluation of psychosocial and organizational stressors
- c. Evaluation of the health effects of both (a) and (b), and especially their interactions: acute injury, musculoskeletal disorders, cardiovascular disease, mental health, etc.
- d. Prevention of these exposures and their health effects through intervention at both the micro level (job, workplace) and the macro level (national public policy, economic incentive structure).



#### **4. Associated Personnel (Faculty and Staff)**

Dr. Robert Karasek, Professor and Director  
Dr. Laura Punnett, Professor  
Dr. Sean Collins, Associate Professor  
Dr. Maria Brunette, Assistant Professor  
Dr. Bryan Buchholz, Professor  
Dr. David Wegman, Dean  
Sandra Gibson, Staff Assistant, Job Content Questionnaire Center

#### **5. New and temporary faculty affiliations (2007 - 2008)**

1. Dr. BongKyoo Choi has been a post-doctoral research fellow of the Kerr UML. He worked with Professors: Robert Karasek, Laura Punnett, Meg Bond (UML) and Per-Olof Ostergren (Lund University, Sweden). He has investigated the buffering effects of job control and social support at work on the associations of job demands with mental health with a prospective Swedish dataset. He has designed and conducted a work demand project on UML non-faculty workers that qualitatively investigate potential differential understandings of the work demands items of the JCQ. In addition, he has assisted Prof. Karasek to organize an international JCQ work demand workshop at the 3<sup>rd</sup> ICOH-WOPS conference (Quebec, Canada, 2008; described in detail later). Furthermore, he has examined measurement equivalence of translated JCQs into several European languages with both quantitative and qualitative methods for assuring the JCQ scale score comparability among European countries.

#### **6. Current Research Projects (2007-08)**

*a. JCQ: International Coordination and Evolution of Job Stress Assessment Methodologies*  
(NOTE: Background information was described in the Kerr 2006-07 report in detail)

The Job Content Questionnaire (JCQ), developed by Dr. Karasek with U.S. nationally standardized data, is broadly utilized around the world for assessing psychosocial workplace risks in epidemiological studies of chronic disease and wellbeing. The JCQ provides the basis for assessing job stress according to the Karasek "demand/control" model and has been translated into 27 languages. Several very large (40,000+ subjects), multi-country, multi-site Japanese and European studies of job stress and heart disease use the JCQ, developed, with agreements to make the data available to KEI researchers.

International coordination of job stress hazard assessments in the workplace is managed at the JCQ Center, within KEI. The JCQ Center has an international board of directors and represents an example of international collaboration on an impressive scale. Several Work Environment students have utilized the JCQ for course projects in local industries, in developing research project summaries for the 100+ JCQ projects, in developing the user network in conjunction with the Psychology Department, and in international standardization of stress hazard instruments.



a. The status of the JCQ 2.0 development process (the Job Content Questionnaire, a psychosocial work hazards questionnaire).

The main accomplishment is a revision of the much-used JCQ. This new version, JCQ 2.0, is now being pilot tested in studies involving 5000 workers in China – in studies in five sites. As can be seen below – this involves measurements of worker control (JCQ decision latitude) in a new form involving global neo-liberal effects, job security and organizational impacts. The results from two of these five studies will be presented and discussed at the 3<sup>rd</sup> ICOH-WOPS conference (Quebec, Canada, September 1 to 4, 2008) and the JCQ work demands workshop (Quebec, Canada, September 4 to 5, 2008; for details, see below).

This new version of the JCQ was developed in multiple steps, starting with the testing of a Korean Pilot instrument already in February 2005 on 8,000 Korean workers. The next step – at the beginning of the Karasek sabbatical (2005-06) - was the formation of the Chinese JCQ 2.0 Pilot group in August 2005 and the Second ICOH Conference in Okayama, Japan, and this was followed by the International Workshop in Amsterdam in November 2005 (with the Chinese and Koreans participating), and finally with the international discussions during February and March 2006.

Based on critical reviews on the Korean and Chinese JCQ 2.0 pilot studies at the JCQ work demands workshop, another round of JCQ 2.0 pilot studies will be planned in collaboration with international JCQ board members and international JCQ user group. At present, three opportunities are identified: Prof. Maureen Dollard (University of South Australia, Australia); Prof. Junming Dai (China, Fudan University), and Prof. Per-Olof Ostergren (Sweden, Lund University).

b. International JCQ workshop on work demands: Measuring Complex, Multilevel Social Job Demands in the Global Economy and Service/Information Society.

The existing work demands scales of the JCQ (and perhaps other contemporary psychosocial questionnaires) may not optimally measure complex social demands in the global economy, or demands of the service/information society.

How to improve the work demands scales theoretically and methodologically to address new types of these challenges, as we move to complete the JCQ 2.0. The spread of a global economy with few protective social structures increases coping challenges for many workers all over the globe. The extension of social services in the developed and developing countries and the “information society” provide complex new social job demands. A variety of theoretical expansions (including the new “Associationist” Demand/Control model) and understandings of complex social behavior imply the need for a new look at demands scales, as do statistical, and comparative analysis of demand scale properties. These all confirm the need to accommodate new dynamic changes, and multiple levels of stressors and control. However, how these conceptions would be translated into practical assessment tools requires a broad new discussion.

Prof. Karasek and Dr. BongKyoo Choi have organized the international JCQ workshop on work demands. About 35 internationally renowned scholars will attend the workshop and its detailed program is as follows:

- Sept. 4, 2008 (4:30 pm to 6:00 pm – just after ICOH closing): The New Challenge: several background presentations.
- Sept. 5, 2008 (8:30 am to 12:30 pm): Main Discussion (a) Breakout Groups bridging our current research themes with these new social challenges and potentially broader theoretical constructions: a) multiple-level “quantitative demands” -labor intensification; b) multi-level emotional labor, social support, hostility, justice; c) multi-level human relations personal politics; d) job insecurity; e) boundaryless, work and unpredictability. (b) Plenary discussion: What must be measured? (c) Writing group and next pilot location?
- Sept. 5, 2008 (1:15 pm to 2:30 pm): Discussion - Macro Decision Latitude results from the Korean and Chinese pilot studies.

### c. International Comparison of Psychosocial Job Hazards (JCQ)

Current assessment of bad working conditions used in international discussions-such as ILO statistics (accidents, work-related fatalities, or absenteeism registries in some developed countries) typically do not assess the social organization of work and its consequences working situations directly. This leaves a major gap in our understanding of the human costs of our global economics development, which has increased workplace competitive pressures, and restricted worker's powers and protections. One barrier for understanding the full international scope of this problem is lack of scientifically appropriate tools for internationally comparative assessment of psychosocial working conditions.

We contacted and already identified enthusiastic interests of eleven renowned researchers from ten different countries in this project who have the JCQ datasets that represent 100,000 workers in ten countries: US (Robert Karasek and BongKyo Choi), Brazil (Tania Araujo), South Korea (Sejin Chang), Mexico (Leonor Cedillo), Taiwan (Yawen Cheng), Canada (Chantal Brisson), Japan (Norito Kawakami), Sweden (Per-Olof Ostergren), Italy (Marco Ferrario), and Belgium (Marcel Kornitzer). Also we already developed a four-stage methodology for a cross-cultural (national) comparative studies of perceive psychosocial job hazards (BongKyo Choi) in 2006.

The aforementioned international research network and developed cross-cultural comparative methodology can be used for three future projects in relation to the JCQ 2.0.

1. To examine the difference and similarity of the function (reliability) of the JCQ 2.0 by culture (nation), gender, social class, industry, and occupation (project I).

2. Comparisons of social policies on quality of working life (psychosocial) or job-stress related policies among countries (European countries, USA, Japan, Korea, Brazil, Taiwan, and Mexico) (project II).

3. Assessing the predictive validity of the new JCQ 2.0 in an internationally comparative context for the three main health outcome variables (MSDs, Mental Health, and CVDs) – as measured by self-report questionnaire health data available in the surveys -forthcoming data collection (project III).



*b. Heart Rate Variability and Monitoring of Job Stress/Stress-Disequilibrium Theory*

(NOTE: this section includes description of activities from 2005-06 that were omitted in the Kerr 2005-06 report).

This area of research effort includes several related components that take tools from clinical medicine and using them in a new manner for job stress and health research. . It focuses on a broadly applicable method for measuring the physiological effects of stress on the body: cardiovascular monitoring of stress response via heart rate variability (HRV). The heart rate-variability field methodology, based on new techniques for analyses of standard Holter EKG monitoring, can assess the above "system-level" deficiencies in physiologic functioning linking cardiovascular, central nervous system, and endocrine response. Measuring the deregulation that occurs under chronic stress should allow understanding of peripheral blood flow contributions to chronic musculoskeletal disease development, as well as to understanding of the numerous job stress/coronary heart disease findings in epidemiologic studies.

This project is important for assessing the health status of workforce participants as aging workforce chronic disease incidence increases (diabetes II, depression, heart disease-hypertension, etc.). This is a promising new area of job stress physiological risk measurement, with applications for cardiovascular disease (CVD), depression, pain response, asthma, and metabolic illness.

The current goal is to develop a new field study – and write a research proposal for this involving Danish / EU funding – and parallel US/UML funding - to test the extent to which long term autonomic deregulation can be related to job stress.

The project involves the beginning the research proposal (Boston/Copenhagen) – HRV Job Stress Study Design Panel – with a panel discussion at for university students, May 2, 2007 (KU/NFA - Copenhagen).

*b: Testing Job Stress/Heart Rate Variability and Workshop Development*

This second area of effort includes several related components: (a) 2 day international workshop where we provide the content for a new approach which takes tools from clinical medicine and using them in a new manner for occupational health research; (b) the seminar series at AMI; and (c) the beginning research proposal (Boston/Copenhagen). This project is important for assessing the health status of workforce participants as aging workforce chronic disease incidence increases (diabetes II, depression, heart disease-hypertension, etc.). This workshop introduces a promising new area of job stress physiological risk measurement, with applications for cardiovascular disease (CVD), depression, pain response, asthma, and metabolic illness. It focuses on a broadly applicable method for measuring the physiological effects of stress on the body: cardiovascular monitoring of stress response via heart rate variability (HRV).

1. A NIVA (Nordic collaboration support council) international workshop: "Job Stress, Chronic Disease, and Heart Rate Variability: Measuring a New Pathway of Work-related Chronic Disease Risk" at the National Institute for Occupational Health (NFA/AMI) in Copenhagen Denmark, June 6-7, 2006 in Copenhagen, Denmark.

Karasek was the chair, and organized this workshop as a major portion of this goal of the sabbatical to support Heart Rate Variability and Job Stress research. I provide roughly 2 hours of the workshop lecture material, and detailed content outline of the full seminar (PPT). The co-chair Sean Collins, from University of Massachusetts Lowell brought critical new research in this area, and Jester C Kristiansen, PhD AMI (Danish National Institute for Occupational



Health), also a researcher in this area. 35 researchers from eight countries attended from Europe, Asia and North America.

It should be noted that Harvard Medical School ran a large workshop in Boston on HRV methods in chronic disease one month before ours in Copenhagen. However, persons who attended both workshops thought ours was much better – and far more useful for environment and health issues. In spite of numerous presentation at the HarvMed event, there was no mention whatever there of the effects of job stress, nor any hints of the possibility of using HRV methods for the purpose of assessing healthy (or exhausted) response to the environment – only methodological details, drug relations, etc.

2. Karasek organized, with Jesper Kristiansen of AMI, a series of research seminars in the heart rate variability, job stress and chronic disease area – to reinforce analytic skills in this area (sabbatical year 2005-06). As we began our research dialogue in the fall of 2005 it became clear that short discussion with individual researchers contributing short reviews and inconsistent coverage would not be sufficient to support truly successful research contributions in this area. A more tightly integrated approach was needed to develop the dialogue to support HRV research in this new occupational health direction, and support the “finale” the NIVA international Workshop.

The Job Stress and HRV Seminars were all held at AMI, starting in /spring 2006: January 11, 2006 (Karasek); February 22, 2006 (Kristensen and Garde), March 8, 2006 (Eilers); April 19th, 2006 (Gogenur); May 10 (Malmberg), 2006.

### *c. Expanding the Demand/Control Model, and Links to Social Policy and to Other Social Well-being Approaches*

(NOTE: this section includes description of activities from 2005-06 that were omitted in the Kerr 2005-06 report).

In this area, the major activity was another international conference: the 30th birthday of the D/C Model – an international convocation to integrate the Karasek Demand/Control approach with other related intellectual/social policy contributions.

1. “From Healthy Work to Healthy Society, the Thirtieth Birthday of the Demand/Control/Support Model”, Stockholm, Sweden

Karasek was conference co-organizer with Töres Theorell, at the IPM national Institute for Psychosocial Medicine in Stockholm. The Conference was held at Moderna Museet, Stockholm, May 31 to June 1, 2006. Töres Theorell and IPM stood for the practical organization of the conference, while Karasek developed conference plan, new content, and built discussion linkages between different approaches. 32 researchers from over fifteen countries attended – well-known researchers in the area of social epidemiology, social differences in health, and psychosocial, work organization and stress physiology attended

This is the birthday/anniversary celebration for the research direction that Karasek started in 1976 with the Demand/Control Model. Since much of the work since the late 1970’s has been in collaboration with Töres Theorell (also co/author of Health Work), we collaborated on organization of this international discussion: The goal was to re-link to the Scandinavian “movement toward improvements of social and political conditions for increased individual control in daily life related not only to the Demand/Control Model but also to its intellectual



cousins and to the D/C model's several extensions." This was discussed in the context of Distribution, Production, Health and Reproduction.

Karasek introductory talk (30 minutes PPT) focused on the political economic background of the current neo-liberal market economy – and how a comprehensive work organization and psychosocial approach (including the demand control model extensions – but importantly- all of the other related political economic approaches) could provide the foundations for an alternative political economy. Karasek co-chaired the General Discussion with Töres Theorell.

The conference succeeded in building the platform for social policy discussions in the future linked to work organization and psychosocial factors. Conference contributions are now collected as a coming special issue of the Scandinavian Journal of Work Environment and Health (2008).

#### *d. Testing of the Job Stress Work-relatedness of Chronic Disease Disability*

This project has proceeded in multiple steps since fall of 2005, and is still ongoing. It involves research at Lund University/Malmö Hospital in collaboration with Per-Olof Ostergren, department chair, Mahnaz Mogaddiassi, Catarina Canivet, myself and BongKyoo Choi. The project involves following up new disability cases developing over a ten-year period from a base population in a representative sample of Malmö residents who were investigated initially for job stress association with heart disease (JACE database), MSD and cancer using the JCQ. Swedish population registries make possible data-linkage to national disability and health insurance information. A number of publications are currently in draft status.

#### *e. Occupation-specific associations between the JCQ psychological and physical demands items*

Dr. BongKyoo Choi and Prof. Laura Punnett have investigated occupation-specific relationships between the JCQ psychological and physical demands items in collaboration with Prof. Meg Bond (Center for Women and Work). Quantitative clustering analyses were carried out in each of six broad occupation groups and their results were compared across occupations in the UML 2000 employee survey dataset. In addition, one male worker and one female worker for each of the six occupations were interviewed on how they interpreted the JCQ two demands items. The interviews are being transcribed by Alicia Kurowski (Work Environment UML) and a draft manuscript is being prepared by BongKyoo Choi. The results of this study will be used for revising the present JCQ work demands items in the context of the JCQ 2.0 development.

#### *f. Cost-Effectiveness of Occupational Health Interventions*

Dr. Punnett and other KEI investigators have collaborated with Supriya Lahiri, Ph.D., in the Department of Economics, in the analysis of the cost-effectiveness of interventions to prevent occupational disease. (Previous work was described in detail in last year's report.) New work this year has shifted to the Center for Promotion of Health in the New England Workplace, directed by Dr. Punnett, within which Dr. Lahiri is collaborating on the comprehensive analysis of the cost-effectiveness of a "No-Lift" program to reduce low back pain (LBP) and injuries in the nursing home sector. Dr. Lahiri also has another ongoing effort to extend this work, with regard to LBP in the produce distribution sector, with UNICAMP Brazil and the Ergonomics



Laboratory at the Calcutta University, College of Science and Technology. The overall goal is to validate the net-cost model for the monitoring, reporting and analyzing cost and effectiveness data through prospective studies in a variety of industrial settings and in countries at various stages of economic development.

*g. Ergonomic Exposures and Musculoskeletal Disorders in the Construction Sector*

Building on our past experience in construction ergonomics, a newly funded project seeks to develop data on occupational exposures relevant to studying osteoarthritis and other chronic knee disorders, using ergonomic field observation methods and questionnaire-based exposure assessments from two carpenters' databases. Knee disorders are a major source of disability and early departure from work but there is limited knowledge about the risk of knee disorders related to work. Most studies finding associations with work have relied on job titles or relatively simple questionnaire surveys for exposure assessment and characterized exposure crudely, without information on level or type of biomechanical risk factors. As a result, little is known about the association of knee disorders with compressive force or torque on the knee joint resulting from varying intensities and durations of exposures to awkward sustained postures, squatting, kneeling, weight lifted, etc. Our goals are to improve upon this qualitative risk characterization by providing better specification of types of ergonomic risk factors along with semi-quantitative estimates of exposure intensity for these. A working population of union carpenters will be targeted because they have a range of types and intensity of biomechanical risks for knee disorders. The proposed study is designed with a focus on the risk of osteoarthritis and other chronic knee conditions associated with chronic biomechanical exposures to the lower limb. The outcomes from this study will be new knowledge about biomechanical exposures in these jobs that can be directly applied to preventing known risk circumstances (e.g., tasks resulting in unacceptable torque). This is an important area of research because there has been little research on chronic knee disorders as related to work exposures. It is innovative in the development of the health and exposure databases and the potential applicability of this method to extract useful data from other administrative health databases.

In a separate initiative, we analyzed the data from a NIOSH cross-sectional study of musculoskeletal pain reports and ergonomic risk factors in operators of heavy mobile equipment. A self-administered survey was administered to 598 unionized operating engineers in 9 states attending classes at union training centers. The survey assessed musculoskeletal pain at multiple body sites, workplace ergonomic and psychosocial exposures, general working conditions, job history, age, personal health and habits. Musculoskeletal symptoms at nine body locations were combined into four response variables by body area (full-body, arm, leg, and back/neck) and dichotomized (high/low) for multivariable logistic regression analysis. Results showed that lack of adjustability and poor physical environment were each associated with musculoskeletal pain in the back and neck, upper and lower extremities. Inadequate maintenance was most strongly associated with upper extremity symptoms. There was a high risk of leg pain among those who had to jump off their vehicle. Number of rest breaks per day (including lunch) had a weak and inconsistent protective effect. In multivariable models, strong associations between symptoms and ergonomic risk factors remained when adjusted for personal and general working environment factors. Symptom prevalence was positively associated with body mass index (BMI) but not age. Ergonomic exposures governed by equipment design were associated with



reports of musculoskeletal symptoms in operating engineers, indicating a potential role for ergonomically designed equipment in injury prevention.

#### *h. Ergonomic Exposures and Musculoskeletal Disorders in Automobile Manufacturing*

We have carried out several studies of ergonomic exposures and musculoskeletal disorders of the back and upper extremity in the automotive industry. (Previous work was described in detail in last year's report.) Most notable in this follow-up study was the extent of changes in production technology over six years and how these tracked workers' perceptions of decision latitude on the job, as well as how they forced substantial revision in the ergonomic job analysis methodology utilized (informed by previous developments at KEI in the analysis of construction labor) [Gold et al., 2006]. Two other papers, one published this year and one under review, have addressed reproducibility of self-reported exposure to physical and psychosocial exposures at work by automotive plant employees [d'Errico et al., 2007 and under review]; and the extent of forgetting prior musculoskeletal symptoms by employees who were no longer symptomatic [Miranda et al., 2006].

Another set of analyses examined agreement between subjective ratings and direct measures of ergonomic exposure in a subset of 76 workers. Direct measurements were found to explain some of the variability in several psychophysical exposure ratings in automobile manufacturing workers. In particular, significant relationships were found between self-reported manual effort and absolute grip force, estimated from electromyography (EMG), and between workers' ratings of pace and directly measured grip force and wrist motion. When grip force was expressed as a percentage of each subject's strength, the association was stronger and the regression model explained 27% of the variability in the manual effort ratings. Similarly, a multivariate regression model of work pace ratings on relative grip force and flexion-extension acceleration explained 35% of the variability. Musculoskeletal disorder symptoms (dichotomous) at the time of the direct measurements had an effect on these relationships: workers with hand/wrist symptoms provided ratings that were much more strongly related to the directly measured exposures. This effect modification was also observed for the relationship between the rating of wrist and hand position and direct measurements of wrist motion.

#### *i. Socioeconomic Disparities in Health*

This NIOSH-funded research project (Principal Investigators, Drs. Craig Slatin and Laura Punnett), on the extent to which working conditions explain the relationship between socioeconomic status and health in the healthcare sector, submitted its final report in December, 2006. The work environment conditions that are risk factors for injury and disease showed a marked socioeconomic gradient: physical load (e.g., heavy lifting or repetitive manual work), shift work, high psychological job demands with low decision autonomy, threat of interpersonal violence, etc. Among many other findings, we showed that these features of the work environment were strongly associated with the risk of acute workplace injuries in the two study hospitals, and also that these job characteristics explained a high proportion of the strong socioeconomic gradient in injury risk [d'Errico et al., 2007].



#### *j. Global Burden of Work-Related Low Back Pain and Arthritis*

The questions of whether or not musculoskeletal disorders (MSDs) are causally associated with physical workload, whether or not dose-response curves can be defined, and what proportion of MSDs in the U.S. workforce can be attributed to work demands, have generated substantial discussion in recent years. Challenges in interpreting the literature include diverse exposure assessment methods, definitions of endpoints, and other methodologic issues discussed below. In this context, we have previously undertaken several reviews of the epidemiology, some of which have been published in the open literature. Most recently we have collaborated with researchers at the World Health Organization in analyzing two large international data sets to estimate that about 37% of low back pain and as much as 60% of arthritis, world-wide, could be attributable to working conditions.

#### *k. Gender Issues in Occupational Health*

Overall differences between men and women in the rates and patterns of workplace injury and illness result to a large extent from the patterns of employment of men and women and the consequent differences in their exposures to health and safety hazards. With regard to musculoskeletal disorders, in particular, some of the gender differences in rates - even within job titles - appear to result from (formal or informal) job segregation and different task distributions, although the epidemiologic literature is not conclusive. To the extent that there are real differences, not confounded by job demands, these may represent behavioral or physiological factors or the added contribution of household work and the “double duty” of work and family (both physical and psychosocial aspects). Successful strategies for resolving health and safety problems among women workers need to take into account the features of women’s employment and its broader socioeconomic context. Collaboration with the UML Center for Women and Work to develop a research program related to these issues has been supported by the CFCI since 1998 and continued both as part of the recently concluded project on Socioeconomic Disparities in Health (see above) as well as separately. In May, 2007, Dr. Punnett was an invited plenary keynote speaker on this topic at the American Occupational Health Conference, annual meeting of the American College of Occupational and Environmental Medicine, in New Orleans LA..

### **7. Publications (2007-2008)**

#### **a. Peer-Reviewed Journal Articles**

Araujo T, R. Karasek, ”Validity and reliability of the Job Content Questionnaire in formal and informal jobs in Brazil”, *Scandinavian Journal of Work Environment and Health*, (accepted May, 2007).

Buchholz, B., Park, J.-S., Gold, J.E. and Punnett, L. Subjective ratings of upper extremity exposures: Inter-method agreement with direct measurement of exposures. *Ergonomics* 2008; **51**(7): 1064-1077.



Canivet C, Östergren PO, Choi BK, Nilsson P, af Sillén U, Moghadassi M, Karasek RA, Isacson SO. Self-reported sleeping problems as a risk factor for subsequent muscular pain. Results from a one-year follow-up of the Malmö Shoulder Neck Study cohort. *International Journal of Behavioral Medicine*. (accepted January 2008).

Cho SL, Eum KD, Choi BK, Paek DM, Karasek R. Social class, job insecurity, and job strain in Korea. *Scand J Work Environ Health Suppl* 2008; 6 (Accepted July 2007).

Choi BK, Kawakami N, Chang SJ, Koh SB, Bjorner J, Punnett L, Karasek R. A cross-national study on the multidimensional characteristics of the five-item psychological demands scale of the Job Content Questionnaire. *Intern J Behav Med* 2008; 15(2): 120-132.

Choi BK, Clays E, de Bacquer D, Karasek R. Socioeconomic status, job strain, and common mental disorders: an ecological (occupational) analysis. *Scand J Work Environ Health Suppl* 2008; 6: 22-32.

Cifuentes M, Gore R, Boyer J, Tessler J, d'Errico A, Scollin P, Lerner D, Kriebel D, Punnett L, Phase in Healthcare Research Team. Inter-method agreement between O\*NET and survey measures of psychosocial exposure among healthcare industry employees. *Am J Ind Med* 2007; 50(7):545-553.

Clays E, F Leynen, D de Backer, M Kornitzer, F Kittel, R Karasek, G de Backer, "High job strain and ambulatory blood pressure in middle-aged men and women from the Belstress study," *J Occup Environ Med* 2007; 49(4): 360-367

Dai JM, Collins SM, Hu F, Fua H. Comparison of Job Stress Models in Predicting Job Burnout in Shanghai Employees. *Journal of Occupational and Environmental Medicine* 2008;50(7):785-790.

d'Errico A, Gore R, Gold JE, Park JS, Punnett L. Medium- and long-term reproducibility of self-reported exposure to physical ergonomics factors at work. *Applied Ergonomics* 2007 Mar;38(2):167-75.

d'Errico A, Punnett L, Cifuentes M, Boyer J, Tessler J, Gore R, Scollin P, Slatin C, Promoting Healthy and Safe Employment in Healthcare Research Team. Hospital injury rates in relation to socioeconomic status and working conditions. *Occup Envir Med* 2007;64:325-333.

KD Eum, J Li, HJ Jhun, JT Park, SW Tak R Karasek, SI Cho, "Psychometric Properties of the Korean Version of the Job Content Questionnaire: Data from Health Care Workers," *International Archives of Occupational and Environmental Health* 2007; 80(6):497-504.



Karasek, R. "Low social control and physiological deregulation: An outline of the Stress-Disequilibrium theory of chronic disease development, Towards a new Demand/Control model" Scand J Work Environ Health Suppl 2008;6: 117-135.

Karasek R, Choi BK, Ostergren PO, Kornitzer M, deSmet P. Testing two methods to create comparable scale scoring between the JCQ and JCQ-like questionnaires in the JACE study. *International Journal of Behavioral Medicine* 2007; 14(4): 189-201.

Miranda H, Punnett L, Viikari-Juntura E, Heliövaara M, Knekt P,. Physical work and chronic shoulder disorder. Results of a prospective population-based study. Annals Rheum Dis 2008; 67(2):218-223.

Myers D, Kriebel D, Wegman DH, Karasek RA, Punnett L. The social distribution of risk at work: Acute injuries and physical assaults among healthcare workers working in a long-term care facility. Social Science Med 2007;64:794-806.

Tak SW, Punnett L, Paquet V, Woskie S, Buchholz B. Estimation of compressive force on the lumbar spine from categorical posture data. Ergonomics 2007; 50(12): 2082-2094.

Wallace RF, Kriebel D, Punnett L, Wegman DH, Amoroso PJ. Prior heat illness hospitalization and risk of early death. Environmental Research 2007 Jun;104(2):290-5.

## **b. Books and Book Chapters**

Bond MA, Kalaja A, Punnett L, Cazeca D, Daniel S, Tsurikova L. *Expanding our Understanding of the Psychosocial Work Environment: A Compendium of Measures of Discrimination, Harassment, and Biases*. Cincinnati OH: U.S. National Institute of Occupational Safety and Health, February 2008 (NIOSH publication No. 2008-104).

## **c. Technical Reports**

Adams KP, Punnett L. Musculoskeletal Symptoms and Risk Factors in Operators of Heavy Mobile Equipment. Final Project Report: Contract # 254-2006-M-17949, National Institute of Occupational Safety and Health, June 2007.

## **d. Invited Commentaries & Other**

Collins SM, Landsbergis P, Warren N, LaMontagne AD. Stopping Stress at its Origins: Working Conditions. *Hypertension* 2007; 49:e33.



MacDonald LA, Härenstam A, Warren ND, Punnett L. Incorporating work organization into occupational health research - An invitation for dialog. *Occup Environ Med* 2008;**65**:1-3.

#### **e. Manuscripts in review and preparation**

Choi, BK, J. Bjorner, P-O Ostergren, E. Clays, I Houtman, P de Smet, G. de Backer, M. Ferrario, L. Punnett, A. Rosengren, R. Karasek. A study on cross-cultural differential item functioning of the Job Content Questionnaire among European countries: the JACE Study (submitted to the *Int J Behav Med*, April 2008).

Choi BK, Ostergren PO, Canivet C, Moghadassi M, Lindeberg S, Nilsson P, af Sillén U, Karasek RA, Isacson SO. Testing buffer hypotheses of the job demand-control-support model in relation to psychological distress (submitted to the *Int J Behav Med*, May 2008).

Choi BK, Kawakami N, Chang SJ, Clays E, Koh SB, de Bacquer D, de Smet P, & Karasek RA. “Exploring the relationship between socioeconomic status and job strain of the Karasek’s Demand-Control Model: a cross-national study,” (manuscript under revision).

Choi BK, Kurowski A, Punnett L, Bond M. Occupation-specific association between the JCQ psychological and physical job demand items in university workers (Manuscript in preparation)

Eum KD, Yim SH, Lee YK, Han II, Yoon GW, Paek DM, Choi BK, Johnson J, Karasek RA, & Cho SI. (2008 May). First Proto-pilot Version of Job Content Questionnaire 2.0: Validity and Reliability of Pilot Version of Original Core JCQ. (submitted to the *Int J Behav Med*, May 2008).

Karasek RA, Choi BK, Ostergren PO, Ferrario M, & De Smet P. International comparison of perceived psychosocial job hazards among European countries. (Manuscript under review among authors)

#### **f. Student Theses**

Chun, Heekyoung. “Job insecurity and workers’ compensation filing” November 2007. (Thesis advisor: Robert Karasek)

#### **g. Conference Abstracts & Presentations**

Adams KP, Punnett L. Musculoskeletal Symptoms and Risk Factors in Operators of Heavy Mobile Equipment. Sixth International Scientific Conference on Prevention of Work-related Musculoskeletal Disorders (PREMUS 2007), Boston MA, Aug 2007 (accepted).

Boyer J, Tessler, J, Cifuentes M, Punnett L, PHASE in Healthcare. Development of an ergonomic job exposure matrix (JEM) for the healthcare sector. Sixth International Scientific Conference on Prevention of Work-related Musculoskeletal Disorders (PREMUS 2007), Boston MA, Aug 2007 (accepted).

Buchholz B, Punnett L, Park J-S, Gold JE. Agreement between subjective ratings and direct measures of ergonomic exposure. Sixth International Scientific Conference on Prevention of Work-related Musculoskeletal Disorders (PREMUS 2007), Boston MA, Aug 2007 (accepted).

Canivet C, Östergren PO, Choi BK, Nilsson P, af Sillén U, Moghadassi M, Karasek RA, & Isacson SO. Self-reported sleeping problems as a risk factor for subsequent muscular pain. Results from a one-year follow-up of the Malmö Shoulder Neck Study cohort (accepted as an oral presentation). 10<sup>th</sup> International Congress of Behavioral Medicine, Tokyo, Aug 27-30, Japan, 2008.

Cho SI, Eum KD, Karasek R, Choi BK, Yim SH, & Paek DM. Multiscale characteristics of job demand and their implications for JCQ 2.0 development. (accepted as an oral presentation). 3rd International Congress of Occupational Health on Psychosocial Factors at Work, Quebec, September 1-4, Canada, 2008).

Choi BK, Ostergren PO, Canivet C, Moghadassi M, Lindeberg S, Nilsson P, af Sillén U, Karasek RA, Isacson SO. A prospective study on the buffer hypotheses of the Karasek's demand-control-support model in relation to common mental disorders (accepted as a poster presentation). 10<sup>th</sup> International Congress of Behavioral Medicine, Tokyo, Aug 27-30, Japan, 2008.

Choi BK, Punnett L, & Bond M. A Construct Validity Study on the Psychological and Physical Job Demands Scales of the Job Content Questionnaire (JCQ) in University Workers (accepted as an oral presentation). 10<sup>th</sup> International Congress of Behavioral Medicine, Tokyo, Aug 27-30, Japan, 2008.

Choi BK, Bjorner J, Ostergren PO, Clay E, Houtman I, Punnett L, Rosengren A, de Bacquer D, Ferrario M, Bilau M, & Karasek RA. A study on cross-cultural differential item functioning of the Job Content Questionnaire among European countries: the JACE Study. (accepted as an oral presentation). 3rd International Congress of Occupational Health on Psychosocial Factors at Work, Quebec, September 1-4, Canada, 2008).

Choi BK, Eum KD, Kawakami N, Johnson J, Yim SH, Paek DM, Karasek R, & Cho SI. A psychometric study for incorporating emotional demand items into the Job Content Questionnaire (JCQ) 2.0: the Korean Pilot Study. (accepted as an oral presentation). 3rd International Congress of Occupational Health on Psychosocial Factors at Work, Quebec, September 1-4, Canada, 2008.

Cifuentes M, Tak SW, Sembajwe G, Gore R, Punnett L, Kriebel D. International co-morbidity of low back pain and major depressive episode. Sixth International Scientific Conference on Prevention of Work-related Musculoskeletal Disorders (PREMUS 2007), Boston MA, Aug 2007 (accepted).

Eum KD, Lee MS, Yim SH, Lee YK, Han II, Yoon GW, Paek DM, **Choi BK**, Johnson JV, Karasek R, & Cho SI. (2007). Direct and indirect effects of job insecurity through psychosocial and physical conditions on musculoskeletal disorders (oral presentation). Sixth International Scientific Conference on Prevention of Work-related Musculoskeletal Disorders (PREMUS), August 27 to 30, 2007, Boston, USA.



Kang DM, Kim I, Kim J, Kim E, Koh SB, Punnett L. Reliability and validity of questionnaire to assess labor intensification. Sixth International Scientific Conference on Prevention of Work-related Musculoskeletal Disorders (PREMUS 2007), Boston MA, Aug 2007 (accepted).

Karasek R. Theoretical base for transition to JCQ 2.0: Associationist Demand/Control Model (accepted as an oral presentation). 3rd International Congress of Occupational Health on Psychosocial Factors at Work, Quebec, September 1-4, Canada, 2008).

Li J, Karasek R, Cho SI, Choi BK, Johnson J, Ostry A, & Landsbergis P. Reliability analysis, scale structure, and findings from Chinese JCQ 2.0 Proto-Pilot Study. (accepted as an oral presentation). 3rd International Congress of Occupational Health on Psychosocial Factors at Work, Quebec, September 1-4, Canada, 2008).

MacDonald L, Härenstam A, Warren N, Punnett L. Work organization and risk factors for musculoskeletal disorders. Invited keynote: Sixth International Scientific Conference on Prevention of Work-related Musculoskeletal Disorders (PREMUS 2007), Boston MA, Aug 2007 (accepted).

Östergren PO, Canivet C, Lindeberg S, Choi BK, Karasek RA, Moghadassi M, & Isacson SO. Conflict between the work and home domains may be important for understanding the difference in exhaustion between vocationally active men and women (accepted as a poster presentation). 10<sup>th</sup> International Congress of Behavioral Medicine, Tokyo, Aug 27-30, Japan, 2008.

Park J.K., Buchholz B, Punnett L. Effects of work surface heights on wrist posture during laboratory simulated pipetting task. 2007 Joint Meeting of the Ergonomics Society of Korea/Japanese Ergonomics Society, May 2007.

Punnett, L. (May 2007) *Inequitable Distribution of Workplace Risks: Insights from Studying Musculoskeletal Disorders*. C. O. Sappington Memorial Lecture (Invited Keynote). American College of Occupational and Environmental Medicine, American Occupational Health Conference, New Orleans LA.

Punnett, L. (June 2007) *Socioeconomic disparities in health and in occupational exposures: Relevance for workplace health promotion and protection programs*. NORA Symposium, Midwest Center for Occupational Health and Safety, University of Minnesota, Minneapolis MN.

Punnett L, Boyer J, Cifuentes M, d'Errico A, Gore R, Park J, Tessler J, PHASE in Healthcare Research Team. (June 2007) *Ergonomic and psychosocial risk factors for injuries in healthcare work*. Invited speaker at the conference, Workplace Hazards to Nurses and Other Healthcare Workers: Promising Practices for Prevention, Massachusetts Nurses Association & the University of Massachusetts Lowell, Marlborough MA.

Tak S, Punnett L, Sembjwe G, Cifuentes M, Gore R, Kriebel D. Global estimate of arthritis attributable to work by occupations: An analysis of the World Health Survey, 2002-2003. Sixth International Scientific Conference on Prevention of Work-related Musculoskeletal Disorders (PREMUS 2007), Boston MA, Aug 2007 (accepted).



Tak S, Punnett L, Paquet V, Buchholz B, Woskie S. Sources of variance in risk factors for knee injury in construction. Sixth International Scientific Conference on Prevention of Work-related Musculoskeletal Disorders (PREMUS 2007), Boston MA, Aug 2007 (accepted).

Yuan L, Buchholz B, Punnett L, Kriebel D. Estimation of muscle contraction forces and joint resultant forces at the low back and shoulder during drywall installation. Human Factors and Ergonomics Society 51st Annual Meeting, Baltimore MD, Oct 2007 (accepted).

## **8. Collaboration with Other UML Centers, Institutes, and Departments**

KEI works with other centers on the UML campus in projects involving workplace linkages to community, gender and social inequality issues. In particular, we enjoy a multi-year collaboration with the UML Center for Women and Work (CWW), which extends our research agenda to examine the relationship between workplace climate and employee stress, health and work outcomes (absenteeism, turnover, lowered productivity, and costs). Specific research activities included completion of the UML employee survey on work climate and health, with the help of the research assistant supported by CFCI; collaboration on development of qualitative and quantitative study instruments for the Socioeconomic Disparities in Health project (see above); and preparation of a NIOSH-funded compendium of survey instruments for assessing aspects of workplace climate that are not typically included in the psychosocial domain by occupational health researchers.

Collaboration has been established between Kerr and other research institutes and faculty members, especially within the School of Health and the Environment. The co-P.I.'s of the research project, Socioeconomic Disparities in Health ("PHASE in Healthcare"), were Dr. Punnett and Dr. Slatin of the Center for Public Health and Health Promotion. Participating faculty members were also drawn from the Departments of Nursing, Economics, and Community Health and Sustainability. Other major current topics of collaboration across UML are heart rate variability and chronic disease; cost-effectiveness of occupational health interventions; and workplace management of disability (see project descriptions above).

## **9. Regional, National and International Outreach**

Collaboration with entities outside UML is illustrated throughout this report. Other institutes of higher education with whom we have current research projects include the University of Connecticut, University of Massachusetts Medical Center, Harvard School of Public Health, and Washington University School of Medicine (St. Louis). We have also engaged colleagues in research and outreach activities from the Liberty Mutual Research Institute, the Massachusetts and Connecticut Departments of Public Health, UNITE-HERE (Union of Needletrades, Industrial and Textile Employees merged with Hotel Employees and Restaurant Employees International Union), U.S. Army Research Institute for Environmental Medicine, and the U.S. National Institute for Occupational Safety and Health. Internationally, our research has involved collaboration with the Swedish National Institute of Working Life, the Swedish National Institute of Psychosocial Medicine, Luleå University of Technology (Sweden), and the World Health Organization.



Special recognition is due to the international networking undertaken by the JCQ Center, including the organizing of international symposia and workshops during each of the last several years: Brisbane Australia, 2000; Dusseldorf Germany, 2002; Toronto Canada, 2003; Los Angeles CA, March 2005; Okayama Japan, August, 2005; Amsterdam the Netherlands, November, 2005; and Stockholm Sweden, June 2006. Development of internationally comparative methods for psychosocial work hazard assessment is one current major focus. Significant progress has been achieved in evaluation of the reliability and cross-cultural interpretations of the JCQ scales, and to begin planning for a revision of the JCQ ("JCQ 2.0").

Within the past year, a series of energetic discussions for developing the JCQ 2.0 took place at the 2<sup>nd</sup> ICOH conference, "Psychosocial Actors At Work," Okayama Japan, August 2005. Key domain areas under discussion are a) emotional demands, b) globalization and precarious employment, c) implications of new forms of production and work organization transforming work relations in the global economy (e.g., functional flexibility, employment flexibility, numeration flexibility, and technology impacts), and d) review of many new candidate scales and questions proposed by the JCQ Board and tested in a Korean subway worker study in 2005.

The JCQ Workshop, "Methodologies for measurement of macro-decision latitude," was held in Amsterdam, the Netherlands, November 10-11, 2005. It drew 14 researchers from 7 countries. The main focus of this workshop was how to measure macro-level decision latitude in the globalization and flexibilization contexts. Following the workshop, the JCQ Board developed 23 new items of macro-decision latitude scale for the JCQ 2.0 pilot study in China, referencing the preliminary results of the Korean JCQ 2.0 pilot study. Those new items were administered in a survey at Kunming, China, in July, 2006 and will be further tested in other sites (Beijing, Shanghai, and Chengdu, China) by the end of 2006.

The international workshop, "From healthy work to healthy society: 30 years with the Demand/Control/Support Model," was held in Stockholm, Sweden, May 31 to June 1, 2006. The workshop was organized by Dr. Karasek and Dr. Töres Thoerell, of the Swedish National Institute of Psychosocial Medicine. Over 30 researchers from 15 countries discussed how to organize internationally and boost the movement towards improvement of social and political conditions for increased individual control in daily life related to not only the Demand-Control Model, but also to its intellectual cousins, and to the D-C model's several extensions. The workshop participants achieved important consensus on several action plans: a) "Stockholm declaration for healthy psychosocial work conditions" addressing WHO primarily; b) co-authoring a monograph for educated lay people describing results of research on the DC and related models so far and their implications for societies worldwide; c) a web-based instrument, primarily aimed at ILO use, focusing on practical translations with heavy emphasis on interventions and scientific evaluations of those; d) a strategy document which aims at increased understanding of our research in a societal context; e) and a technical document describing deeper aspects of the demand-control model, the conducive production model and the stress-equilibrium model and their implications.

Dr. Punnett is chair of the Local Organizing Committee of PREMUS 2007, the Sixth International Scientific Conference on Prevention of Work-Related Musculoskeletal Disorders, which will take place in Boston on 26–30 August 2007. This meeting will bring together over



400 researchers and practitioners from numerous countries, representing occupational ergonomists, health and safety specialists, economists, industrial engineers, kinesiologists, social scientists, and policy makers. This is the pre-eminent international meeting of researchers on causes and prevention of work-related musculoskeletal disorders, hosted by the Scientific Committee on Musculoskeletal Disorders of the International Congress on Occupational Health.



28. LOWELL CENTER FOR SUSTAINABLE PRODUCTION  
University of Massachusetts Lowell

Annual Report 2007-2008

1. Mission

**The mission of the Lowell Center for Sustainable Production is to promote communities, workplaces, and products to be healthy, humane, and respectful of natural systems.**

**We use rigorous science and innovative strategies to develop practical solutions that promote environmentally sound systems of production and consumption.**

**We reject the assumption that pollution, resource depletion, and health impairment are inevitable consequences of modern life.**

**We also reject the assumption that the less powerful and privileged should be disproportionately harmed by practices and policies that degrade health, the environment, or human dignity.**

**Instead, we are committed to working collaboratively with citizen groups, workers, businesses, institutions, and governments to build healthy work environments, thriving communities, and viable businesses and institutions that support a more sustainable world.**

2. General Description and Goals

The Lowell Center applies expertise in a number of fields including occupational health, environmental management and science, materials and process engineering, epidemiology, health policy, science policy, chemicals policy, economics, and organizational change to research and promote forms of production and consumption that are safe, healthy, environmentally sound, and socially accountable.

3. Research Focus Areas

Chemicals and Science Policy Program ([www.chemicalspolicy.org](http://www.chemicalspolicy.org))

Since its inception in 2001, the Chemicals Policy and Science Initiative (formerly the Chemicals Policy Initiative) has grown into being the most prominent academic chemicals policy effort in the country. It has served as a catalyst in sparking dialog at the state and federal levels on chemicals policy reform; has provided training and technical support to a range of stakeholders on European policies and tools for moving towards safer chemicals; and it has developed models and frameworks for safer chemicals policy. The Initiative develops scientific tools, methods, and policies that promote a more precautionary integrated chemicals policy regime. The ultimate goal of our initiative is the design and application of safer chemicals and products, consistent with principles of sustainable production and green chemistry. We motivate and support the design and application of safer chemicals and products through research and strategic engagement with a range of stakeholders.

Environmental Health Initiative



The Environmental Health Initiative (EHI) joined the Lowell center in September, 2004. EHI seeks to better understand relationships between environmental exposures and human health in workplaces and communities, and to develop and implement programs and policies aimed at reducing exposures to reverse rates of chronic disease. Working at the local, state, New England regional and national levels, EHI conducts research and analysis, and provides leadership and technical support to initiatives that seek effective action on links between the environment and human health. EHI currently works in three areas: asthma and environment; cancer and environment; and the application of scientific knowledge in public policy. EHI partners with the Asthma Regional Council in an initiative to promote investment by the health sector in environmental interventions, and is leading an initiative across the Lowell Center to develop a technical assistance program focused on environmental health-related communities.

#### Environmental Management Systems (EMS) Service Program ([www.uml.edu/emsc](http://www.uml.edu/emsc))

The EMS Service Program's mission is to help public entities improve compliance, sustainability and environmental health and safety through the use of Environmental Management Systems and tools. Designated by EPA as a Local Resource Center in the PEER Center network, the Program provides training and designs opportunities for dialogue and sharing of experiences, and develops guides and tools to support efforts to move to sustainability. The Program continues to provide training and audit services to municipalities and the Massachusetts Bay Transportation Authority. New activities include the design and delivery of energy improvement management workshops for water and wastewater utilities across the country. The Program also has and continues to develop tools and guides for K-12 schools, water and wastewater utilities and colleges and universities.

#### Sustainable Hospitals Program ([www.sustainablehospitals.org](http://www.sustainablehospitals.org))

The Sustainable Hospitals Program (SHP) was initiated at the University of Massachusetts Lowell in 1998 to provide technical support to the healthcare industry for selecting products and practices that reduce occupational and environmental hazards. Based within the Lowell Center for Sustainable Production, the SHP effort was established in response to the observation that pollution prevention solutions could inadvertently introduce new occupational safety and health problems, and vice versa. (This is sometimes referred to as “risk shifting”, when a solution in one area causes problems in another. For example, selecting vinyl gloves to replace latex gloves reduces an occupational hazard yet increases an environmental concern). Since occupational and environmental hazards arise from the same sources, comprehensive solutions require an integrated approach. Therefore the SHP focuses on integrating pollution prevention (P<sup>2</sup>) and occupational safety and health (OSH) in order to facilitate sound, sustainable practices. Key components of the SHP:

- Project SHARRP – *Safe Homecare and Risk Reduction for Providers*. This is a research project for prevention of needlestick injuries and blood exposures in the home healthcare setting. This 4 year study (2004-2008) is funded by the National Institute for Occupational Safety and Health (NIOSH) and is being conducted in partnership with industry, labor and state government.
- Technical Assistance for Sharps Injury Surveillance. This is a hands-on support role funded by the MA DPH to assist their sharps injury prevention efforts in Massachusetts



hospitals. The DPH claims title to the longest-running and most successful state-based sharps injury surveillance program in the United States and the SHP provides technical support to this model program.

- Contribution to Public Health Policy. The SHP participates in public health policy initiatives at the both the state and national levels. At the national level, SHP Director Margaret Quinn serves on the NIOSH NORA Healthcare Council and the NIOSH Prevention through Design (PtD) Committee. Locally, the SHP is a member of the Massachusetts Needlestick Advisory Committee. This committee advises the Massachusetts Department of Public Health on it promulgation of the rules and regulations of the Massachusetts Act Relative to Needlestick Injury Prevention (MGL Chapter 111 §53D).
- The SHP website. A highly visible component of the SHP, the website provides resources to educate and help healthcare practitioners identify and evaluate more benign alternatives to existing products and practices.
- Educational outreach. Members of the SHP educate members of the healthcare community on timely topics related to pollution prevention and occupational safety and health. This is accomplished through presentations at conferences and meetings, publication of articles, technical bulletins and fact sheets, and on-site seminars.

#### 4. Associated Personnel 2007-2008



Ken Geiser	Co-Director, Lowell Center for Sustainable Production Director, Toxics Use Reduction Institute Professor, Work Environment
David Kriebel	Co-Director, Lowell Center for Sustainable Production Professor, Work Environment
Cathy Crumbley	Program Director, Lowell Center for Sustainable Production
Stephanie Chalupka	Professor, Nursing
Richard Clapp	Adjunct Faculty, Work Environment
Melissa Coffin	Project Associate, Chemicals Science and Policy Program
Sally Edwards	Project Director, Sustainable Children's Products Initiative
Catherine Galligan	Project Manager, Sustainable Hospitals Program
Rebecca Gore	Statistical Analyst, Sustainable Hospitals Program
Richard Healey	Senior Advisor
**Polly Hoppin	Director, Environmental Health Initiative; Research Assistant Professor, Work Environment**
Molly Jacobs	Project Manager, Environmental Health Initiative
Pia Markkanen	Sustainable Hospitals Program; Research Assistant Professor, Work Environment **
Gregory Morose	Senior Program Manager, Mercury in Consumer Products and Alternatives Assessment
Aisling O'Connor	Technical Support Coordinator, Chemicals Policy and Science Initiative
Margaret Quinn	Director, Sustainable Hospitals Program Professor, Work Environment
**Susan Sama	Sustainable Hospitals Program; Research Assistant Professor, Work Environment **
Madeline Snow	Director, EMS Service Program
Joel Tickner	Director, Chemicals Science and Policy Program Assistant Professor, Community Health and Sustainability
Yve Torrie	Project Manager, Chemicals Science and Policy Program

\*\*New Research Faculty within Last 3 Years

#### Consultants

Andrew Fasey	Chemicals Science and Policy
Fred Murphy	EMS Auditor and Trainer
Amy Perlmutter	Clean Tech project
Lynn Rose	Environmental Health and Safety Consultant and Trainer

#### 6. Students Supported



Rossy Alvarez <sup>1</sup>	Clean Tech and Sustainable Toys Initiative
Anila Bello	Sustainable Hospitals
Marisa Caliri	Towards Tomorrow, Clean Tech
Aliza Gordon	Chemicals Policy and Science Initiative
Homero Harari	Chemicals Policy and Science Initiative
Hyun Kim	Sustainable Hospitals
John Lindberg	Nanotechnology
Jessica Schifano	Chemicals Policy
Shreya Vyas	Environmental Management Systems

## 7. Current Research Projects

**Project SHARRP.** A major research effort of the Sustainable Hospitals Program (SHP) is Project SHARRP – *Safe Homecare and Risk Reduction for Providers* – to address needlestick injuries and blood exposures among home healthcare practitioners. In its final year of a four-year effort (2004-2008) funded by the National Institute for Occupational Safety and Health (NIOSH), the project is realizing its ultimate objective of protecting the rapidly growing population of home healthcare practitioners from risks associated with needlestick injuries and blood exposures.

Surveillance activities and a series of focus groups, interviews and comprehensive survey completed by 1200 home healthcare clinicians have provided a wealth of both quantitative and qualitative information about sharps injuries and blood exposures. The findings are providing guidance for appropriate interventions to make home healthcare a safer, more productive and satisfying work environment and providing the basis for our subsequent research of injuries in home care delivered through the social service sector.

The importance of this effort cannot be overstated, as the Center for Disease Control and Prevention (CDC) estimates 600,000 to 800,000 injuries occur annually nationwide (in all healthcare settings) from needles and other sharp devices, potentially leading to hepatitis and HIV infection. Home healthcare is a critical area because most prevention efforts have been focused on hospitals and little attention has been given to the rapidly growing home healthcare industry, which is predicted to increase in size by 68 percent within the next decade.

**Technical Assistance for Sharps Injury Surveillance.** In this project, the Sustainable Hospitals Program provides behind-the-scenes technical expertise to the Massachusetts Department of Public Health for its highly regarded and influential Sharps Injury Surveillance and Prevention Project. The SHP’s expertise in nursing, epidemiology, and data analysis and management reinforce the DPH’s role in effecting sharps injury prevention.

**Sustainable Solutions Science.** Over the academic year, a working group has met regularly to refine our model of what we have come to call “Sustainable Solutions Science.” This model integrates research and analysis with action aimed at social and technological change. The focus is on how best to act based on what is already known so that knowledge and action advance together. We are enthusiastic about discussing this model with our **peers and enlisting their**

10:15:45 AM\_\_\_\_\_

<sup>1</sup> Supported with CFCI Funding



support for both refining and disseminating it. This work is an extension of more than five years' research and network building on the precautionary principle. The precaution work, while quite successful, showed us that precaution per se does not capture the fundamental shift in science that is needed to support sustainable production.

Daniel Sarewitz, director of the Consortium for Science, Policy, and Outcomes (CSPO) at Arizona State University spent his sabbatical with the Lowell Center. He brought a wealth of experience and expertise in science policy and provided valuable insights for our discussions and writing. With his collaboration, we drafted an initial concept paper on this topic which was discussed with a small group of invited scientists from the Greater Boston area at a half-day working session in May. These efforts are part of our plan to develop an academic/NGO network to promote sustainable solutions science, supporting both academics and activists who work at the science/policy interface.

#### Supply Chain Engagement around Green Chemistry

Following the 2005 Innovators Roundtable at the Darden School of Business, the Green Chemistry and Commerce Council (GC3) held its third annual Innovators Roundtable at the Nike World Headquarters in Beaverton, Oregon in July 2008. In addition to existing participants of the GC3 working groups (Advancing Design for Environment (DfE) and Green Chemistry in Government, Tools for Safer Chemical Assessment and Decision Making, and Drivers for Innovation and Marketing), this year's roundtable brought new firms into the Council and agreed on new projects for the year ahead. In addition to the Roundtable, each of the working groups continued to advance their individual projects, including:

- A glossary of commonly used terminology in marketing green products.
- A survey of firms' green chemistry programs.
- Engaging retailers around their chemicals policy efforts
- A compilation of restricted substance lists used by more than 15 firms participating in the GC3, and an accompanying analysis of these lists.
- A series of webinars presented by various firms on tools for assessing chemical safety already developed for corporate use.
- A series of conference calls and an in-person meeting with US EPA Deputy Director Jim Gulliford to discuss strengthening and expanding the DfE program at EPA.
- Two meetings between members of the National Pollution Prevention Roundtable (NPPR) and the GC3 to work collaboratively to build incentives for industry to work toward implementing Green Chemistry and DfE programs.

#### Strategic Corporate Partnerships for Safer Chemistry

CPSI is partnering with True Textiles (formerly Interface Fabrics) to peer review their framework for assessing which substances used in their production should be restricted based on the company's commitment to sustainability. Similarly, we are working with United Technologies Corporation to design a framework for evaluating their programs across business units for identifying, prioritizing and managing materials of concern.

**State Chemicals Policy Reform Efforts.** CPSI is engaged with state-level chemicals policy reform on four fronts. First project staff coordinates monthly conference calls with state agencies and legislative offices about the current and future status of chemicals policy efforts at



the state level, their implications, barriers to implementation, and opportunities for cross-state collaboration. These calls cover a range of chemicals policy topics, such as model policy options and advancing green chemistry. Second, CPSI is assisting Michigan in implementing its Green Chemistry Support Program as outlined in Governor Jennifer M. Granholm's Executive Directive No. 2007-6 (Directive), "Promotion of Green Chemistry for Sustainable Economic Development and Protection of Public Health" from October 2006. The Directive establishes state policy encouraging the use of safer, less toxic, or non-toxic chemical alternatives to hazardous substances and the research, development, and implementation of Green Chemistry in Michigan. Third, CPSI has developed an online database of state legislation and executive branch policies on chemicals passed since 1990, as well as those that are pending. After finalizing this database, an analysis of the strengths and weaknesses of these laws and policies will be conducted as a reference for government and NGOs. Lastly, CSPI is taking a leadership role in the development of an Interstate Chemicals Clearinghouse which would bring together research and data gathered on chemical hazards, alternatives, and initiatives for implementation of safer chemicals policies by the states into a single location.

CPSI authored two reports published by the Lowell Center in 2008. The first explores the limits of federal regulations in protecting consumers from hazardous chemicals in products. The second outlines a range of options to help reshape and reorient state level chemicals policy to more effectively protect health and environment while stimulating innovation, and safer chemistry and products.

**Assisting NGOs With International Chemicals Policy.** CPSI hosted a two-day meeting in Lowell focused on how to advance alternatives assessment as a tool for addition of and implementation of chemicals restrictions under the Stockholm Convention and how to apply the approach more broadly. Additionally, CPSI continued its collaboration with the SAFER coalition of state-based NGOs working on chemical policy reform issues to provide technical and policy support. CPSI also began work in 2008 with the United Steelworkers in the US and in Canada, UNITE HERE, the Labor Institute at Cornell University, and SustainLabor to improve trade union collaboration around chemicals policy issues.

**Sustainable Children's Products Initiative.** The mission of the Sustainable Children's Products Initiative is to promote the sustainable design and development of children's products, through engaging a diverse group of stakeholders in this discussion and providing information that can spark innovative, environmentally sound solutions. In 2007 the Lowell Center for Sustainable Production and GreenBlue began a collaborative effort with a working group of decision makers in the toy industry and representatives from citizen advocacy groups, government and academia. We engaged stakeholders throughout the supply chain, including manufacturers, retailers and designers. In December, we held a planning meeting of these stakeholders, including Mattel, Hasbro, Wal-Mart, several small toy manufacturers, toy designers, US EPA, and representatives of citizen advocacy groups including Consumers Union and Clean Production Action. The objective of this meeting was to assess the need for this initiative with our stakeholders and if there was interest, to work together to design and plan this new program. There was widespread consensus among attendees that there is a real need for this effort, and as a result of this meeting a work group has formed to move this initiative forward.



Although we initially framed this effort as the Sustainable Toys Initiative, at this meeting we learned that a broader focus on children's products was essential, as concerns about sustainability go beyond toys and include products such as arts and crafts, infant products, and children's jewelry. In our discussions with industry and citizen stakeholders, many have expressed a pressing need for information to make better decisions. Citizen advocacy groups have primarily focused on identification of the problem but consumers are now requesting information about solutions. Within the children's products industry, designers and engineers often do not have information about environmentally preferable chemicals and materials. To move away from problematic chemicals and materials, easily accessible information about alternatives must be available.

Since our initial meeting in December 2007, the Lowell Center has convened six work group conference calls, including stakeholders from Mattel, Hasbro, Wal-Mart, Target, Fashion Angels, the Toys Industry Association, the Institute for Children's Environmental Health, Clean Production Action, and GreenBlue. The group has created an ambitious vision and has had a wide-ranging dialogue on a range of issues related to the sustainability of toys and children's products.

**Biobased plastics.** Doctoral candidate in Cleaner Production Rossy Alvarez prepared a report entitled "The Potential for use of bio-based plastics in toys and children's products."<sup>2</sup> The purpose of this report is to evaluate the potential for use of bio-based plastics as alternatives to the petroleum-based plastics currently used to make toys and children's products. Bio-based materials are promising as their feedstocks are renewable, theoretically they can be composted or recycled, and often their production process is more energy efficient than petroleum-based plastics processing. The report considers how to define a sustainable plastic; reviews ranking schemes and criteria that have been developed in the last decade to aid in decision-making; provides an overview of plastics use and processing in toys; defines and describes types of biobased plastics according to their source, production process, uses, costs, environmental, health and safety impacts, recyclability, compostability, and commercial readiness. Each bio-based plastic is considered for its possible application in the toys and children's products industry and is reviewed according to sustainability criteria.

**Environmental and Occupational Causes of Cancer.** This EHI project seeks to enhance mitigating environmental and occupational causes of cancer by informing the public health professionals, academics, politicians, and advocates about the links between environmental and occupational exposures and cancer, and stimulating innovative research on the causes of breast cancer. In November 2007, EHI published an update of its 2005 report on environmental and occupational causes of cancer based on a recent review of the literatures from 2005-2007. This report was published in a peer-reviewed academic journal in the spring of 2008. EHI is also working closely with partners at Commonwealth, the Collaborative on Health & Environment (CHE) and Breast Cancer Fund to create a consensus statement on environmental causes of cancer and a series of fact sheets for the convening of the National Cancer Institute's, President's Cancer Panel. This Panel will host 4 meetings in the fall 2008 to winter 2009 and based on expert testimony and public comments, will submit its report to the President regarding specific policy and research recommendations. EHI is also leading a project in partnership with Silent

<sup>2</sup> Supported with CFCI funding



Spring and Massachusetts Breast Cancer Coalition to stimulate innovative research on preventative strategies to mitigate the environmental causes of breast cancer.

**Linking Disease Prevention to Sustainable Production.** The goal of this project is to demonstrate the creative synergies between sustainable production and chronic disease prevention. Prevention is under-used and under-funded in our current healthcare system, but it is fundamental to sustainability. Many citizens and government officials continue to view economic development and health promotion/disease prevention as entirely separate issues and interest groups. To the contrary, an economy based on clean production and healthy work organizations can be both productive and directly benefiting the public's health. By strategic reframing of what it means to be "clean" and "green," the project is changing old patterns of thinking, reducing the avoidable disease burden in communities, and build momentum for both a more effective healthcare system and new forms of economic development. This project is initially focusing on the Merrimack Valley of Massachusetts and New Hampshire, and exploring root causes of two diseases – cancer and asthma, including exposures in production processes and consumption patterns.

**Breast cancer risk reduction project.** LCSP is partnering with Silent Spring Institute (SSI) & the Massachusetts Breast Cancer Coalition (MBCC) to build a statewide initiative to develop and disseminate new breast cancer risk reduction strategies in order to mitigate exposures to environmental and occupational causes of breast cancer. LCSP's EHI program is overseeing the efforts of both SSI (developing new sampling technology and strategies for identifying chemical pollutants in the home) and MBCC (educational outreach) and is responsible for helping to re-build the Massachusetts' breast cancer pilot studies program with an emphasis on prevention strategies. The primary aims of the breast cancer pilot studies program are to encourage scientific and lay communities within Massachusetts to collaborate in order to: (1) enhance knowledge regarding environmental and occupational factors that contribute to the initiation or the progression of breast cancer or to susceptibility to the disease and (2) explore innovative preventive interventions that mitigate exposures to these contributing factors. The development of the prevention-oriented breast cancer research program was envisioned as a 2-year process with the 3rd year culminating in the dissemination of pilot research grants. FY08 was the project's 1st year and EHI's activities in this first year included: (1) conducting background research, including a geographic "hot spot" analysis of breast cancer incidence and high volume chemical hazard use in Massachusetts, (2) researching lessons-learned from other innovative breast cancer and environment grants programs, and (3) convening an advisory committee to endorse a comprehensive strategy to develop a public-interest breast cancer prevention research agenda.

**Environmental Management Systems (EMS) Service Program.** The EMS Service Program's mission is to help organizations improve and sustain environmental performance through Environmental Management Systems. Designated by EPA as a Local Resource Center in the PEER Center network, the Program continues to work with colleges and universities, public schools, and municipalities in a variety of efforts to improve environmental performance and sustainability. Highlights over the past year include (1) Audit of Phase 1 facilities at the Massachusetts Bay Transportation Authority to improve compliance and environmental stewardship; (2) Facility assessments and training for managers, mechanics, and shop foremen of



‘Phase 2’ facilities; (3) Training and consultation to the Town of Spencer in the development of a compliance-focused EMS; (4) Completing *Environmental Roles and Responsibilities in a Climate of Change—Campus EH&S at a Crossroads*; (5) Design and delivery of introductory workshops on frameworks on compliance and sustainability (American Public Works Association, New Hampshire DES and other agencies); (6) Design and delivery of two Energy Improvement Management workshops in New England (with an 6 workshops scheduled across the country). The Program was recognized as a member of a team receiving an EPA Environmental Merit Award for work with school facilities managers.

**Toward Tomorrow: A Common Agenda for Health and Environment.** EHI and Chemicals Science and Policy staff play key roles in this project, the overall purpose of which is to provide inspiration and tools that enable a wide range of organizations to envision a sustainable future and take effective steps towards it. The initiative seeks to develop an agenda for action on health and the environment by bringing together leaders and scholars from diverse fields—both people late in their careers and those who will shape and implement programs and policies over the next forty years. The aim is to identify goals that will guide the next generation as they address the complex linkages between human and ecosystem health: linkages critical for the diagnosis, treatment and prevention of global health threats. *Toward Tomorrow* activities include 1) Conducting oral histories with individuals whose work has substantially contributed to movements that seek economically, environmentally and socially equitable and sustainable systems of human activity; 2) Developing a Common Agenda for action on environmental and human health in the coming decades by drawing on the ideas and insights in the oral histories, and working with leaders from a range of organizations; and 3) Disseminating the Common Agenda to a wide array of groups capable of advancing it through their education, outreach and advocacy activities. This year, Lowell Center staff convened eight discussion groups, each comprised of groups working on specific health or environmental issues, to develop “generational goals” for where they hope their issue will be in 30 years. Representatives of the discussion groups came together at the second White Oak meeting (held at the White Oak conference center near Jacksonville, Florida) to craft a Common Agenda that identifies six cross-cutting generational goals. Both in its content and its process, the Common Agenda brings groups and issues together that have historically worked independently, and sometimes in competition.

**Initiative to Promote Environmental Investments for Asthma.** EHI works in partnership with the Asthma Regional Council (ARC) to provide leadership and conduct relevant research and analysis on a major New England-wide initiative to advance the delivery and financing of comprehensive asthma management, with particular emphasis on home-based environmental interventions (e.g., supplies and services such as integrated pest management, smoking cessation, and education about environmental triggers). The premise of the initiative is that if environmental interventions—now shown to be effective in improving asthma symptoms and financially viable—are to be sustainable, and if they are to meet their potential to help reduce the burden of asthma, they need to be embedded in traditional delivery systems and financed by those funding sources that pay for health care. This year, EHI staff completed and made multiple presentations of its publication “Investing in Best Practices for Ashtma: A Business Case for Education and Environmental Interventions” which reviews the literature on the cost and cost-effectiveness of asthma education and environmental interventions. The project worked closely



with the Asthma Regional Council to convene leading providers in a process of generating a statement of consensus about what they need from health systems, payers and public agencies to more effectively implement the national asthma management guidelines. In June, 2008, the project co-hosted with ARC a major conference for 100 providers, payers and government officials to review the most recent science on asthma management and prevention, and to refine the draft provider consensus statement. Activities going forward include meeting with organizations in key constituencies—payers, providers (including health systems), state government and employers to discuss specific opportunities for advancing the recommendations in the consensus statement. Funders for the ARC/EHI initiative include EPA, Children’s Hospital and The Boston Foundation.

**Coordination of Collaborative on Health (CHE) and Environment Asthma Discussion Group; Generation of Draft Research Agenda.** EHI continued its work with CHE to develop a new national asthma discussion group, which brings together leaders and professionals from a range of organizations and settings to exchange information and insights about approaches for addressing the environmental aspects of asthma. In addition to ongoing work to plan bi-monthly phone conferences, including identifying and recruiting participants and speakers, EHI has participated this year in the drafting of a concept paper for development a national research agenda for asthma with a focus on filling the gap in research leading to opportunities for primary prevention.

**Report and Outreach on Environmental and Occupational Causes of Cancer.** In conjunction with CHE Cancer group, EHI completed an update of the scientific literature on environmental and occupational causes of cancer, mechanisms of cancer induction, and primary prevention of cancer. In addition, EHI calculated the estimated proportion of 2007 cancer cases with some evidence of occupational and environmental causes; presented a summary of cancer trends at a Commonwealth meeting as part of an effort to bring together women’s health organizations concerned about environmental causes of cancer; and collaborated with the Mass. Breast Cancer Coalition and Silent Spring Institute in educating policy makers about the importance of including breast cancer research funds in the state budget.

**Clean Tech: An Agenda for a Healthy Economy.** The goal of this project is to identify specific opportunities and benefits to making Massachusetts a leader in clean technologies (energy, materials reuse, advanced materials, safer chemistry, and green buildings) that serve the world, and to recommend a path to get there. The project is defining the clean tech sector in the state, gaining an understanding of the market potential and business needs to support growth and innovation, creating a vision for an economy based on cleaner, safer technologies, and evaluating the potential direct and indirect economic impacts of that economy. The project is looking at the existing resources in the state—including clean tech businesses, researchers, investors, government programs, and NGOs—as well as external drivers, and identify opportunities and tools for growth, including policies, partnerships, investments, research, business support, and education initiatives. Over the past year, we drafted a report of initial findings and are holding regional meetings around the state to discuss findings and recommendations. For this project, doctoral student Rossy Alvarez conducted a survey of U.S. state governments to compile a listing of clean tech initiatives.<sup>3</sup>

10:15:45 AM\_\_\_\_\_

<sup>3</sup> Conducted with CFCI funding



## 8. Publications (2007-2008)

Chalupka S, Markkanen P, Galligan CJ, Quinn M. (2008). **Sharps injuries and bloodborne pathogen exposures in home healthcare.** *AAOHN Journal* 2008. 56(1):pp.15-29.

Chalupka S, Markkanen P, Galligan C, Quinn M. **Needlestick and Sharps Injury Prevention: Are We Reaching Our Goals?** *AAACN Viewpoint*. March/April 2008.

Clapp R. **Polychlorinated biphenyls.** In: *Last's Public Health and Preventive Medicine*, 15<sup>th</sup> ed. (in press)

Clapp RW, Jacobs MM, Loechler EL. **Environmental and occupational causes of cancer: new evidence 2005-2007.** *Reviews on Environmental Health*, 2008; 23(1): 1-37).

Belpomme D, Irigaray P, Newby JA, Howard V, Clapp R, Sasco AJ, Hardell L. **The growing incidence of cancer: Role of lifestyle and screening detection (Review).** *Int J Oncology* (in press).

Galligan C, Chalupka S, Laramie A, Davis L. **Procedure Kits & Trays: A call to action for sharps safety.** Accepted for publication by *Nursing* 2008 (date TBD). Written in collaboration with the Mass. Department of Public Health.

Hansen, Steffen and Joel Tickner. **Forthcoming 2007. The challenges of adopting voluntary health, safety and environment measures for manufactured nanomaterials. Lessons from the past for more effective adoption in the future.** *Nanotechnology Law and Business*.

Hansen, SF; Kraye von Krauss, MP; Tickner, J. 2007. **Categorizing Mistaken False Positives in Regulation of Human and Environmental Health.** *Risk Analysis* 27 (1): 225-240.

Hansen, Steffen. **Martin Kraye von Krauss and Joel Tickner. The Precautionary Principle and False Positives.** **Forthcoming.** *Late Lessons from Early Warnings II*. European Environment Agency.

Hoppin P, Jacobs M, Stillman L. **Investing in Best Practices for Asthma: A Business Case for Education and Environmental Interventions.** *Asthma Regional Council*, 2007.

Jacobs M, Sperrazza K, Hoppin P, Clapp R. **Identifying targets for reducing exposures to agents that cause or exacerbate asthma in Massachusetts.** June 2008.

Kriebel D. **Reanalysis: lessons great and small.** *Occupational & Environmental Medicine* 2008; 65: 368-370.



**Kriebel D.** If society is our patient, how shall we take its pulse? *New Solutions J of Environ & Public Health Policy* 2008; 18(2): 111-9.

**Kriebel D.** How much evidence is enough? Conventions of causal inference. *Law & Contemporary Problems*, in press.

**Kriebel D,** Checkoway H, Pearce N. Exposure and Dose Modeling in Occupational Epidemiology. *Occup Environ Med*, in press.

**Kriebel D.** The reactionary principle: inaction for public health. *Occupational and Environmental Medicine*, in press.

Cifuentes M, Boyer J, Gore R, d'Errico A, Tessler J, Scollin P, Lerner D, **Kriebel D**, Punnett L, Slatin C; PHASE in Healthcare Research Team. Inter-method agreement between O\*NET and survey measures of psychosocial exposure among healthcare industry employees. *Am J Ind Med* 2007 Jul; 50(7):545-53.

Kang D, Davis LK, Hunt P, **Kriebel D.** Cancer Incidence among Male Massachusetts Firefighters, 1987-2003. *Am J Ind Med* 2008; 51:329-335.

Cifuentes M, Boyer J, Rebecca G, d'Errico A, Scollin P, Tessler J, Lerner D, **Kriebel D**, Slatin C, Punnett L. Job Strain Predicts Survey Response in Healthcare Industry Workers. *Am J Ind Med* 2008; 51(4): 281-9.

Hemmingsson T, **Kriebel D**, Melin B, Allebeck P, Lundberg I. How does IQ affect onset of smoking and cessation of smoking – Linking the Swedish 1969 conscription cohort to the Swedish Survey of Living Conditions. *Psychosomatic Medicine*, in press.

Seniori Costantini A, Benvenuti A, Vineis P, **Kriebel D**, Tumino R, Ramazzotti V, Rodella S, Stagnaro E, Crosignani P, Amadori D, Mirabelli D, Sommani L, Belletti I, Troschel L, Romeo R, Miceli G, Tozzi GA, Mendico I, Alberghini Maltoni S, Miligi L. Risk of Leukemia and Multiple Myeloma associated with exposure to benzene and other organic solvents: evidence from the Italian multicenter case-control study. *Am J Ind Med*, in press.

**Myers DJ, Kriebel D, Karasek R, Punnett L, Wegman DH.** The social distribution of risk at work: Acute injuries and physical assaults among healthcare workers working in a long-term care facility. *Social Science & Medicine* 2007, 64:794–806.

**Dodič Fikfak M, Kriebel D, Quinn MM, Eisen EA, Wegman DW.** A case control study of lung cancer and exposure to chrysotile and amphibole at a Slovenian asbestos-cement plant. *Annals Occup Hygiene* 2007; 51:261 – 268.

**Cozzenza da Silva M, Fassa AG, Domingues MR, Kriebel D.** Gonalgia entre Trabalhadores e Fatores Ocupacionais Associados: Uma Revisão Sistemática [in Portuguese: Knee pain in workers and associated occupational factors: a systematic review]. *Cadernos De Saúde Pública / Reports In Public Health*, in press.



**Checkoway H, Pearce N, Kriebel D. Selecting appropriate study designs to address specific research questions in occupational epidemiology. *Occup Environ Med*, in press.**

**Wallace RF, Kriebel D, Punnett L, Wegman DH, Amoroso PJ. Prior heat illness hospitalization and risk of early death. *Environmental Research*, in press.**

**Hemmingsson T, Kriebel D, Tynelius P, Rasmussen F, Lundberg I. Adolescent mental health predicts quitting smoking in adulthood: a longitudinal analysis. *European Journal of Public Health*, in press.**

**Lowell Center for Sustainable Production. Options for state chemicals policy reform: a resource guide. Lowell Center for Sustainable Production, Lowell, MA.2008.**

**Markkanen P, Quinn M, Galligan C, Chalupka S, Davis L, Laramie A. (2007). There is no place like home: A qualitative study of the working conditions of home healthcare providers. *Journal of Occupational and Environmental Medicine*, Vol 49 (3), pp.327-337.**

**Markkanen P, Chalupka S, Galligan C, Sama S, Gore R, Kim H, Bello A, Kriebel D, Quinn M. Studying Home Healthcare Nurses and Aides: Research Design and Challenges. *Journal of Research in Nursing*; accepted for publication in September 2008**

**Quinn MM, Sembajwe G, Stoddard AM, Kriebel D, Krieger N, Sorensen G, Hartman C, Naishadham D, Barbeau EM. Social Disparities in the Burden of Occupational Exposures: Results of a Cross-Sectional Study. *Am J Ind Med* 2007; 50:861–875.**

**Snow, M. Environmental Roles and Responsibilities in a Climate of Change—Campus EH&S at a Crossroads. Campus Consortium for Environmental Excellence. <http://www.c2e2.org/What%27sChangedMay08.pdf> 2008.**

**Snow, M. Ensuring a Sustainable Future: An Energy Management Guidebook for Wastewater and Water Utilities, EPA, January 2008. [http://www.epa.gov/waterinfrastructure/pdfs/guidebook\\_si\\_energymanagement.pdf](http://www.epa.gov/waterinfrastructure/pdfs/guidebook_si_energymanagement.pdf)**

**Tickner J. and Yve Torrie. Presumption of safety: Limits of federal policies on toxic substances in consumer products, Lowell Center for Sustainable Production, Lowell, MA. 2008**

**Tickner, Joel. Forthcoming. From Reaction to Sustainable Solutions: A Framework for Improving Environmental Decision-Making in the Context of Complex Social-Ecological Systems. In, Ruiz de Elvira, Antonio, Incendios y Medio Ambiente en Galicia: Una Reflexion Critica.Academy of Public Service of Galicia.**

**Tickner, Joel. 2007. Risk Assessment is not Enough. Rationale for the Precautionary Principle. In, Toscano, W and Robson, M. Risk Assessment in Public Health. Jossey Bass.**



**Hansen, S and Joel Tickner. The challenges of adopting voluntary health, safety and environment measures for manufactured nanomaterials. Lessons from the past for more effective adoption in the future. *Nanotechnology Law and Business* 4: 341-359; 2007.**

## 9. Events and Presentations

### Events

Energy Improvement Management Workshops for Water and Wastewater Utilities: New Haven, CT (12/11/06) and Lowell, MA (March 6, 2008).

Introduction to Management Systems Training: MA Facility Administrators' Association members (11/20/07); NH Department of Environmental Services (4/7/08); American Public Works Association (4/16/08).

2 training sessions for the Town of Spencer in developing a compliance-focused EMS.

**4 training sessions for the Massachusetts Bay Transportation Authority on environmental management systems, compliance, and sustainability.**

**Hosting of semi-annual meeting of the Public Entity EMS Resource Center: Boston, MA May, 2008.**

**Recent Developments in Asthma Prevention and Control: Today's Opportunities for Health Providers and Payers. Shrewsbury, MA. June 19, 2008.**

**Asthma Provider Consensus Statement Meeting. March 25, 2008, Framingham, MA.**

**Toward Tomorrow Summit: Integrating Generational Goals: Developing a Common Agenda for Health & the Environment White Oak Conservation Center, Yulee, Florida, March 9 -11, 2008.**

**Promoting Environmental Investments and Education for Asthma: A Meeting for Stakeholders  
JFK Federal Building, Boston, MA., Sept. 20, 2007**

**Advancing Alternatives Assessment for Safer Chemicals Policy: Links to the Stockholm Convention's POPRC. Lowell, MA, June 11-13, 2008**

### Presentations

**Clapp, R and Jacobs M. "Occupational and Environmental Causes of Cancer." Collaborative on Health and Environment Partnership Conference call. January 17, 2008.**



**Crumbly, C.** Moderator of panel on business opportunities for conference Green, Clean and Sustainable: Economic Development for the 21st Century. A forum to discuss the expansion of Green Jobs in the 5th District. Northern Essex Community College, Haverhill, MA May 19, 2008

**Edwards, S.** **Alternatives Assessment: A brief review of methods and approaches”**  
**Presentation at Advancing Alternatives Assessment for Safer Chemicals Policy: Links to the Stockholm Convention's POPRC, Lowell, MA. June 12, 2008**

**Edwards, S.** **“A Perfect Storm: Drivers for Sustainable Product Design in toys and children’s products”** Speaker at National Product Stewardship Forum, Boston, MA. **June, 2008**

**Edwards, S.** **“Protecting Children from Toxic Chemicals in Toys, Jewelry and other Products”**  
**Panelist at New York State Children’s Environmental Health Symposium, Albany, NY. March, 2008**

**Edwards, S.** **“Sustainable Product Design: Thinking Ecologically about Toys and Children’s Products”** Presentation at Revolving Museum, Lowell, MA, **March, 2008**

**Edwards, S.** **“Toys and Sustainability: What are key issues for buyers?”** Presentation to Wal-Mart toy buyers, Bentonville, Arkansas. **August, 2007**

**Edwards, S.** **“Product Design and Sustainability”** Presentation at NIOSH Prevention through Design Workshop, Washington, DC. **July, 2007**

**Hoppin, P, Jacobs M and Stillman L.** **“The Role of Asthma Education and Environmental Interventions: What Do We Know About Effectiveness and Cost?”** At Recent Developments in Asthma Prevention and Control: Today’s Opportunities for Health Providers and Payers. **June 19, 2008, Shrewsbury, MA.**

**Hoppin, P. and Chalupka S.** **“The Role of the Nurse and Community Educator in Comprehensive Asthma Management.”** At Recent Developments in Asthma Prevention and Control: Today’s Opportunities for Health Providers and Payers. **Shrewsbury, MA., June 19, 2008**

**Hoppin P, Jacobs M and Stillman L** **“A Business Case for Asthma Education and Environmental Interventions. At “Getting the Bugs Out: Integrated Pest Control Strategies for Affordable Housing.”** Boston, MA., **April 18, 2008.**

**Hoppin P. and Jacobs M.** **Radio interview with Maura Lyason, All Things Considered, NPR, on asthma education bill pending in MA. State legislature. Boston, MA., July, 2007.**



**Kriebel D.** Biologically-based Models in Exposure Assessment and Epidemiology. American Industrial Hygiene Association Conference, May 2008.

**Kriebel, D.** Precaution and Uncertainty: Cancer and the Environment. Invited presentation to the American Cancer Society, Atlanta, GA. January 2008.

**Kriebel, D.** **Biologically Based Models in Epidemiology. 9-hour course at the National Institute for Occupational Safety and Health, Morgantown WV, Nov. 2008.**

**Markkanen, P.,** ScD; Stephanie Chalupka, EdD; Catherine Galligan, MSc; Susan Sama, ScD, RN; Rebecca Gore, PhD; Hyun Kim, MS; Anila Bello, MS; David Kriebel, ScD; and Margaret M. Quinn, ScD, CIH. Survey Methods and recruitment of a population of home healthcare providers. APHA Annual Meeting, November 6, 2007. Washington, DC.

Quinn, M. and Sally Edwards, Moderators. Healthcare and Social Assistance Sector Breakout Session, Prevention through Design (PtD) Workshop, Washington DC, July 9-11, 2007

**Tickner, Joel. State and Federal Chemicals Management Activities in the US. Training on REACH and Chemicals Policy, Lansing, MI, September 27, 2007.**

**Tickner, Joel. Moving Towards Safer Chemistry – Problems and Opportunities Coalition for a Safe & Healthy Connecticut. Coalition for a Safe and Healthy Connecticut. Hartford, CT October 12, 2007.**

**Tickner, Joel. Taking Corporate Leadership on Sustainable Chemicals Management Policies: An Opportunity for Bayer MaterialScience. Bayer Material Science, Pittsburgh, PA, January 24, 2008.**

**Tickner, Joel. Ignorance is Bliss: Corporate Responsibility for Uncertain Chemical Risks. New England School of Law Conference on Corporate Responsibility and the Bhopal Disaster, February 7, 2008.**

**Tickner, Joel. REACH – Overview and Timelines. Connecticut Conference on Green Chemistry and Chemicals Policy, Hartford, CT, February 9, 2008.**

**Tickner, Joel. International Influences on Chemicals Policy Reform. Connecticut Conference on Green Chemistry and Chemicals Policy, Hartford, CT, February 9, 2008.**

**Tickner, Joel. Drivers for State Action on Safer Chemicals and Products. National Pollution Prevention Roundtable, Baltimore, MD May 20, 2008.**

**Tickner, Joel. Drivers for State Action on Safer Chemicals and Products. Seminar at Harvard Kennedy School of Government, Cambridge, MA, May 20, 2008.**



**Tickner, Joel. Precautionary Principle: A Proactive Approach to Environmental Health Risks in Israel. Presentation to Israeli Knesset, Isreal, June 3, 2008.**

**Tickner, Joel. Reaction or Precaution? Two Choices for the Future of Health, Environment, and Sustainability in Israel. Presentation at Conference on the Precautionary Principle and Public Health, Tel Aviv University, Tel Aviviv, Israel, June 4, 2008.**

**Tickner, Joel. The Precautionary Principle: Moving from a Reactionary to a Proactive Approach to Environmental and Occupational Health Hazards. Presentation at Techion University Haifa Seminar, Haifa, Israel, June 5, 2008.**

**Tickner, Joel. Taking Corporate Leadership on Precautionary, Sustainable Chemicals Management: An Opportunity for Israel, Presentation at Israeli Chemical Industry Seminar, Haifa, Israel, June 5, 2008.**

**Tickner, Joel. Challenges to Safer Alternatives: Barriers and Opportunities. Advancing Alternatives Assessment for Safer Chemicals Policy: Links to the Stockholm Convention's POPRC, Lowell, MA, June 11-13, 2008.**

**Tickner, Joel. Green Chemistry and Commerce Council—A Year In Perspective. Green Chemistry and Commerce Council Innovators Roundtable: The Role of Standards, Policy and Retail in the Sustainable Management of Chemicals Along Supply Chains, Beaverton, OR, July 10, 2008.**

**Tickner, Joel. Barriers and Opportunities for Advancing Design for Environment and Green Chemistry in Industry. IPC Conference Its not Easy Being Green. Boston, MA, July 17, 2008,.**

10. Collaboration with other Center Centers/Institutes and/or Departments

**Polly Hoppin devoted a half day per week this year promoting collaboration across Centers and Departments within the School of Health and Environment on asthma, and supporting the Dean in his development of an Advisory Council.**

**The EMS Service Program collaborated with UMass Lowell's Center for Family Work & Community, UMass Dartmouth and UMass Boston to develop a 'Green Economy' recently funded by through the UMass President's 'Creative Economy' grant program**

11. Regional/Local Outreach (Other Institutes of Higher Education, Industries, Government Agencies, schools, etc.)

**Richard Clapp provided technical support for C-10 radiation and cancer monitoring in Newburyport and other Merrimack Valley towns; also located support for shellfish examination around Seabrook Nuclear Power Station.**



**Richard Clapp worked with the Massachusetts Breast Cancer Coalition and Silent Spring Institute to educate policy makers about the importance of including breast cancer research funds in the Massachusetts state budget.**

**Polly Hoppin worked closely with the Asthma Regional Council, Children's Hospital, Boston Medical Center, Boston Public Health Commission, Massachusetts Department of Public Health, Allergy and Asthma Foundation of America, and Neighborhood Health Plan in convening leading asthma providers to develop a consensus statement and in organizing a major state-wide asthma conference.**

**Polly Hoppin worked with Clean Water Action, Boston Medical Center, Boston Urban Asthma Coalition, and the Collaborative on Health and Environment on a consensus document calling attention to the role of chemicals in the onset and exacerbation of asthma.**

**Polly Hoppin participated as an invited expert in a workshop on Advancing the Case for Comprehensive Asthma Management, organized by the Environmental Protection Agency.**

**Polly Hoppin coordinated national conference calls on new developments in asthma science and policy on behalf of the Collaborative on Health and Environment.**

**Over the past year, the Lowell Center provided research assistance and technical support to:**

- Advocates throughout the country working to advance integrated chemicals policies.
- A coalition of state governments to develop a proposal for an Interstate Chemicals Clearinghouse.
- The **Government of Ontario** on new toxics use reduction legislation.
- The **International POPs Elimination Network** on alternatives assessment methodologies.
- The **Maine Health Strategy Center** on the creation of draft legislation for chemicals policy reform in Maine
- **Global Chemicals Resource Team's** work on promoting progressive chemicals policy in developing countries and countries in transition.
- **The University of California Berkeley** in its research on chemicals policy.

**Joel Tickner and Yve Torrie collaborated with the Michigan Department of Environmental Quality on developing Michigan's Green Chemistry Initiative.**

**Joel Tickner worked with True Textiles to peer review their chemical review process for reaching the company's sustainability goals.**

**Joel Tickner worked with United Technologies Corporation to assess and improve the company's implementation of policies regulating their use of materials of concern.**



**Joel Tickner worked with the United Steelworkers, UNITE HERE, SustainLabor, and The Labor Institute at Cornell University to plan and attend a meeting in Toronto, Ontario focused on international union collaboration on chemicals policy issues.**

**Cathy Crumbley is a member of the Steering Committee of the Sustainable Biomaterials Collaborative, a collaborative initiative with the Institute for Local Self Reliance, the Institute for Agriculture and Trade Policy, Clean Production Action, Healthy Building Network, and Green Harvest Technologies.**

### *Boards and Advisory Groups*

**Margaret Quinn, Catherine Galligan and Pia Markkanen serve on the Massachusetts Statewide Advisory Board on Needlestick Injuries and Safe Needle Devices, MA Dept of Public Health; Boston, MA**

**Margaret Quinn serves on the NIOSH NORA Healthcare Council and serves as representative to the NIOSH Prevention through Design (PtD) Committee.**

12. **Ken Geiser is a Member of the Chemical Information Management Advisory Panel of the U.S. Environmental Protection Agency.**

13. **David Kriebel is a Member of the Committee on Beryllium, National Academy of Sciences, Board on Environmental Science and Toxicology.**

**Polly Hoppin is a Member of the Board of Directors of Clean Water Fund.**

**Ken Geiser serves on Ontario's Science Task Force offering guidance on toxics use reduction.**

**Ken Geiser serves on the California Governor's Green Chemistry Advisory Panel**

### *Classroom Presentations*

**Sally Edwards presented "The Politics of Toxics in Toys and Children's Products: Problems and Solutions" Lecture at University of Massachusetts Lowell (guest lecturer in Craig Slatin's "Politics of Health" class). April, 2008**

**Molly Jacobs and Polly Hoppin gave an afternoon seminar for Dick Clapp's Public Health Surveillance class at Boston University.**

## 12. Proposals Submitted 2007-2008

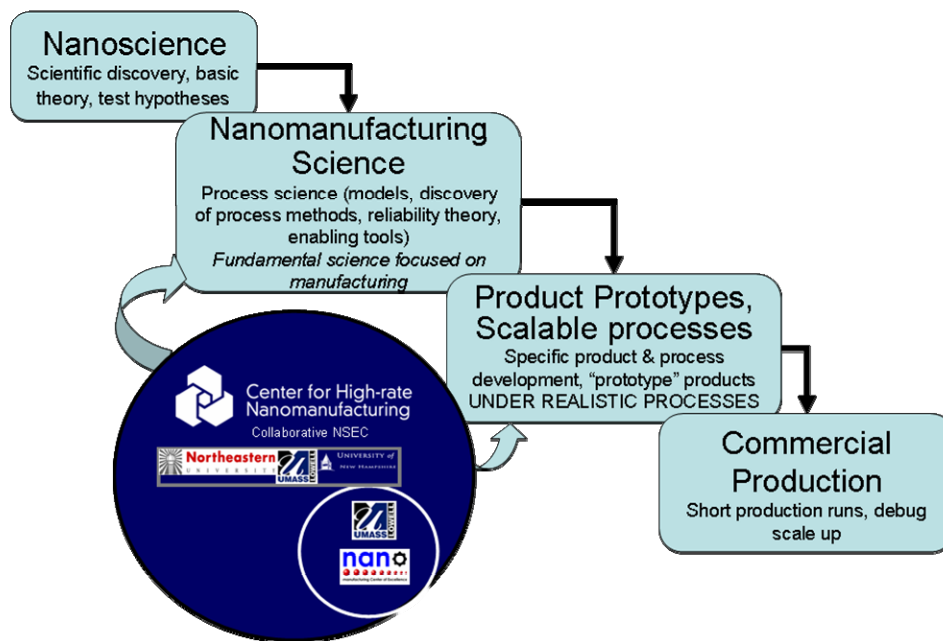
### Lowell Center Funding Proposals Submitted July 2007-June 2008

Submitted Date	Sponsor	PI	Co-PI	Title	Start Date	End Date	Total Proposal Budget
06/14/07	KENDEDA FUND	Kriebel	Crumbley	Strengthening Core Activities of the Lowell Center for Sustainable Production, University of Massachusetts Lowell	08/15/07	08/14/08	\$109,494.00
07/18/07	COMMONWEAL	Hoppin	Crumbley	Supporting Cancer Prevention Efforts Among Women's Cancer Organizations	07/15/07	07/14/08	\$45,241.00
08/08/07	JOHN MERCK FUND	Tickner	Crumbley	Advancing Chemicals Policy Reform at the Federal, State, and Corporate Level in	10/01/07	09/30/08	\$75,605.00
09/21/07	COMMONWEALTH OF MASSACHUSETTS	Geiser	Crumbley	Training Services and Materials for Massachusetts Department of Environmental Protection	12/01/07	11/30/08	\$39,753.00
09/28/07	CENTERS FOR DISEASE CONTROL & PREVEN	Quinn,N		Sharps Injuries and Blood Exposure in Home Health Care	09/01/07	08/31/08	\$60,000.00
10/25/2007	U.S. ENVIRONMENTAL PROTECTION AGENCY	Geiser	Crumbley	Innovative Energy Management Workshops for Water and Wastewater Facilities	12/11/07	09/30/08	\$6,500.00
12/4/2007	GREENBLUE	Geiser	Crumbley	Sustainable Toys Initiative	10/1/2007	3/31/2008	\$13,000.00
12/6/2007	VARIOUS SPONSORS	Geiser	Crumbley	Income Acct. For Innovative Energy Management Workshops for Water and Wastewater Facilities	12/11/2007	9/30/2008	\$0.00
12/11/2007	MICHIGAN DEPT OF ENVIRONMENTAL QUALI	Tickner	Crumbley	Advanced Green Chemistry in Michigan	12/1/2007	9/30/2009	\$49,000.00
01/02/08	InterfacesFABRICS	Tickner	Crumbley	Proposal to InterfaceFABRIC for Independent Peer Review of TerraCHECK Protocol	02/01/08	11/14/08	\$52,475.00
01/15/08	MA DEPARTMENT OF PUBLIC HEALTH	Quinn,Margaret		Technical Assistance for Sharps Injury Surveillance	03/01/08	06/30/08	\$20,000.00
01/18/08	UNITED NATIONS ENVIRON PROGRAMME	Morose	Crumbley	Mercury Intercessional Project	01/01/08	12/31/08	\$50,000.00
01/29/08	AMERICAN PUBLIC WORKS ASSOCIATION	Geiser	Crumbley	EMS Training Workshops for APWA Public Works Managers	02/15/08	05/30/08	\$3,047.00
01/30/08	TOWN OF SPENCER	Geiser	Crumbley	Assistance to Town of Spencer for Development of EMS	03/01/08	02/28/10	\$21,380.00
03/05/08	NATL INST FOR OCCUPATIONAL SAFETY&HE	Quinn,N	Chalupka	Safety & Health for Home Care Workers in Social Assistance and Healthcare	12/01/08	11/30/12	\$1,798,881.00
03/06/08	US GREEN BUILDING COUNCIL	Quinn,N	Crumbley	Indoor Cleaning: Evaluation of Health & Safety and Recommendations for Improved Designs	09/01/08	08/31/09	\$148,316.00
04/22/08	THE CADMUS GROUP, INC.	Hoppin		Support for Policy Development, Analysis and Information Development, Communications Strategy Design, Education, and Outreach Products, and Dissemination of Guidance on Indoor Environmental Quality Issues	10/01/08	09/30/13	\$67,805.00
04/25/08	KENDEDA FUND	Kriebel	Crumbley	Strengthening Core Activities of the Lowell Center for Sustainable Production University of Massachusetts Lowell	05/15/08	05/14/09	\$250,000.00
04/30/08	JOHN MERCK FUND	Geiser	Crumbley	A Proposal for Planning the Establishment of an Interstate Chemicals Clearinghouse (IC2)	06/15/08	06/14/09	\$48,778.00
5/9/2008	NEW YORK COMMUNITY TRUST	Tickner	Crumbley	Engaging Pro-Active Industry in Advancing Safer Chemicals and Products	10/01/08	09/30/10	\$200,000.00
5/27/2008	INTERNATIONAL JOINT COMMISSION	Tickner	Crumbley	Analysis of Policies for Emerging Contaminants of Concern in the Great Lakes	05/15/08	08/30/08	\$20,094.00
06/09/08	U S ENVIRONMENTAL PROTECTION AGENCY	Geiser	Crumbley	Improving Pollution Prevention, Compliance, and Environmental Stewardship at Public Transportation Authorities	10/01/08	12/31/10	\$22,080.00

## 29. CHN/NCOE NANOMANUFACTURING CENTER

### 1. Mission Statement

In order to accelerate the development of commercial products, the University of Massachusetts Lowell is focused on nanomanufacturing research. Through the Nanomanufacturing Center, novel processes are being developed to enable high-rate, high volume assembly of nanoelements (including polymer systems) for use in a variety of applications including biomedical and electronic devices. These efforts are critical to support the development of the innovation economy in the Commonwealth of Massachusetts and to strengthen the global competitiveness of the local industry and U.S. Industry as a whole.



### 2. General Description and Goals

The Center is anchored by the National Science Foundation-funded Nanoscale Science and Engineering Center (NSEC) – the Center for High-rate Nanomanufacturing (CHN) and the associated state-funded Nanoscale Center for Excellence (NCOE). The NSEC is an equal partnership between the University of Massachusetts Lowell, Northeastern University, and the University of New Hampshire. At the University of Massachusetts Lowell, CHN/NCOE is a confederation of about 40 faculty members from the sciences, engineering, health and environment, humanities, and art. The Center provides the infrastructure for interdisciplinary collaborations and expanded nanomanufacturing research.

Overall, the mission of the Center is to become an engine of growth for UML and the region—this mission will be achieved by having the Center recognized for:

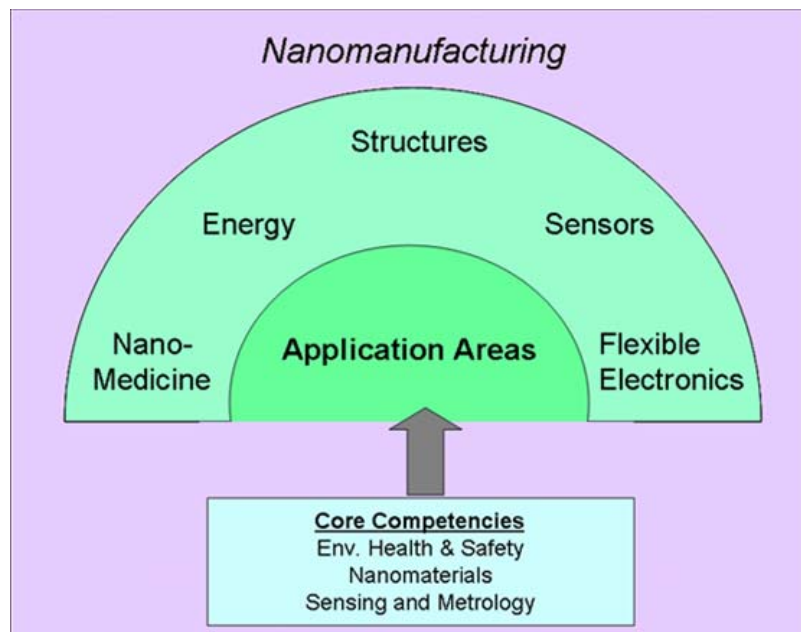
1. World-class research

2. First-class, unique, state-of-the-art research facilities, including the new Emerging Technologies and Innovation Center, (ETIC)
3. Development of nanomanufacturing processes and technologies that will lead to products
4. Supporting the regional economy by aiding current and future companies to grow and by spawning the development of new businesses
5. Providing for the responsible development of nanotechnology by addressing environmental, health & safety (EHS) issues
6. Educating and training a skilled workforce to support a nanomanufacturing industry in the northeast
7. Development of further income streams from contracts, collaborations and licensing of intellectual property (IP)

### 3. Research Focus Areas

The research activities highlight what is unique at UML. UML has always had a strong position as a leader in industry-relevant programs, manufacturing (for example, plastics engineering), and environmental health and safety. Nanomanufacturing (rather than nanoscience or nanotechnology) was a strategic choice – “branding”. UML has made significant strides in developing our visibility as leaders in this area and distinguishing us as different, not only by nanomanufacturing, but also in what we nanomanufacture. The concentration on plastics/polymers/composites and environmental health and safety sets us apart from other institutions. UML is small and is challenged to compete with larger, more established institutions without a niche. We clearly have this niche.

As shown below, the Nanomanufacturing Center has core competencies in nanomaterials, environmental health and safety, and sensing and metrology. These competencies have been focused on applications in nanomedicine, energy, structures, sensors, and flexible electronics.





#### 4. Associated Personnel (Faculty, Staff)

**Co-directors:** Carol Barry, Julie Chen, and Joey Mead

**Staff:** Lois Heath, Adrianna Morris, George Kachen,

**Faculty:**

Alkim Akyurtlu	Electrical and Computer Engineering
Todd Avery	English
Peter Avitabile	Mechanical Engineering
Dhimiter Bello	Work Environment
Susan Braunhut	Biological Sciences
Bridgette Budhlall	Plastics Engineering
Majid Charmchi	Mechanical Engineering
Michael Ellenbecker	Work Environment
Rudolf Faust	Chemistry
Zhiyong Gu	Chemical Engineering
Guixin (Susan) He	Clinical Laboratory Sciences
David Kazmer	Plastics Engineering
Byungki Kim	Mechanical Engineering
Jayant Kumar	Physics
Young-kyun Kwon	Physics
Pradeep Kurup	Civil and Environmental Engineering
Xuejun Lu	Electrical and Computer Engineering
Sanjeev Manohar	Chemical Engineering
Martin Margala	Electrical and Computer Engineering
Kenneth Marx	Chemistry
Barbara Mawn	Nursing
Melisenda McDonald	Chemistry
Ramaswamy Nagarajan	Plastics Engineering
Robert Nicolosi	Clinical Laboratory Sciences
Christopher Niezrecki	Mechanical Engineering
Margaret Quinn	Work Environment
Emmanuelle Reynaud	Mechanical Engineering
Eugene Rogers	Clinical Laboratory Sciences
Marina Ruths	Chemistry
Daniel Sandman	Chemistry
Daniel Schmidt	Plastics Engineering
Thomas Shea	Biological Sciences
Mengyan Shen	Physics
Linda Silka	Regional Economic & Social Development
Hongwei Sun	Mechanical Engineering
Joel Therrien	Electrical and Computer Engineering
Arthur Watterson	Chemistry (Emeritus)
James Whitten	Chemistry
Xingwei (Vivian) Wang	Electrical and Computer Engineering



Xiaoqi (Jackie) Zhang

Civil and Environmental Engineering

## 5. New and Temporary Faculty

### New faculty:

Majid Charmchi

Mechanical Engineering

Guixin (Susan) He

Clinical Laboratory Sciences

Martin Margala

Electrical and Computer Engineering

Barbara Mawn

Nursing

**Research faculty and scientists:** Lisa-Jo Clarizia, Jijun Huang, Jun Lee, Sandip Sengupta

## 6. Students Supported

The NSF Center (CHN) directly supports ~35 graduate students, whereas NCOE primarily provides infrastructure. Other grants run under the CHN/NCOE umbrella support at least another 30 students.

## 7. Current Research Projects

The Center is currently bringing in roughly \$5M/year. Partnerships are the key to the Center's future growth and sustainability. These partnerships provide both direct funding and significant competitive advantage for external funds. Here, we highlight some of the key connections that have been made:

- **NSF-funded Center for High-rate Nanomanufacturing (CHN):** This three university partnership has been critical as a foundational element in the Center, in terms of funding (\$3.5M+, with the potential of doubling), complementary technical expertise, and visibility.
- **Army Research Lab (Nanomanufacturing of Multifunctional Sensors):** This large, multi-year program (\$2.9M/2 years, renewal anticipated) has enabled us to expand our collaborations with several different groups within the Army and with various Army contractors. Specific examples include the primary ARL Aberdeen connection, AMRDEC, Redstone Arsenal, Boeing, and Sikorsky. We plan to build on these connections for long-term collaborative funding opportunities.
- **MA Life Sciences Initiative:** We view our participation on the UMass Life Sciences Task Force (Faust, Gu, Wang, Rogers, Budhlall) as important not only for the Governor's Life Sciences Initiative, but also towards developing connections for other funding opportunities. For example, we are an initial partner in the UMass Nanomedicine Institute (Amherst, Worcester, Lowell), and intend to help this Institute obtain longer-term external funding.
- **Industry Partnerships:** The Center has been directly funded by 32 companies, totaling over \$2M. Our partners include large Fortune 100/Fortune 500 companies such as Raytheon and Boston Scientific; large, global, employee-owned companies such as Nypro; and New England-based small businesses such as Triton Systems and EIC Labs. In addition to direct funding, there has been partnering on federally-funded projects (e.g., SBIR) that has led to a significant amount of funding for the Center and our partners.

- **International Collaborations:** The State of MA and UMass are committed to expanding international efforts, with a particular focus on China, due to its economic impact. The Center has helped to support this effort by hosting two visitors from Tsinghua University

## 8. Publications

### Journal articles reported for CHN Annual Report (April 1, 2008)

- Ashter, A., S. Tsai, M. J. Ellenbecker, J. Mead, and C. Barry, “Effects of Nanoparticle Feed Location during Nanocomposite Compounding,” accepted for *Polymer Eng. and Science*, 2008.
- Tsai, S., E. Ada, J. Isaacs, and M.J. Ellenbecker, “Airborne Nanoparticle Exposures Associated with the Manual Handling of Nanoalumina in Fume Hoods,” accepted for publication, *J. Nanoparticle Res.*, 2007.
- Bello, D., Wardle, B., Ahn, K., Yamamoto, N., Garcia, E., Hart, A., Ellenbecker, M., Hallock, M., “Exposure to Nanoscale Particles and Fibers During Fabrication and Machining of Hybrid CNT Advanced Composites,” *J Nanoparticle Research*, 2008, under review.
- Rogers E, S F Hsieh, N Rao, D Bello: “A high throughput analytical approach to screen for oxidative stress potential exerted by nanomaterials in a biologically relevant matrix: human blood serum,” 2008, *Nanotoxicology*, under review.
- Bello, D., A.J. Hart, K. Ahn, M. Hallock, N. Yamamoto, E. Garcia, M.J. Ellenbecker, and B.L. Wardle, “Exposure to Nanoscale Particles during CVD Growth and Subsequent Handling of Vertically-aligned CNT Films,” submitted to *Carbon*, 2007 .
- Ellenbecker, M.J., S. Tsai, and J. Isaacs, “Guidelines for the Safe Handling of Nanoparticles in University Research Laboratories,” submitted to *NANO*, 2007.
- Hahm, M., Lee, E., Kwon, Y., and Jung, Y., “Diameter Selective Growth of Vertically Aligned Single Walled Carbon Nanotubes by Ethanol Flow Control,” submitted to *Advanced Materials*, 2008.
- Shang, Y., Wei, M., Kazmer, D., Barry, C., and Mead, J., “Numerical simulation of phase separation of immiscible polymer blends on a heterogeneously functionalized substrate,” submitted to *Journal of Chemical Physics*, 2008.
- Tsai, S., A. Ashter, E. Ada, J. Mead, C. Barry, and M. J. Ellenbecker, “Control of Airborne Nanoparticle Release during Compounding of Polymer Nanocomposites,” submitted to *NANO*, 2007.
- Tsai, S., A. Ashter, E. Ada, J. Mead, C. Barry, and M. J. Ellenbecker, “Airborne Nanoparticle Release Associated with the Compounding of Nanocomposites using Nanoalumina as Fillers,” submitted to *Aerosol and Air Quality Research*, 2008.
- Yin, Y., Zhang, X., Graham, J., and Luongo, L., “Impacts of purified single-walled carbon nanotubes on activated sludge process,” submitted to *Chemosphere*, 2008.
- Yin, Y., and Zhang, X., “Evaluation of the Impact of Single-Walled Carbon Nanotubes in an Activated Sludge Wastewater Reactor,” submitted to *Wat. Sci and Tech.*, 2008.
- Chandekar, A., Alabran, M., Sengupta, S., Lee, J., Mead, J., Barry, C., Whitten, J., Somu, S., Busnaina, A., “Fabrication of Stamps for Microcontact Printing by Injection Molding”, *Microelectronic Eng.*, 85, 187-194 (2008).

- Chandekar, A. and J. Whitten, “Nanoscale Patterning of a Conjugated Oligomer,” *Appl. Phys. Lett.*, 91, 113103-113106 (2007).
- Chandekar, A., S. Sengupta, and J. Whitten, “Template-Directed Patterning of Polymers and Biomaterials”, *Micros. Res. Tech.*, 70, 506-512 (2007).
- Fonseka, P., Vasudevan, G., Clarizia, L., McDonald, M., “Temperature Dependent Soret Spectral Band Shifts Accompany Human CN-Mesohemoglobin Assembly”, *The Protein Journal*, 26(4), 257-263 (2007)
- Kim, D., J. S. Lee, C. F. Barry, and J. L. Mead, “Evaluation and Prediction of the Effects of Melt Processing Conditions On The Degree of Mixing in Alumina / Poly(Ethylene Terephthalate) Nanocomposites,” *Journal of Applied Polymer Science*, 109(5), 2924-2934 (2008).
- Kim, T. W., Hong, Y. J., Yi, G.-C., Kwon, J.-H., Kim, M., Han, H. N., Kim, D. H., Oh, K. H., Kong, K.-J., and Kwon, Y.-K., “Morphology transformation of patterned, uniform and faceted GaN microcrystals,” *J. Phys. D: Appl. Phys.* 41, 015406 (2008).
- Song, H. J., Lee, Y., Jiang, T., Kussow, A.-G., Lee, M., Hong, S., Kwon, Y.-K., and Choi, H. C., “Self-clusterized Glycines on Single Walled Carbon Nanotubes for Alcohol Sensing,” *J. Phys. Chem. C*, 112, 629 (2008).

#### **Reviewed conference papers reported for CHN Annual Report (April 1, 2008)**

- Fang, L., Shang, Y., Barry, C., Mead, J., and Kazmer, D., “Effect of mold temperature on the surface phase morphology of injection molded block copolymer”, *Proceedings of the Annual Technical Conference of the Society of Plastics Engineers*, 66, (2008).
- Kumar, A., Wei, M., Barry, C., Orroth, S., Busnaina, A., and Mead, J.”Transfer of Template Patterned Carbon Nanotubes to a Polymer Surface using the Thermoforming Process,” *Proceedings of the Annual Technical Conference of the Society of Plastics Engineers*, 66, (2008)..
- Padmanabha, P., Yoon, S., Lee, J., Mead, J., Cha, N., Busnaina, A., and Barry, C., “Effect Of Vacuum Venting In Micro-Injection Molding,” *Proceedings of the Annual Technical Conference of the Society of Plastics Engineers*, 66, (2008).
- Shen, J., Wei, M., Barry, C. and Mead, J., “The Transfer of Patterned Conducting Polymer To Plastic Substrates,” *Proceedings of the Annual Technical Conference of the Society of Plastics Engineers*, 66, (2008).
- Thiruvenkataswamy, R., Yoon, S., Mead, J., and Barry, C., “Controlling Dimensions When Injection Molding Microfluidic Devices,” *Proceedings of the Annual Technical Conference of the Society of Plastics Engineers*, 66, (2008).
- Yoon, S., Cha, N., Park, K., Padmanabha, P., Lee, J., Mead, J., Busnaina, A., and Barry, C., “Evaluation of Metal-Polymer Hybrid Tooling for Micro-injection Molding”, *Proceedings of the Annual Technical Conference of the Society of Plastics Engineers*, 66, (2008).

#### **Conference papers reported for CHN Annual Report (April 1, 2008)**

- Chandekar, A., Im, J-S, Sengupta, S. and Whitten, J. “Patterning of a Wide Variety of Materials by Template-Directed Adsorption on Alkanethiol-Patterned Gold Surfaces”, *234<sup>th</sup> American Chemical Society National Meeting*, Boston, MA, Aug. 19-23 (2007)
- Clarizia, L., J. Mead, M. McDonald, “Enhancement of Immunoassay Sensitivity by Unique Noncovalent Protein-Polymer Substrate Interaction,” *Prot. Sci.*, B169, (2007).

- Clarizia, L., J. Mead, M. McDonald, “Novel Polymer-Protein Substrate for Immunosorbent Assays,” *BIO 2007*, Boston MA (2007)
- Ruths, M., “Controlled-roughness surfaces for studies of adhesion and friction of multi-asperity contacts”, *Proceedings of 2008 NSF CMMI Engineering Research and Innovation Conference*, Knoxville, TN. National Science Foundation, Arlington, VA, Grant#0645065, 1–2 (2008)
- Singh, J and Whitten, J. “Interaction of Thermally Deposited Gold with 3-Mercaptopropyltrimethoxysilane-Modified Silicon Surfaces”, *234<sup>th</sup> American Chemical Society National Meeting*, Boston, MA, Aug. 19-23 (2007).
- Wang, W., Clarizia, L., Wang, X., McDonald, M., “Label free fiber optic biosensor with single PMMA functional layer”, *Proceedings of The International Society for Optical Engineering (SPIE)*, 7004, (2007).
- Yin, Y., and Zhang, X., “Assessment of Carbon Nanotubes on Activated Sludge Wastewater Treatment Process,” *Conference Proceedings of the 80<sup>th</sup> Annual Water Environment Federation Technical Exhibition and Conference*. San Diego, CA (2007).
- Yin, Y., and Zhang, X., “Evaluation of the Impact of Single-Walled Carbon Nanotubes in an Activated Sludge Wastewater Reactor,” submitted for *International Water Association*, Vienna, Austria, 2008.

## 9. Conference Presentations

### Conference presentations reported for CHN Annual Report (April 1, 2008)

*In addition to the presentations listed here, the 13 conference papers listed in the previous section were also presented during 2007-2008.*

- Ellenbecker, M.J., K. Ahn, S. Tsai, “Best Practices for Working Safely with Nanoparticles In University Research Laboratories,” presented at the 3<sup>rd</sup> International Symposium on Nanotechnology, Occupational and Environmental Health, Taipei, Taiwan, August 2007.
- Ellenbecker, M.J., S. Tsai, J. Isaacs, “Guidelines for the Safe Handling of Nanoparticles in University Research Laboratories,” presented at the International Symposium on Nanotechnology in Environmental Protection and Pollution, ISNEPP 2007, Ft. Lauderdale, December 2007.
- Ellenbecker, M.J., “Exposure to Nanoparticles: Is This Something We should Worry About? If So, What Should We Do About It?,” presented at the Conference on Nanotechnology, Literature, and Society, Lowell, MA, December 2007.
- Hahm, M., Lee, E., Kwon, Y., and Jung Y., “Diameter Selective Growth of Vertically Aligned Single Walled Carbon Nanotubes by Ethanol Flow Control” oral presentation at *NSTI Nanotech 2008*, Boston, MA, (2008).
- Hsieh, S.F, Bello, D., and Rogers, E., “An Analytical Approach to Screen for Oxidative Stress Exerted by Nanomaterials in Human Blood Plasma,” *3<sup>rd</sup> International Symposium on Nanotechnology, Occupational and Environmental Health*, Taipei, Taiwan, (2007).
- Noah, M. and Kwon, Y., “Toward 100% Semiconducting Devices from Mixed Chirality Nanotube Networks,” *APS March Meeting*, Denver, CO, (2007).
- Rogers, E., Bello, D., and Hsieh, S., F., “Research Thrust for Social and Environmental Health and Safety Implications of Nanomaterials,” *Nanoscale Science and Engineering 2007 NSF Grantees Conference*, Arlington VA, (2007).



- Tsai, S., K. Ahn, J. Isaacs, M.J. Ellenbecker, “Monitoring of Airborne Nanoparticles in Research Laboratories at the Center for High-Rate Nanomanufacturing (CHN),” presented at the American Industrial Hygiene Conference & Expo (AIHCE), Philadelphia, June 2007.
- Tsai, S., E. Ada, M.J. Ellenbecker, ”Airborne Nanoparticle Exposures Associated with the Manual Handling of Nanoalumina in Fume Hoods,” presented at the 3<sup>rd</sup> International Symposium on Nanotechnology, Occupational and Environmental Health, Taipei, Taiwan, August 2007.
- Tsai, S., K. Ahn, E. Ada, M.J. Ellenbecker, “Workplace Nanoparticle Exposure Measurement at University Research Centers,” presented at the 3<sup>rd</sup> International Symposium on Nanotechnology, Occupational and Environmental Health, Taipei, Taiwan, August 2007.
- Tsai, S., K. Ahn, E. Ada, M.J. Ellenbecker, M.F. Hallock, J. Isaacs, “Workplace Nanoparticle Exposure Measurement at University Research Centers,” presented at the Campus Safety Health and Environmental Management Association annual meeting, Boston, July 2007.
- Tsai, S., E. Ada, M.J. Ellenbecker, “Measurement of Airborne Nanoparticle Exposures Associated with the Use of Fume Hoods,” presented at the annual conference of the American Association for Aerosol Research, Reno, NV, September 2007.
- Tsai, S., E. Ada., K. Ahn, M.J. Ellenbecker, “Measured Airborne Nanoparticle Exposures at an NSF Nanoscale Science and Engineering Center,” presented at the annual conference of the American Association for Aerosol Research, Reno, NV, September 2007.
- Tsai, S., A. Ashter, E. Ada, J. Mead, C. Barry, M.J. Ellenbecker, “Control of Airborne Nanoparticle Release during Compounding of Polymer Nanocomposites Using Twin Screw Extruder,” presented at the International Symposium on Nanotechnology in Environmental Protection and Pollution, ISNEPP 2007, Ft. Lauderdale, December 2007.

## **10. Collaboration with other Centers/Institutes and/or Departments**

Center for Family, Work, and Community  
Center for Field Service and Studies  
Chemistry Department  
Department of Biological Sciences  
Department of Chemical Engineering  
Department of Electrical and Computer Engineering  
Department of Mechanical Engineering  
Department of Plastics Engineering  
Department of Work Environment  
English Department  
Graduate School of Education  
Physics Department

## **11. Regional/Local Outreach (Other Institutes of Higher Education, Industries, Government Agencies, schools, etc.)**



### **K-12 Outreach**

- Summer, 2007 – College Prep – provided three-afternoon programming and presenters for nanotechnology
- Fall, 2007 - Bartlett School Extended Day Program (Lowell, MA) – provided programming and student presenters for the program (two days per week for five weeks)
- Fall, 2007 – WIST program (Manchester, NH) – Carol Barry presented woman’s prospective for day-long women in science and technology program (Nov. 2, 2007)
- Fall, 2007 – sponsored Nanotech 2007 Teacher’s Symposium at the Museum of Science, Boston – Dhimiter Bello was a featured speaker for a program that reached 70 K-12 teachers
- Fall, 2007 – Carol Barry presented Introduction to Nanotechnology to Chelmsford High School science teachers as part of their professional development
- Spring, 2008 - Science of Small Things – provided programming and student presenters for the program (one days per week for 10 weeks) at Lowell High School
- Spring, 2008 – TEAMS Academy - provided programming and student presenters for two sessions (March 7, 2008)
- Spring, 2008 – NSTA Conference, Boston, MA – Carol Barry and Rinky Devre presented nanotechnology modules for middle school to science teachers (March 28, 2008)
- Spring, 2008 – WIS (Shrewsbury, MA) - Carol Barry presented Nanotechnology in Fashion to middle school girls in a day-long women in science and technology program (April 5, 2008)
- Spring, 2008 – Region IV Middle School Science and Engineering Fair – about 93 student presented 60 projects on May 3, 2008 – 25 projects were sent to the State Science and Engineering Fair

### **Collaborations with Community Colleges**

Middlesex Community College – CHN is supporting recently-received NSF ATE Award  
Northern Essex Community College – provided student for 2007 REU program

### **Research Experiences for Undergraduate (REU) Program**

CHN ran its third 10-week summer REU program with 30 participants in summer 2007 (15 were at UML). The undergraduate students are in CHN laboratories from early June to mid August. Students, as individuals or in collaboration with other undergraduates, conducted research under the guidance of their advisors, other professors, graduate students, and post-doctoral researchers. Research projects included both a literature review of relevant material and experiments related to CHN research. The undergraduates presented the results of their research at the end of the program.

The cross-university professional development program created for this REU program included laboratory safety, library skills, technical communication, ethics, participation in the NSF Site Visit and 5<sup>th</sup> New England International Nanomanufacturing Workshop, and a tour of NanoComp (Manchester, NH). Technical communications training consisted of an introduction to performing a literature search and writing an introduction to a technical paper as well as a workshop “Technically Speaking” run by Museum of Science, Boston, science



educators. This program was disseminated as a conference paper and presentation at the 2008 ASEE Annual Conference in Pittsburgh, PA (June, 2008).

Program Director: Carol Barry

2007 Faculty Hosts: Carol Barry, Dhimiter Bello, Young-kyun Kwon, Melisenda McDonald, Joey Mead, Daniel Schmidt, James Whitten, and Xiaoqi (Jackie) Zhang

Other 2007 Hosts: Susan Bunker, American Textile History Museum (Lowell, MA)

Students' Home Institutions: Carnegie Mellon University (1); City College of New York (1); Northeastern University (1); Northern Essex Community College (1); Rensselaer Polytechnic Institute (1); and University of Massachusetts Lowell (10)

### **Research Experiences for Teachers (RET) Program**

CHN participated in its third Research Experience for Teachers (RET) program during summer 2007. Summer research internships are an opportunity for teachers to participate in active research projects in professional laboratory settings. So, this program is a six-week summer research experience for middle and high school mathematics and science teachers and community college faculty. The primary program is an RET Site at Northeastern University, which provides teacher recruitment, professional development, and teacher tracking. CHN supports four participants, who are placed in research assignments in pairs at Northeastern University and UML; they spend a minimum of 35 hours per week working in the research laboratories.

2007 UML faculty hosts: Carol Barry and Joey Mead

2007 RET participants at UML: Ryan Hoffman (North Reading High School, North Reading, MA) and Mark Lawrence (Dover High School, Dover, NH)

### **Nanotechnology, Literature, and Society Conference (December 6-7, 2007)**

Sponsored by CHN and held at the University of Massachusetts Lowell (UML), the interdisciplinary conference *Nanotechnology, Literature, and Society* featured four invited speakers:

- Charles Rubin (Duquesne University), "The Real World of Nanotechnology: Michael Crichton's PREY"
- Brooks Landon (University of Iowa), "Minding the Gap: Map/Territory - Distinctions in the Discourse of Nanotech"
- Colin Milburn (University of California Davis), "Playtime on Nano Island: The Laboratory as Ludic Space"
- Christopher Toumey (University of South Carolina), "Reading Feynman into Nanotechnology"

and five panels. Panelists included engineers, industrial hygienists, economics, social scientists, and humanists. On the first day, the conference participants attended a dinner reception at the Revolving Museum (Lowell, MA), which was sponsored by UML's English Department. They then watched the UML Off-Broadway Players production of Bertolt Brecht's *Galileo*. The second day concluded with dinner in Lowell, an event that was graced by many of the conference presenters and panelists. Attendees ranged from K12 teachers to humanists and social scientists to physical scientists and engineers.



Conference Organizer: Todd Avery

### **Outreach to the General Public**

Funding from NSF and the Commonwealth of Massachusetts (through the John Adams Innovation Institute) allows CHN and the Museum of Science, Boston, to collaborate in the development innovative science communication strategies for enhancing public understanding of research in nanoscale science and engineering. CHN's effort focuses on nanomanufacturing, thereby complementing programs supported by the Harvard NSEC. This initiative included live presentations, cable casts, podcasts, and YouTube.com videos. Live presentations, delivered on the Museum's Gordon Current Science & Technology (CS&T) Stage, have reached about 8000 members of the public each year, whereas live New England Cable News updates on nanotechnology reach up to 3.5 million homes in 1,021 New England communities. Podcasts and YouTube videos, a collaborative effort with Nanoscale Informal Science Education Network (NISE) media group, reach other audiences.

Collaboration with the Museum of Science has also produced the previously mentioned *Nanotech Symposia* and science educators have trained CHN's REU participants to present technical information to general audiences. CHN researchers have also participated in NISE Network activities, with 1) CHN graduate students (Rinky Devre and Daniel Murphy) participating in the NISE Network's Nanoscale Education and Outreach (NEO) program, and 2) a host of CHN personnel and activities contributing to the *NanoDays* program at the Museum on March 30, 2008.

### **Outreach to Industry**

The Center has extensive outreach to industry, facilitated by the Director of Business Development. The outreach includes sponsored research agreements, as well as collaborative proposals, such as SBIRs and STTRs. In addition to the IAB for the NSF center, UML has an Executive Advisory Board composed of companies with direct ties to UML.

**CHN/NCOE Executive Advisory Board.** The Executive Advisory Board (EAB) was established to provide the Center with expertise from a breadth of industry sectors (e.g., biotech, energy, defense, materials, electronics) and company sizes (start-up to Fortune 100 company). In addition, we wanted to involve high-level leaders who had a particular connection to UML, either as alumni or as Massachusetts-based companies, and were enthusiastic about helping in our success. Headed by Donald Latorre, President of L&G Management Consultants (Holmes Beach, FL), the responsibilities of the EAB are to provide (1) input on strategic technical directions (e.g., industry needs, industry megatrends), (2) meaningful connections to industry and government (e.g., strategic alliances, new funding sources), (3) direction for other sources of funding (e.g., equipment donations, fellowships, building/lab naming), and (4) interactive and constructive criticism of the Center as a whole (e.g., structure, strategic plan)

**CHN Industrial Advisory Board.** The Industrial Advisory Board (IAB) for the CHN was formed in January 2003 and is currently chaired by Brent Segal, Co-Founder and Chief Operating Officer of Nantero (woburn, MA), to provide guidance to the researchers concerning industrial needs in nanomanufacturing.



The IAB companies are keenly interested in transitioning the promise of nanotechnology to realistic and improved commercial products. The member companies contribute support for the research effort by 1) contributing scientists or engineers to serve as members of the IAB, to attend regularly scheduled meetings, and to provide technical guidance, 2) supplying experts to work with NEU, UML, and/or UNH researchers at their facilities or at the company’s facility on program tasks related to each company’s interest, 3) providing facilities for proof-of-concept test beds for new nanomanufacturing processes and techniques to be developed by the proposed center, 4) presenting opportunities for NEU, UML, and/or UNH students to be hired as nanomanufacturing interns at their respective company sites, and 5) providing technical review and oversight on commercialization and prototype testbeds.

**Collaborative Proposals with Industry.** A number of collaborative research projects are underway, including evaluation of new polymer systems with Kuraray (Texas), new packaging technologies for electronic devices with Raytheon (Tewksbury, MA), and enhanced medical device materials with Nypro, Inc. (Clinton, MA), the world’s largest custom injection molder. Collaborative research proposals have been submitted with Foster-Miller, EMC, IBM, Brewer Science, and Schlumberger. Textron has also expressed interest in being kept abreast of CHN technologies as they develop, in particular for testbeds related to their technologies.

**Industry Outreach Events.** Contacts with industry and other external constituents has been made primarily through Center-sponsored “Industry Days” and participation at other meetings, workshops, and conferences. Our goal is to host and participate in both selected, (1) smaller, more focused events to develop direct one-to-one contacts with industry and funding agencies; and (2) large, broader events to generate greater overall visibility of the Center. In addition, we plan to increase our one-on-one meetings with program managers at DARPA, NSF, NIH, and DOD. The table below presents an overview of the activities which we have hosted and been participants.

**Selected Industry Outreach Events**

Event	Center Effort	MA or US	Attendees
NanoSummit (UML)	CHN/NCOE hosted – presentations and posters	Mostly MA, regional	> 200
CHN Industry Day (Northeastern U)	CHN hosted – presentations and posters	US, but heavily regional	Invitation only (~25 invited)
NSTI Nanotech (Boston, MA)	CHN booth – also supported UMass reception	US	
NanoCon (Small Times)	Booth – also panelists	US	> 500
DARPA Tech	Participant	US	> 100
New England Innovation Alliance (NEIA)	Hosted breakfast mtg, keynote presentation	MA, regional	~30 small business leaders
Nine Zeros Breakfast Forum	Participant	MA, regional	~50



MA Technology Transfer Ctr events	Booth, presentation	MA, regional	~ 100
Merrimack Valley Venture Forum	Participant – presentation, panel	MA, regional	~ 100

## 12. Proposals Awarded - 2007/2008

### Awards: July, 2007-March, 2008\*

Research Grant Title	Source	Amount	Years	PI's
Science of Small Things	NSF	\$755,000	3	Silka
Industrial Safety of Nanoheaters	NSF	\$589,776	2	J. Chen
MRI Acquisition of a 3D Scanning Laser Vibrometer	NSF	\$491,575	3	Niezrecki
Novel Optical Metamaterials and Approaches for Fabrication	FED	\$100,459	1	Akyurtlu
Development of Antimicrobial PC, Year 2	Nypro (MA)	\$75,000	1	Barry/Mead/Lee
Nanomanufacturing of Sensors	ARL	\$1,600,000	1	Mead
EXP-LA: High Precision Detection and Prediction of Explosives Based on Multiple Sensing Systems and Data Fusion	NSF	\$800,000	3	Kurup
3-Dimensional Isotropic Metamaterials Lens	DARPA (SBIR-MA)	\$23,949	1	Akyurtlu
Center for High-rate Nanomfg, Year 4	NSF	\$679,867	1	Mead/Barry
Synthesis of PIB-Based Copolymers for Medical Applications	Boston Scientific (MA)	\$199,596	?	Faust
Cross-linked Density and Lubricant Concentration on Silicon Rubber	Nypro (MA)	\$6,409	< 1	Lee
Tamper Indicating Stretch Wrap	Infoscitex (MA)	\$7,000	< 1	Barry
Optimization of Rheometrics/ARES Test for Dynamic Properties of Tire Compounds	Cabot (MA)	\$20,000	1	Mead
Literature Survey of Elastomer Contamination	Segway	\$1,526	< 1	Lee
Compounding of Nanodielectrics for High Power Capacitors	Air Force (Agilitron)	\$50,000	1	Mead
Effect of Processing and Filler Type on Dispersion in Polycarbonate	Nanoproducts	\$2,130	< 1	Mead
Nanomanufacturing of Enhanced Materials	Textron Systems	\$10,000	< 1	Mead
<b>Total Awarded</b>		<b>\$5,412,287</b>		

\* We have not collected 4<sup>th</sup> Q 2008 information, yet.



CHN and CHN/CNOE award seed funding for new research. These funds are used to assist faculty in pursuing new research directions. The 2007-2008 CHN seed awards are listed below. During 2007-2008, CHN/NCOE awarded funding to Susan He, but this project will not start until 2008-2009.

#### CHN Seed Grants

PIs	Amount	Project Title
Bello/Rogers (UML)	\$30,000	Development of a high throughput in vitro screening assay to evaluate the degree of oxidative stress exerted by nanomaterials in human plasma
Gu (UML)	\$30,000	Integration and Bonding of Nanowire and Nanotube Assemblies Using Lead-free Solders
Dokmeci (NEU)	\$38,400	Large Scale High Yield Three Dimensional Dielectrophoretic Assembly - Development for Single-Walled Carbon Nanotubes and Gold Nanoparticles and Applications to NanoSensors
Menon (NEU)	\$35,000	Ultra-high aspect ratio TiO <sub>2</sub> --C nanotubes
<b>Total</b>	<b>\$133,400</b>	



### 30. PHOTONICS CENTER 2007/2008 Report

## 1) Mission Statement

The Photonics Center at the University of Massachusetts Lowell was established in 1994. The Center's mission is to support government research, regional industries, and start-ups; train undergraduate and graduate students; perform industrial and governmental sponsored research; and form a core of design and fabrication technology to support various University initiatives requiring innovative semiconductor-based photonic and electronic device technologies.

## 2) Goals and Description

- Train undergraduate and graduate students in both the theory and application of state-of-the-art photonics and optoelectronics
- Seek and be granted Federal support for research, development, technology conversion and improved manufacturing processes in photonics
- Carry out research into scientific and engineering concepts in photonic technologies; this will include the preparation and characterization of new materials, the development of new industry compatible processing technologies, and the evaluation of photonic and optoelectronic devices, systems, and networks
- Establish a regional resource center in photonics, offering materials, design and fabrication technology and system support and provide technical expertise and support for start-up companies.

The Center is located in a modern 9,000 sq. ft. building located at 720 Suffolk Street, Lowell Massachusetts (the Ames building). Currently optics and characterization laboratories, an 800 sq. ft. class 100,000 clean room with wet stations, a computer room with internet access, a conference room, and office areas are operational. Fabrication equipment that has been installed in the clean room includes photolithography equipment, a rapid thermal annealing system, thermal evaporator, e-beam evaporator and three solid source



molecular beam epitaxy systems. A 2007 DURIP award has allowed the Center to upgrade its antimonide MBE system with an atomic hydrogen cleaning gun and a valved Sb cracker source. The Center also has a new optical characterization laboratory housing a Horiba JobinYvon iHR320 spectrometer with a LN<sub>2</sub>-cooled CCD detector ideally suited for VIS/near-IR photoluminescence, emission, and absorption spectroscopy experiments. In addition, the lab boasts a newly acquired Bruker V70 FTIR spectrometer with time-resolved step-scan capabilities, four HgCdTe (MCT) detectors (one internal, three external) and multiple exit and entrance ports for transmission, photoconductivity, and electroluminescence experiments in the mid-IR wavelength range. Custom built, automated systems attached opposite FTIR exit ports offer 1) transmission/reflection measurements on samples with 360° rotation of the sample and 270° rotation of the detector and detector optics and 2) spatially resolved transmission/scattering spectroscopy. Multiple cryostats, with both near-IR/visible and mid-IR optical access are available for low-temperature PL, EL and transmission measurements across a broad range of wavelengths (400nm-22μm). Quantum Cascade, Argon ion, HeNe, and other visible and near-IR lasers are also housed in the lab, for use in characterization experiments.



### 3) Research and Focus Areas

**Theory and Modeling Effort:** The Center's device theory and modeling group is managed by Profs. Karakashian, Wasserman, and Goodhue. Libraries of canned and student-generated software are maintained in order to support center activities. The Center's approach to thesis work requires all students to work on both theory and experiment. The current focus is on mid-infrared and terahertz lasers, laser cavity design, high-speed photodetectors, and micro-electrical-mechanical membranes.

**Experimental Effort:** Prof. Daniel Wasserman and Prof. William Goodhue guide the experimental efforts at the Center. Their interests include:

- Quantum dot nanostructures
- Optical-optical and optical-electrical spatial light modulators
- III-V MBE Technology, particularly GaSb and other 0.61 nm III-V materials, particularly as they apply to avalanche photo diode technology
- Surface States in Quantum Wells
- Ohmic Contacts to Antimonide based semiconductors
- Integrated Waveguide Optics
- Frequency Selective Materials, Photonic Crystals and Metamaterials
- Surface-States and gas cluster ion beam smoothing of GaSb
- Point Defects in Semiconductors
- Diode, Quantum Cascade, and SHOC Lasers
- Semiconductor Etching Techniques
- Fabrication Techniques

### 4) Associated Personnel

Director:

Prof. William Goodhue, Physics Dept., Molecular Beam Epitaxy, Devices, and Advance Fabrication, (978) 934-3785  
[William\\_Goodhue@uml.edu](mailto:William_Goodhue@uml.edu)

Co-Director:

Prof. Daniel Wasserman, Physics Dept., Mid-IR Photonics, Lasers, Detectors, and Plasmonic Devices, (978) 934-4530. [Daniel\\_Wasserman@uml.edu](mailto:Daniel_Wasserman@uml.edu)

Center Post-Doc:

Dr. Shivashankar R. Vangala, Physics Dept. Antimonides and THz Sources. (978) 934-3974. [Shivashankar\\_Vangala@uml.edu](mailto:Shivashankar_Vangala@uml.edu)

Faculty/Staff

Prof. Alkin Akyurtlu (ECE) - Metamaterials (978-934-3336)

Prof. Craig Armiento (ECE) - Optical Networks, Device Modeling, and Optics (978)-934-3395.

Dr. Andrew Gatesman, Submillimeter-Wave Technology Laboratory, Modeling of Frequency Selective Surfaces, (978) 934-1365.

Prof. Robert Giles (Physics), Submillimeter-Wave Technology Laboratory,



Director, Modeling of Dielectric Materials,  
(978) 934-1360.

Prof. Aram Karakashian (Physics) Metamaterials and Optics (978)-934-3487.

Prof. Xuejun Lu (ECE) Photonics, Security Using Photonics (978)-934-3359.

Prof. Hongwei Sun (ME) - Dr Sun and Prof Goodhue have recently teamed with Physical Sciences, Inc. to win a Phase II STTR in the area of GaAs wafer bonding.

Prof. Joel Therrien (ECE) - Drs Therrien, Akyurtlu, and Goodhue are collaborating on functionalizing silicon carbide nanoparticles for metamaterial applications, (978) 934-3324

Prof. Jerry Waldman (Physics) Submillimeter-Wave Technology Laboratory, Principal Scientist, (978) 934-1355.

### 5) New Faculty Affiliations

The Photonics Center has been very involved with helping new faculty establish themselves on the UMass Lowell campus (see above). The following new faculty member has started using the Center over this past year:

Prof. Xingwei Wang (ECE) Biophotonic Applications, (978) 934-1981.

### 6) Associated Students and Student Support

Student	Research	Status
Paul Alcorn	Antimonide Fabrication (MS) RA	Graduated
Neelima Chandrayan	Devices (Ph.D.) TA, Summer RA	G
Michael Grzesik	Avalance Photodiodes (Ph.D.) RA	G
Vaibhav Mathur	MEMS Devices (Ph.D.) RA (Finished MS)	G
Xifeng Qian	Quantum Dot Devices (Ph.D.)RA	G
Troy Ribaud	Plasmonics (Ph.D.) TA/RA	G
Joseph Shahbazian	Metamaterials (Ph.D.) Summer RA	G
Krongtip Termkoa	Wafer Fusion (Ph.D.) RA	G
Shivashankar Vangala	Photodiode Gowth (Ph.D.) RA	Graduated
David Adams	Plasmonic Emitters (Ph.D.), Summer RA	G
Melissa Spencer	LIV Set-up (Summer)	UG
John Lipiello	Device mounting set-up (summer)	UG
Christopher Reidy	CdSe QD characterization (summer)	UG

(UG -undergraduate student, G - graduate student)

Note: All undergraduates received part time support.



## 7) 2007/2008 Funded Projects

**Development of Long Wavelength Technologies and Devices:** Graduate students Mike Grzesik, Shiva Vangala, and Paul Alcorn, along with Prof. Karakashian, Prof. Armiento, and Prof Goodhue worked with Hanscom SNHC to develop high speed long wavelength photodetectors. The Center set up novel MBE systems for the project. Sponsor - AFRL/SNHC.

**MEMs Based Spatial Light Modulators:** The Center is working with Hanscom SNHC to develop an optical-optical micro-mechanical based spatial light modulator. Graduate students involved include Xefeng Qian, and Vaibhav Mathur Sponsor - AFRL/SNHC.

**Development of Waveguiding Structures in the Visible Regime Using Nanoscale Metamaterials:** The Center has begun work to develop visible waveguides with Prof Akyurtlu (ECE) with the goal of developing nanoscale metamaterials that work in the visible portion of the electromagnetic spectrum. Sponsor – AFRL. CFCI funds were used to seed this project.

**Development of Magnetically Based Homogeneous Metamaterials:** Profs. Akyurtlu and Goodhue are working on developing anew type of homogenous metamaterials that can be tuned in a magnetic field. Sponsor - NSF

**THz Sources, Optics and Detectors:** The Center is being funded from the Army through its sister laboratory, the Submillimeter-Wave Technology laboratory to develop quantum cascade THz lasers, THz output couplers, THz quantum dot detectors and THz photonic crystal-based devices. Dr. Jin Li, Prof Goodhue and graduate students Beihong Zhu and Xifeng Qian worked on the effort.

**MBE Materials for Wright Patterson AFB Applications:** Dr Goodhue is providing MBE grown materials for AFRL applications. Sponsor - AFRL/SNWP.

**Development of Long Wavelength Quantum Dot Detectors:** Drs. Lu, and Goodhue are developing long wavelenth detectors for DOD applications. Graduate student Xefeng Qian is also working on the project. Sponsor - Raython.

**Galaxy Phase II SBIR:** In conjunction with the Galaxy, the Photonics Center is measuring the materials properties of very low doped GaSb materials being developed for DOD applications. Post Doc Shiva Vangala is working on the project.

**Galaxy Phase II SBIR:** In conjunction with the Galaxy, the Photonics Center is measuring the materials properties of large InSb wafers for DOD imaging applications. Post Doc Shiva Vangala is working on the project.

**AFRL/Hanscom Project:** A Variety of Antimonide based detector technologies are being developed for DOD. Post Doc Shiva Vangala is working on the project.



**Poled GaAs:** AFOSR Phase II STTR to develop frequency halving optical materials for DOD applications. Graduate student Krongtip Termkoa is working on the project with Prof. Goodhue and Dr. Vangala.

**Mid-IR Emission from InAs Quantum Dots in Photonic Crystal Cavities:** Sandia National Labs, LDRD to develop mid-IR emitters with InAs quantum dot active regions and fabricate these emitters in photonic crystal cavities to improve emission and move towards gain and lasing in these devices. Graduate student Troy Ribauda is working on the project with Professor Daniel Wasserman.

## 8) Thesis and Recent Publications by Primary Center Faculty/Students

### Thesis

- 1) Shivashankar Vangala, "Surface preparation of GaSb and InSb for MBE growth and development of Sb alloy-based devices," UMass Lowell Physics Dept. Doctoral Thesis (Advisor - Goodhue) 2007.
- 2) Paul Alcorn, "Atomic hydrogen cleaning of Sb," UMass Lowell Physics Dept. Masters Thesis (Advisor - Goodhue) 2008.

### Journal Articles and Conference Proceedings (Primary Students/Faculty)

1. J. Li, D.B. Fenner, K. Termkoa, M.G. Allen, P.F. Moulton, C. Lynch, D.F. Bliss, W.D. Goodhue, "Wafer-fused orientation-patterned GaAs," SPIE Photonics West, San Jose, January 19-24, 2008.
2. K. Krishnaswami, S.R. Vangala, H. Dauplaise, L.P. Allen, G. Dallas, D. Bakken, D. Bliss, G. Dallas, D. Bakken, K.S. Jones, and W. D. Goodhue, "Molecular beam epitaxy on gas cluster ion beam prepared GaSb substrates: towards improved surfaces and interfaces," Journal of Crystal Growth, **310**, 1619 (2008)
3. S.R. Vangala, H. Dauplaise, C. Santeufemio, C. Lynch, P. Alcorn, L.P. Allen, G. Dallas, K. Vaccaro, D. Bliss, and W.D. Goodhue, "Atomic hydrogen cleaning of epitaxially grown InSb (100), (111)B, and GCIB processed InSb (111)B surfaces," Digest of papers, International Conference on Compound Semiconductor Manufacturing Technology, 113 (2007).
4. L.P. Allen, G. Dallas, K. Blanchet, S.R. Vangala, C. Santeufemio, W.D. Goodhue, E. Roehl, C.E. Jones, J. Barton, B. Zide, V. Difilippo, K.S. Jones, "Successful MWIR FPA fabrication using gas cluster ion beam InSb surface finishing," Proceedings of SPIE, **6542**, Infrared Technology and Applications XXXIII, 65423P (2007).

5. J. Li, X. Qian, W. Liu, S. R. Vangala, W. D. Goodhue, A. A. Danylov, J. Waldman, R. H. Giles, and K. J. Linden, "2.4-2.5 THz Quantum Cascade Lasers Obtained by Tuning the Thicknesses of a Structure Emitting at 2.9 THz", 20th Annual Meeting of the IEEE Laser and Electro-optics Society, 860 (2007).
6. A. A. Danylov, J. Waldman, T. M. Goyette, A. J. Gatesman, R. H. Giles, J. Li, W.D. Goodhue, K. J. Linden, W. E. Nixon, "Terahertz sideband-tuned quantum cascade laser radiation," Optics Express, 16 (8), 5171 (2008).
7. V. Mathur, J. Li, and W.D. Goodhue, "FEM simulation of nanotubes manipulation using dielectrophoresis," Proceedings of the COMSOL Conference, Boston 2007.
8. V. Mathur, J. Li, and W.D. Goodhue, "Design and fabrication of optical-MEMS sensor," Mater. Res. Soc. Symp. Proc. Vol. 1052, 1052-DD04-08, 2008.
9. D. Wasserman, "Active Surface Plasmons: Tuning of surface plasmons leads to new optoelectronic devices", *Laser Focus World*, January (2008).

## 9) Conference Presentations

1. J. Li, D.B. Fenner, K. Termkoa, M.G. Allen, P.F. Moulton, C. Lynch, D.F. Bliss, W.D. Goodhue, "Wafer-fused orientation-patterned GaAs," SPIE Photonics West, San Jose, Jan 19-24, 2008.
2. S.R. Vangala, H. Dauplaise, C. Santeufemio, C. Lynch, P. Alcorn, L.P. Allen, G. Dallas, K. Vaccaro, D. Bliss, and W.D. Goodhue, "Atomic hydrogen cleaning of epi-ready InSb (100), (111)B, and GCIB processed InSb (111)B surfaces," International Conference on Compound Semiconductor Manufacturing Technology, P113, Austin, May 14-17, 2007.
3. K. Krishnaswami, S.R. Vangala, H. Dauplaise, L.P. Allen, G. Dallas, D. Bakken, D. Bliss, G. Dallas, D. Bakken, K.S. Jones, and W. D. Goodhue, "Molecular beam epitaxy on gas cluster ion beam prepared GaSb substrates: towards improved surfaces and interfaces," International conference on Crystal Growth, , Salt Lake City, Aug 12-17, 2007.
4. S.R. Vangala, K. Krishnaswami, H. Dauplaise, C. Lynch, D. Bliss, L.P. Allen, G. Dallas, and W.D. Goodhue, "GaSb and InSb Substrate and Substrate/Epi Interface Issues from an MBE Perspective," 15<sup>th</sup> International conference on Crystal Growth, Salt Lake City, Aug 12-17, 2007.
5. V. Mathur, J. Li, and W.D. Goodhue, "FEM simulation of nanotubes manipulation using dielectrophoresis," Comsol Users Conference, Boston, Oct 4-6, 2007.



6. V. Mathur, J. Li, and W.D. Goodhue, "Design and fabrication of optical-MEMS sensor," MRS Fall Meeting, Boston, Nov 26-30, 2007.
7. D. Wasserman, E.A. Shaner, and J.G. Cederberg, "Electrical Control of Mid-Infrared Extraordinary Optical Transmission Gratings", 2008 CLEO/QELS Conference, San Jose, CA. May 7<sup>th</sup>, 2008.
8. D. Wasserman, E.A. Shaner, J.G. Cederberg, "Doping Tunable Extraordinary Optical Transmission Gratings", Optics East, 2007, Boston MA.

## 10) Intra-University Collaborations and CFCI Funded Project

**Quantum Cascade Far-Infrared Laser:** Graduate physics students Neelima Chandrayan, Krongtip Termkoa and Andre Danylov along with Drs. Jin Li (now with Corning)) and Andrew Gatesman and Profs. Goodhue, Karakashian, Ram-Mohan, Giles and Waldman worked on a GaAlAs quantum well laser device that is designed to emit in the terahertz. Such a device would be of interest in spectroscopy and remote sensing. This is a collaboration between the Photonics Center, the Submillimeter-Wave Technology Laboratory and WPI. Although previously sponsored by the CFCI and DARPA, the work continues with Army funding. Currently UMass Lowell is the only US University to successfully grow THz lasers.

**Photonic Crystals and Metamaterials:** Initially the CFCI sponsored research applied metamaterials and photonic crystal technology to applications in the submillimeter region of the electromagnetic spectrum. The team included graduate student Jin Li, Dr. Gatesman and Profs Goodhue, Giles, Karakashian, and Akyurtlu. The work has moved to the visible and besides being funded by the Air Force is also now funded by NSF.

**Poled GaAs:** This Physical Sciences Inc., Air Force Sponsored STTR is a joint collaboration between Physical Sciences, Prof Goodhue, and Prof Sun of the Mechanical Engineering Dept.

**Quantum Dot Nanostructures:** This now Raytheon funded team effort between Prof. Lu and Dr. Li and Prof. Goodhue continues to develop near and mid infrared detectors. The work was originally CFCI funded.

**The Air Force Long Wavelength Detector and MEMS Programs:** This work is a collaboration between the Photonics Center (Goodhue), CMOS (Armiento) and AFRL/SNHC.

**CFCI Funded Project:** Graduate student Xifeng Qian developed a nanolithography method for producing aligned arrays of quantum dots and then passivating the surfaces of the dots with mass transport. These are key steps in fabricating THz quantum dot detectors. As part of the work he also used the NSF facility at Harvard University.



## 11) Outreach

Prof. Wasserman visited Lowell High to teach a LHS Honors Physics class. The subject of Dr. Wasserman's lecture was "The Physics of the Curve Ball". Professor Wasserman also worked with the GEAR UP program, presenting a short workshop entitled "Build Your Own Hard Drive". Finally, Professor Wasserman organized, developed, and hosted a half-day Physics Activity Workshop for a Lowell High Physics class.

Prof Goodhue hosted the Bartlett School (City of Lowell) Science Club for an afternoon. The group had fun discovering the properties of liquid nitrogen in a show entitled "Liquid Nitrogen Magic Show."

## 12) Proposals Submitted/Awarded 2007/2008

1. **DURIP:** A proposal for a tunable visible pulsed laser. \$114,000 (AFOSR), Not Awarded
2. **Physical Sciences Poled GaAs Phase II SBIR:** app. \$150,000 (AFOSR), Awarded
3. **NSF Equipment Grant:** X-ray system, app \$250,000, Not Awarded
4. **MBE Growth Runs for AFRL/SNWP.** \$30,000 (Wyle Laboratories), Awarded
5. **Long Wavelength Quantum Dot Detectors:** \$120,000 (Raytheon), Awarded
6. **MBE growth and characterization of Sb alloy based heterostructures for the development of IR Photodetectors:** app \$160,000, (AFRL/RYHC), Awarded.
7. **Mid-Infrared Electrically Pumped Quantum Dot Light Emitters:** \$120,400, (Sandia National Labs), Awarded
8. **Mid-IR Beam Steering Using Plasmonic Devices:** \$75,000 (AFRL Sensors Directorate), Awarded.
9. **Alloy Surfaces Inc.:** Frequency Selective coatings for exothermic material (awarded): \$25,000.
10. **Single Photon Detection in the Mid-IR: (ARO Young Investigator),** Pending.
11. **InAs Quantum Dots for Mid-IR emission:** (NSF DMR), Not Awarded.
12. **Active Plasmonics for Beam Steering and Sensing Applications:** (ONR Young Investigator), Not Awarded.



- 13. Enhanced Mid-Infrared Optical Spectroscopy of Hydrocarbons Utilizing Resonant Extraordinary Optical Transmission Gratings: (ACS-PRF), Not Awarded.**
- 14. Integrated Nonlinear Crystal-Quantum Cascade Laser For Medical Diagnostic Breath Analysis: (MTTC), Not Awarded.**
- 15. 3.4 $\mu$ m Light Generation Using from Quantum Cascade Laser-Pumped Quasi Phase Matched Orientation-Poled GaAs: (AFOSR), Pending.**



31. RADIATION LABORATORY  
**Annual Report - July 1, 2007 to June 30, 2008.**

**Summary**

1. Mission Statement
2. Associated Faculty and Staff
  - 2.1. Primary
  - 2.2. Secondary
  - 2.3. Post-Doctoral Associates
  - 2.4. Radiation Laboratory Staff
3. Student Interaction
  - 3.1. Ph.D. Recipients
  - 3.2. Dissertation Students
  - 3.3. Pre-Dissertation and Undergraduate Students
  - 3.4. Education
4. Extramural Support
  - 4.1. Industrial Users
  - 4.2. Federal Government
  - 4.3. Universities
  - 4.4. Internal Partnerships
5. Existing Facilities
  - 5.1. The Cobalt-60 Irradiation Facility
  - 5.2. The One Megawatt Research Reactor
  - 5.3. The 5.5 Megavolt Pulsed Van-de-Graaff Accelerator
  - 5.4. Analytical and Assaying Facilities
6. Current Activities
  - 6.1. Accelerator
  - 6.2. Research Reactor (UMLRR)
    - 6.2.1. Research and Service
  - 6.3. Gamma Source
7. Publications, 2006-2007 Academic Year
  - 7.1. Conference Proceedings
  - 7.2. Journals
8. Future Developments
  - 8.1. Accelerator
  - 8.2. Reactor
  - 8.3. Gamma Source
9. Proposals, Awards and Contracts
  - 9.1. Proposal
  - 9.2. Awards
  - 9.3. Contracts

## ***Radiation Laboratory***

### **1. Mission Statement**

The Radiation Laboratory (RL) is one of the oldest centers at UML. Established in 1962 it underwent several reorganizations and was restructured in 1981 with name Radiation Laboratory. In a very broad sense this counts as its members all in-house users of its equipment. More narrowly, members of the RL are who use, operate, and maintain its equipment. This equipment consists of a 1 MW pool type nuclear reactor, Cobalt-60 gamma radiation facilities and a 5.5 MV Van-de-Graaff accelerator.



the  
center

those

The Radiation Laboratory's multi-faceted mission has several components:

***Academic Mission:*** To support the existing degree programs in the sciences, in engineering and in other fields, and to foster interdisciplinary academic activity on the Lowell campus and within the UMass system.

***Research mission:*** To support faculty and student research in all related interdisciplinary activities and to promote expanded opportunities for faculty and staff to obtain external funding.

***Service Mission:*** To seek actively and to develop industrial partnerships; to provide irradiation services and analytical measurements to governmental organizations, to other universities, to hospitals, and to industry.

***Outreach Mission:*** To organize and to support outreach activities for the public on issues related to nuclear science and technology, with emphasis on K-12 students and educators.

The Office of Radiation Safety, which supervises the campus-wide use of radiation in teaching and research, is attached to the RL. The Radiation Safety Officer, Dr. David Medich, reports directly to the UML administration in all matters of radiation safety. His mission is quite distinct from that of the RL. It is his responsibility to assure that radiation users know about the safe use of radiation and follow applicable federal and state laws and regulations.

### **2. Associated Faculty and Staff**



## **2.1. Primary**

Gunter H.R. Kegel, Director and Professor, Department of Physics and Applied Physics.  
James Egan, Professor, Department of Physics and Applied Physics.  
Mary Montesalvo (adjunct faculty), Department of Physics and Applied Physics.  
Leo Bobek (adjunct faculty), Department of Physics and Applied Physics.  
David Medich (adjunct faculty), Department of Physics and Applied Physics  
Thomas Regan (adjunct faculty), Department of Physics and Applied Physics  
Greg Parker, Accelerator Supervisor

## **2.2. Secondary**

Department of Physics and Applied Physics: Profs. P. Chowdhury, C. French, A. Mittler, D. Pullen, W. Schier, and M. Tries. J. Antal (Adjunct Prof. and Senior Scientist)  
Department of Chemistry: Prof. E. Jahngen  
Department of Environmental, Earth, and Atmospheric Sciences: Prof. N. Eby.  
Department of Plastics Engineering: Prof. A. Crugnola., Prof. N. Schott  
Department of Chemical Engineering: Prof. John White  
Center for Advanced Materials: Prof. D. Sandman.  
Center for Atmospheric Research: Prof. B. Reinisch

## **2.3. Post-Doctoral Associate**

Sujit Tandel

## **2.4. Radiation Laboratory Staff**

Steven Snay, Asst. Radiation Safety Officer (Radiochemistry Technician)  
Nasser Rashidifard, Senior Reactor Operator  
Ronald Carmichael, Mechanical Operator  
Lynne Winnett, Administrative Assistant

## **3. Student Interaction**

The Ph.D. recipients listed below received research funding from the Radiation Lab. For the doctoral candidates, a distinction is made between pre-dissertation students and dissertation students. Pre-dissertation students are doctoral candidates who have not yet passed the comprehensive exam and have not selected a dissertation topic or supervisor. Dissertation students have passed this exam and made the topic selection

### **3.1. Graduate Degree Recipients**

Chungcheng Ji, (Ph.D)

### **3.2. Dissertation Students**



Dissertation students who received financial support from the RL are identified with an \*

- \*Urmilla Tandel, Hi-Spin Physics
- \*Afrim Alimeti, Neutron Physics
- \*Chuncheng Ji, Neutron Physics
- Hongmei Chen
- Philip Slingerland
- Sankha Hota

### 3.3. Pre-Dissertation and Undergraduate Students

The following graduate students are conducting research or working at the RL. Students receiving financial support are identified with an \*.

- Don Galata
- \* Stacey Russell
- \*Nasser Rashidifard
- Adam Boehl
- \*Andrew Knox
- \*Michael Talmadge

The following undergraduate students are involved with projects using the reactor or the accelerator:

- Michael Scardone
- \*Justin Ruddock
- \*Michael Dunlevy
- Christopher Signori
- Drew Lajeunesse
- Maureen Ingaharro
- Shawn Smith
- Christopher Reidy
- Marco Bonnet-Matiz
- Thomas Harrington

### 3.4. Education.

The following UML courses use the Radiation Laboratory facilities each year as a major or partial component of the curriculum:

- 95.411/98.541 Radiochemistry



96.443 Radiochemistry Laboratory  
96.393/4 Advanced Experimental Physics Laboratory  
96.306/98.506 Nuclear Instrumentation  
96.201/96.301 Health Physics Internship  
96.402/98.502 Radiation Safety and Control II  
99.102 Radiation and Life Laboratory  
98.666 Reactor Health Physics  
10/24.431 Nuclear Reactor Systems and Operation  
10/24.432 Nuclear Systems Design and Analysis  
24.507 Reactor Engineering Analysis  
87.111 Environmental Science  
84.113 General Chemistry  
19.518 Engineering Controls and PPE  
19.517 Physical Agents

#### **4. Extramural Support**

##### **4.1. Industrial Users**

- Microsemi Corporation (Lawrence, MA); International Rectifier (Leominster, MA facility); Barr Associates (Westford, MA); Assurance Technology Corporation (Chelmsford, MA); Implant Sciences Corporation (Wakefield, MA); Radiation Monitoring Devices (Watertown, MA); AEA Technologies (Burlington, MA); Fibersense (Canton, MA); Datum (Beverly, MA); Cubist Pharmaceuticals (Lexington, MA); SSG Precision Optonics, Inc. (Wilmington, MA); Symeticon (Beverly, MA); Physical Sciences, Inc. (Andover, MA); SatCon Electronics (Marlborough, MA); Bristol-Meyers Squibb Co. (Billerica, MA); National Technical Systems (Acton, MA); Analog Devices, (Norwood, MA); Eyetech Research Center (Lexington, MA); Mitre Corporation (Bedford, MA); Passport Systems, Inc. (Acton, MA); Sypris Test and Measurement (Orlando, FL); Carboline Co. – R&D (St. Louis, MO) Imaging & Sensing Technologies (Horseheads, NY); General Dynamics (Scottsdale, AZ); Spectrum Technologies (Schenectady, NY); M.S. Kennedy Corporation (Liverpool, NY); Keeler & Long, PPG Industries (Watertown, CT); Hunton & Williams, LLP; Nufern (East Granby, CT); Mitre (Bedford, MA) Ameron - Amptek - Cabrera Services - Hawkeye Global, Inc. - - Spire Corp. –SSG, Precision Optonics – MIT LL-Creare, Inc. – Corrosion Control Consultants (Kentwood, MI) – ROV (Brattleboro, VT) – Sherwin Williams (Cleveland, OH) – Frequency Electronics – US Air Force (Hanscom AFB, MA) – Columbia University (NY,NY) – Perkin Elmer (Waltham, MA)

##### **4.2. Federal Government**

U.S Department of Energy (DOE), five different grants or contracts.

1. GNEP Readiness Program
2. Single particle and collective phenomena in nuclei



3. Brookhaven National Laboratory
4. Mitre Corporation
5. MIT, Draper Laboratory

#### **4.3. Universities**

MIT Lincoln Laboratory - Low dose measurements using fiber optics  
Massachusetts Institute of Technology – Neutron Radiography System Development

#### **4.5. Internal Partnerships**

Center for Advanced Materials: Multi-year collaboration involving radiation hardness enhancement of materials.

Department of Biological Science: Sterilization of soils for bacterial studies.

Department of Plastics Engineering: Crosslinking studies.

Biomedical Engineering and Biotechnology: Sterilization of medical implant for surgery training.

### **5. Existing Facilities**

#### **5.1. Cobalt-60 Gamma Irradiation Facilities**

Gamma irradiation is performed at the Radiation Laboratory using various cobalt-60 (Co-60) irradiators. The Co-60 source consists of a number of stainless-steel encapsulated Co-60 strips used and stored underwater at the bottom of the reactor bulk shielding pool. Accurate radiation dosimetry is provided by an EPR (alanine) dosimetry system. A Quality Assurance Program meeting the requirements of 10CFR Part 50 Appendix B provides for the performance and maintenance of gamma dosimetry calibrations that are traceable to the National Institute of Standards and Technology.

##### *Gamma Cave*

This facility is a large, ventilated, dry-irradiation chamber having an equi-dimensional volume of 512 cubic feet. A wide range of dose rates, 1Gray (100 rad) per hour to 10,000 Gray (1 Mrad) per hour, is achieved by using various specific activity Co-60 frames and by varying the centerline distance of the sample from the source window.

##### *Hot Cell*

Originally designed for radioisotope sample preparation, this facility presently houses a single Co-60 source contained in a shielded irradiator. The irradiator provides up to two gamma beams permitting dose rates 0.1 Gray to 5 Gray per hour (10 to 500 Rad/hour). The facility also provides a remote operated overhead crane, remote robotic manipulators, a shielded view port, and multiple conduit ports.

##### **Submersible Canister**

The Submersible Canister (SubCan) is an ambient temperature, watertight chamber, having dimensions 20.3 cm (8 in.) I.D. x 30.5 cm (12 in.). When submerged at the bottom of the bulk



shielding pool, the SubCan is surrounded by up to eight Co-60 frames for a maximum dose rate of 20 kGray/hour (2 MRad/hour).

### **Enhanced Low Dose Response**

The Enhanced Low Dose Response (ELDRs) test facility is located directly opposite to the gamma cave facility on the experimental level of the reactor. It consists of four separated irradiation chambers, inside a 3'x3' reactor pool wall penetration. This facility provides a dose range to 0.01 Rad/s (36 Rad/hr).

## **5.2. The One Megawatt Research Reactor.**

The University of Massachusetts-Lowell Research Reactor (UMLRR) has been serving the university and surrounding community since 1974. The UMLRR is a one-megawatt, steady-state, pool-type reactor. The principal purpose of the UMLRR is to provide a multidisciplinary facility for use in nuclear-related education and research. Although the main focus of the facility is on intra-university research, use by those outside the university is fully welcomed. The UMLRR provides irradiation services benefiting government agencies and industry, and it supports outreach activities for pre-college students that encourage interest in science and engineering careers. The facility is regulated by the Nuclear Regulatory Commission and is currently licensed to 2015.

Various experimental facilities within the UMLRR produce thermal neutrons for radio activation purposes and fast (fission spectrum) neutrons for radiation effects research. Capabilities include: neutron activation analysis (parts per billion sensitivity for most elements), full spectral or enhanced thermal or enhanced fast neutron irradiation facilities (for material effects studies), neutron transmission measurement (for material properties studies) · radiation detector response and calibration to neutron, gamma, and mixed radiation fields; neutron radiography (for materials imaging).

## **5.3. The 5.5 MV Pulsed van-de-Graaff Accelerator**

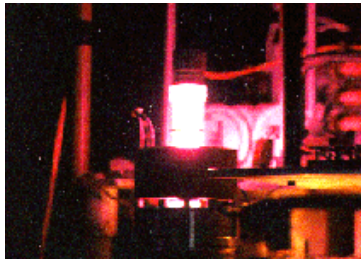
The accelerator produces proton, deuteron, alpha particle, or oxygen ion beams in the pulsed (width~15ns) or dc mode. A Mobley pulse compression system can be used to obtain subnanosecond proton bursts. The pulse repetition frequency is 5 MHz. Accelerator accessories include neutron time-of-flight spectrometers, a PIXE/RBS station, a thick-lithium-target neutron irradiation station, data acquisition systems, electronic modules and other equipment.

## **5.4. Analytical and Assaying Facilities**

The facilities utilize several gamma spectrometers provided with computerized gamma peak identification codes, including several germanium detectors with low-level environmental shields to assay low-activity and environmental samples, and two-state-of-the-art, high-purity, high-efficiency germanium detector for gamma spectra analysis as well as two automated analysis systems for neutron activation analysis.

## **6. Description of current activities**

## 6.1. Accelerator



Research at the Van de Graaff accelerator covers neutron elastic and inelastic scattering cross section measurements and fission neutron energy spectroscopy using neutron time-of-flight techniques. A PIXE (proton induced x-ray emission) spectrometer is used to determine the elemental composition ( $10 \leq Z \leq 82$ ) of complex samples, such as minerals, paints, foodstuffs, archeological objects, etc. A RBS (Rutherford backscattering spectrometer) station can be

applied to the study of inhomogeneous surface layers; this technique permits the determination of the thickness and of the atomic mass of superimposed deposits with thickness in the micron range, e.g. copper objects which are nickel and then gold plated.

Ion beams can be used to implant appropriate targets with selected ions. By controlling the ion energy a deposit at a specified depth can be obtained. By bombarding a range-thick, metallic lithium target with protons a substantial fluence of fast neutrons is obtained, virtually free of slow neutrons and of gamma rays. These fluences may be used to study the effects of neutron irradiation upon semiconducting materials, plant seeds, radiation-resistant bacteria and other objects. For cancer therapy via Boron Neutron Capture Therapy (BNCT) a special phantom has been constructed. This device incorporates two detectors to determine radiation doses to cancerous and to surrounding healthy tissue.

Direct proton irradiations have been performed on windows, lenses and mirrors to be used on satellites. These components must be able to function flawlessly for many years in a hostile outer space environment. The statistical distribution of the number of prompt fission gamma rays has been studied both, by theoretical considerations and by experiment.

PIXE techniques have been used to determine trace element distributions in native copper samples with the aim of correlating the distributions with the geographic origin of the samples. The investigation has been and will be extended to copper samples which have been cold worked into decorative artifacts to obtain information on the origin of these artifacts,

## 6.2. Research Reactor (UMLRR)

The UMLRR is currently involved with a number of radiation effects research projects that include: radiation induced materials enhancement for commercial and military applications, radiation resistant electronics testing for commercial, military, and NASA applications, and non-destructive evaluations.

### 6.2.1. Research and Service.

#### Remote Education

As part of our DOE Reactor Sharing Program, Prof. White (Chem. Eng.) is developing a system for making real-time and archived research reactor data available to educational users via a standard web browser. Virtually any classroom or individual throughout the world will not only



be able to access archived UMLRR experimental data, but also observe most of the UMLRR control room instrument readings, in real-time, in a graphical interface for use in classroom lectures, demonstrations, and experiments.

### Neutron Activation Analysis (NAA)

Nelson Eby continues to do research associated with instrumental neutron activation analysis (INAA) and fission track dating. Since 1990, this work has resulted in 28 publications. Fission-track geochronology, utilizing the minerals apatite and titanite, has been used to determine the both the age of igneous intrusion and the time of unroofing for a number of volcanic and plutonic provinces around the world. The most recent work has been the dating of alkaline igneous activity (420 Ma) in northern New Jersey and the time of unroofing (115 Ma) for this province. INAA has been used to determine the trace element compositions of rocks, minerals, soils, coal, atmospheric aerosols, human hair, film negative, and process sludge. During the past year this technique has been used to determine the trace element chemistry of tree rings (a collaborative project with Lehigh University, the data are used to monitor environmental changes), the trace element composition of volcanic rocks from Antarctica (a collaborative project with the University of Otago, NZ), and trace element compositions of volcanic rocks from central Europe (a collaborative project with the Geological Institute of Hungary)

### **6.3. Gamma source**

The gamma irradiation source at the Radiation Laboratory has been used extensively for food irradiation studies and for developing optimized radiation doses for routine medical product sterilization. By far, the greatest use of the gamma facilities have and continue to be for radiation effects evaluations on electronic components and other materials such as optical components, mirrors, lenses, and windows for space applications. Recent biomedical studies have focused on radiation induced cross-linked polymers for medical applications in tissue engineering and improved prostheses. Other studies involve radiation effects on plastics used in the treatment of cancer.

## **7. Publications**

### **7.1. Conference Proceedings**

J. R. White and L. M. Bobek, "Innovative Use of a Research Reactor for Interdisciplinary Engineering Education," *Amer. Soc. Eng. Ed., Annual Conference* (2007).

J. R. White and L. M. Bobek, "Reactor Operations Training via Web-based Access to the UMass Lowell Research Reactor," *ANS Conference on Nuclear Training and Education – CONTE* (2007).



G.H.R. Kegel and C.F. Roldan, "Computation of the low-energy spectrum obtained by proton irradiation of a thick metallic lithium target", presentation at *The 9<sup>th</sup> European Conference on Accelerators in Applied Research and Technology*, Florence Italy (Sept. 2007)

P. Jain, S. Markidis, B. G. Jones, Rizwan-Uddin, J. R. White, and L. M. Bobek, "Web-casting of Nuclear Reactor Experiments", *Trans. Am. Nuc. Soc.* (Nov. 2006)

M.L. Woodring, James J. Egan, G.H.R. Kegel, P.A. Staples, and D.J. DeSimone, "Fast Neutron Induced Fission Neutron Energy Spectra Below the Incident Energy", Proceedings of the Seventh International Conference on *Methods and Applications of Radioanalytical Chemistry*, Kailua-Kona, Hawaii, 3-7 April 2006.

## 7.2 Journals

Vorotnikova E, Ivkov R, Foreman A, Tries M, Brauhn S. The magnitude and time-dependence of the apoptotic response of normal and malignant cells subjected to ionizing radiation versus hyperthermia. *The International Journal of Radiation Biology* 82:549-559, 2006

Medich D, Tries M, Munro J. Monte Carlo characterization of an Ytterbium-169 high dose rate brachytherapy source with analysis of statistical uncertainty. *Medical Physics* 33:163-172, 2005

Tries M, Mancevice C, Munro J. Experimental determination of the dosimetric characteristics for the I-Plant<sup>TM</sup> model 3600 <sup>125</sup>I brachytherapy source. *Medical Physics* 32:1469-1472, 2005

Bernard J, Hu LW, Tehan T, Tries M. Impact of INIE on the MIT, RINSC, and UMass-Lowell Reactors. *Transactions of the American Nuclear Society* 92:167-169, 2005

## 8. Future Developments

### 8.1. Accelerator

A U.S. Department of Energy grant has been used to acquire a new, inclined field accelerator tube with stainless steel electrodes. This tube is used at present with the older sweeping and focusing input device in order to evaluate focusing properties with known input parameters. These studies indicate the advantage of placing an electrostatic quadrupole doublet below the accelerator baseplate. This doublet is at the design stage.

Once accelerator operation with the new tube plus doublet meets our requirements we plan to install a new sweeping and focusing input device which is now under construction. The combined effect of these improvements will be the extension of the accelerator useful life well beyond the year 2007.



A 2-MeV oxygen beam has been generated and has been used for O-implantation in gallium arsenide wafers. It is planned to use this beam also for Rutherford backscattering studies of impurities in organic compounds since this technique does not detect hydrogen, carbon, or nitrogen.

An ion source assembly line has been set up; this line includes a source conditioning and testing station.

## **8.2. Reactor**

Developing work focuses on using the reactor control room upgrades for web-based educational instruction using the reactor.

With partial funding from the Department of Energy, a license amendment was submitted that will increase the reactor licensed power level to 2 MW.. An upgrade to 2 MW will require no additional equipment. The UML research reactor was originally designed for 5 MW capability and an upgrade to 5 MW would only require a new high-efficiency heat exchanger and cooling tower, and a larger primary cooling pump. The upgrade to 2 MW will double the available neutron fluences available for research. The review of this license amendment is ongoing by the Nuclear Regulatory Commission.

## **8.3. Gamma source**

There is a continuing demand for gamma radiation effects studies on materials and electronics. Both the reactor and the gamma source are used increasingly to study the effects of prolonged low dose-rate irradiations. These studies are needed to understand the deterioration of materials and devices exposed to radiation in outer space and to man-made radiation fields.

## **9. Proposal and Awards**

Nuclear Power Fundamentals Online Certificate Program, U.S. Nuclear Regulatory Commission, John White (PI) and Leo Bobek, Thomas Regan, Gilbert Brown (co-PIs), \$200,000 – pending.

Innovative Use of a Research Reactor for Interdisciplinary STEM Education, National Science Foundation, John White (PI) and Leo Bobek, Thomas Regan (co-PIs), \$149,299-pending.

Nuclear Experiential Education and Training Program at the University of Massachusetts Lowell, U.S. Nuclear Regulatory Commission, Mark Tries (PI) and Leo Bobek, Thomas Regan, Clayton French (co-PIs), \$200,000 – awarded.

GNEP University Readiness Grant, Department of Energy, Leo Bobek (PI) John White, Thomas Regan (co-PIs), \$100,000 – awarded.



Correlated Particle Measurements of Fissile Material, Department of Energy, Gunter Kegel (UML) and Mitchell Woodring (PNNL), CO-PI, pending, funding requested for UML \$850,000. This application is processed through PNNL.

Covert Actinide Processing Revealed by Alpha Spectroscopy of Waste Water, Department of Energy, Gunter Kegel, Lead PI., \$449,329. not funded.

Measurement of Neutron Capture Gamma Ray Spectra, Department of Energy, Gunter Kegel and James Egan, CO-PI., \$329,016., pending.

Neutron Irradiation, Perkin-Elmer Corporation, Mary Montesalvo and Gunter Kegel, \$9454.00 funded

Neutron Physics Studies, Partha Chowdhury, James Egan, and Gunter Kegel Department of Energy, \$ 1,778,401.00, not funded.

Measurement of the Probability Distribution of the number of Neutrons and Gamma Rays, National Science Foundation, \$1,705,976.00, pending.

### **9.1 Contracts**

- Contracts Total for July 1, 2007 to June 30, 2008: \$350,000.
- Microsemi Corporation (Lawrence, MA); International Rectifier (Leominster, MA facility); Barr Associates (Westford, MA); Assurance Technology Corporation (Chelmsford, MA); Implant Sciences Corporation (Wakefield, MA); Radiation Monitoring Devices (Watertown, MA); AEA Technologies (Burlington, MA); Fibersense (Canton, MA); Datum (Beverly, MA); Cubist Pharmaceuticals (Lexington, MA); SSG Precision Optronics, Inc. (Wilmington, MA); Symnetricon (Beverly, MA); Physical Sciences, Inc. (Andover, MA); SatCon Electronics (Marlborough, MA); Bristol-Meyers Squibb Co. (Billerica, MA); National Technical Systems (Acton, MA); Analog Devices, (Norwood, MA); Eyetech Research Center (Lexington, MA); Mitre Corporation (Bedford, MA); Passport Systems, Inc. (Acton, MA); Sypris Test and Measurement (Orlando, FL); Carboline Co. – R&D (St. Louis, MO) Imaging & Sensing Technologies (Horseheads, NY); General Dynamics (Scottsdale, AZ); Spectrum Technologies (Schenectady, NY); M.S. Kennedy Corporation (Liverpool, NY); Keeler & Long, PPG Industries (Watertown, CT); Hunton & Williams, LLP; Nufern (East Granby, CT); Mitre (Bedford, MA) US Air Force (Hanscom AFB, MA) Create, Inc. (Hanover, NH), Corrosion Control Consultants and Lab (Kentwood, MI), ROV (Brattleboro, VT), Sherwin Williams (Cleveland, OH) – Columbia University (NY, NY), Perkin Elmer (Waltham, MA)



32. TOXICS USE REDUCTION INSTITUTE  
**2007-2008 Annual Report**

**1. Mission Statement**

The Toxics Use Reduction Institute (TURI) provides the resources and tools to help industries, communities and institutions implement toxics use reduction to make Massachusetts a safer place to live and work.

**2. General Description and Goals**

In this multidisciplinary research, education and technical support center, the TURI staff of engineers, analysts, educators and support staff provide services in the following five areas:

1. Technology Innovation through supply chain and peer networks and grants to academic researchers and industries working on toxics use reduction (TUR) technologies and methods.
2. TUR Planner core training and annual continuing education courses.
3. Outreach and training in communities through toxics use reduction networking, Community Grants and other programs.
4. Surface Solutions Laboratory testing the performance of non-toxic and less-toxic cleaning alternatives for specific, client-defined applications.
5. Research library and clearinghouse for publications and articles.

**3. Research Focus Areas**

Our research efforts fall into one of two areas, i.e., technical research and methodological research. Technical research concerns the development of new chemicals and/or processes to replace toxic chemicals in current use by industry. For example, the Surface Solutions Laboratory conducts research to develop aqueous cleaning systems to replace cleaning systems that use chlorinated solvents. Methodological research concerns the development of new techniques for analyzing chemical use by industry. For example, we have developed an alternatives assessment methodology for industry and policy makers to evaluate the feasibility and relative safety of substituting a particular alternative for a toxic chemical.

**4. Associated Personnel**

Michael Ellenbecker	Director
Elizabeth Harriman	Deputy Director
Janet Clark	Senior Associate Director for Information
Jack Luskin	Senior Associate Director for Learning
Anne Basanese	Manager of Administration & Events



Pamela Civie	Industry Research Program Manager
Joy Onasch	Community Program Manager
Gregory Morose	Project Manager
Jason Marshall	Laboratory Director
Heidi Wilcox	Lab Technician/Field Implementation Specialist
Rachel Massey	Program Manager
Alex Brown	Systems Administrator
Heather Tenney	Program Manager
Mary Butow	Research Assistant
Peter Chandonait	Trainer
Jan Hutchins	Library Manager
SuJung (Candace) Tsai	Postdoctoral student
Kwangseog Ahn	Postdoctoral student
Robin Gavin	Bookkeeper
Malinda Buchannan	Receptionist
Brenda Wilson	Office Assistant and Bookkeeper

## 5. New Faculty Affiliations

Zhiyong Gu, Jayant Kumar, R. Nagarajan, David Kriebel and Richard Clapp were funded by TURI to perform research projects as described below. In addition, Dhimiter Bello, newly hired as Assistant Professor in Work Environment specifically to do research on the occupational and environmental health impacts of nanotechnology, worked closely with Dr. Ellenbecker on the Center for High-rate Nanomanufacturing as described below.

Cora Roelofs, Research Assistant Professor, is working with TURI on a range of projects. Currently, she is working on our new smaller toxics users initiative.

## 6. Students Supported

### CFCI funded:

Ephraim Massawe

Sally Edwards

### TURI funded:

Su-Jung Tsai (postdoc)

Kwangseog Ahn (postdoc)

Anne Chalupka

Heidi Wilcox

Shweta Bansal

Andrea Cheeseman

Sushma Vasudeva

Chase Isabelle



Subhalakshmi Nagarajan  
Subhadeep Mukherjee  
Fan Gao  
Kathy Sperrazza  
Sharadrao Patil  
Sethumadhavan Ravichandran

## 7. Current Research Projects

### CFCI Funding

Doctoral candidate in Cleaner Production Rossy Alvarez prepared a report entitled “The Potential for use of bio-based plastics in toys and children’s products.” The purpose of this report is to evaluate the potential for use of bio-based plastics as alternatives to the petroleum-based plastics currently used to make toys and children’s products. Bio-based materials are promising as their feedstocks are renewable, theoretically they can be composted or recycled, and often their production process is more energy efficient than petroleum-based plastics processing. The report considers how to define a sustainable plastic; reviews ranking schemes and criteria that have been developed in the last decade to aid in decision-making; provides an overview of plastics use and processing in toys; defines and describes types of biobased plastics according to their source, production process, uses, costs, environmental, health and safety impacts, recyclability, compostability, and commercial readiness. Each bio-based plastic is considered for its possible application in the toys and children’s products industry and is reviewed according to sustainability criteria.

### Core Funding

With our core funding from the Massachusetts Toxics Use Reduction Program, we are supporting a wide range of research into the reduction in the use of toxic chemicals by Massachusetts industries. Some of our largest current projects are described below:

#### TURA Amendments

The Toxics Use Reduction Act, initially passed in 1989, was amended for the first time last year. TURI began devoting considerable resources to the implementation of the changes in the act. The primary tasks were the designation of more hazardous and less hazardous chemicals, decisions on what chemicals to retain on the reportable list, and the provision for new alternative planning possibilities for participating companies. These activities involved considerable planning and coordination with our sister agencies, the Office of Technical Assistance for Toxics Use Reduction (OTA) and the Department of Environmental Protection (DEP).



Much of the technical work in support of the amendments was carried out by the Institute's Science Advisory Board (SAB), a panel of outside scientists established to provide scientific input to the TUR program. The SAB, supported with technical data input from the TURI staff, met seven times in 2007-8 and recommended 22 chemicals for high hazard or low hazard designation and made retention recommendations for more than 300 chemicals.

#### Toxics Use Reduction Community Program.

The Toxics Use Reduction community education and grant program encourages citizen involvement in the State's TUR Program, fosters collaborative action, and develops model projects and materials for other communities to replicate. Each year, grants are given to community and municipal organizations to fund TUR-related activities. This program has a website offering a compilation of projects, materials and policies developed by community organizations and local governments as well as extensive links to additional resources.

This year's ten projects include pesticide reduction in parks in Lowell, town property in Townsend, and private households in Holliston; scholarships for municipal employees to attend organic lawn care seminars put on by the Northeast Organic Farming Association; raising awareness about household toxics through youth in Worcester and asthmatics in Lynn; healthier product alternatives for Brazilian housecleaners in Boston neighborhoods; healthy floor finishing in the Vietnamese community in greater Boston; the switch from chemical emergency flares to safer alternatives on Cape Cod to protect their groundwater; and the start-up of a lecture series on toxics and children's health in the Berkley neighborhood. Descriptions of these projects can be found at [www.turi.org](http://www.turi.org) under the Community tab.

#### Supply Chains.

We sponsor a series of supply chains for Massachusetts industries in order to help them compete in the global marketplace where chemical restrictions are becoming more commonplace. Currently we focus on two groups, the Lead-Free Electronics Consortium and the Coated Wire and Cable Supply Chain.

The New England Lead-Free Electronics Consortium connects peers in industry with their suppliers and markets to address industry challenges and build local competitiveness. Several years of testing and experiments, as well as supply chain workshops and communication have resulted in a large archive of practical presentations, papers, and articles available for downloading. Sponsored by TURI, The University of Massachusetts Lowell, and the U.S. EPA, the Consortium has been working since 2000 to improve the conversion process to lead-free. The Consortium is a collaborative effort among companies that represent the entire printed wiring board (PWB) supply chain. The goal of Consortium projects is to achieve a level of lead-free solder joint manufacture



and reliability comparable or better to that of leaded solder joints. Consortium members working with TURI, university researchers and students ran an exhaustive set of experiments to test materials, manufacturing processes and reflow strategies. The consortium has also employed six sigma tools (DOE, FMEA, etc.) to focus research efforts and enhance the quality of testing results.

The Coated Wire and Cable Supply Chain network brings together raw material suppliers, compounders, extruders and OEMs to address environmental challenges facing the industry. The wire and cable industry faces European, Japanese and US regulatory pressure on a number of key wire and cable materials, including: lead, brominated flame retardants, PVC, and plasticizers. This TURI Network benefits from university research on the environmental impact of wire and cable constituents, laboratory evaluation of alternative materials, and meetings that draw firms from throughout the supply chain together to discuss human and environmental impacts, regulatory requirements, new technology developments, and business and technical strategy.

#### University Research in Sustainability.

TURI funds research performed by faculty in the various departments at the university, based on submissions to an annual RFP. Three projects were funded in 2007-8:

- “Identifying targets for reducing exposure to agents that cause or exacerbate asthma in Massachusetts,” D. Kriebel, R. Clapp, LCSP, \$8K.
- “Greener routes to halogen-free flame retardants,” J. Kumar, R. Nagarajan, Chemistry Dept., \$20K.
- “Nanoscale lead-free solders (“nano solders”): synthesis, characterization and reflow properties,” Z. Gu, Chemical Eng., \$20K.

#### Surface Solutions Laboratory.

The SSL provides technical assistance to companies looking to reduce the amount of hazardous chemicals used for surface cleaning. The Lab does this by testing alternative cleaning chemistries on the company’s parts, and quantifying the cleaning ability of these alternatives. This year, the Laboratory continued its focus on two new research areas critical to SSL’s mission: the assessment of biobased products as alternative chemicals/feedstocks and green chemistry. These fields will become increasingly important in transitioning from a hydrocarbon to a carbohydrate economy that is less dependent on foreign energy supplies, both on a local and national level. More information on the Lab’s activities can be found at [www.turi.org](http://www.turi.org) under the Laboratory tab.



In addition, the SSL was funded by EPA Region I to help small metal working companies in Rhode Island to reduce their use of trichloroethylene; this work is described more fully below.

### Toxics Use Reduction Planning.

The Institute is mandated under the Toxics Use Reduction Act to provide basic and advanced toxics use reduction training to Toxics Use Reduction Planners. Training programs include TUR Planner Training and Professional Continuing Education. Offered once per calendar year, the Toxics Use Reduction Planner Course provides 42 hours of core sessions over a seven-week period. Skills and tools covered are valuable in any production or service context:

1. Toxics Use Reduction reporting requirements
2. Process characterization
3. Materials accounting
4. Worker health and safety
5. Options identification and analysis
6. Regulatory requirements
7. Financial and implementation issues

This course is a prerequisite for state certified Toxics Use Reduction Planners under the Massachusetts Department of Environmental Protection's (DEP) exam track application procedure.

The program also offers specialized continuing education workshops for TUR Planners. TURI holds two continuing education conferences each year, one in the spring and one in the fall. The Institute also offers occasional stand alone full- day workshops.

### Outside Funding

The following research was performed under outside funding during the 2006-2007 year:

#### Center for High-Rate Nanomanufacturing

TURI is an integral part of this NSF Nanoscale Science and Engineering Center, awarded jointly to UMass Lowell, Northeastern University, and the University of New Hampshire. TURI is responsible for ensuring the environmental and occupational health and safety of all participating labs, and for conducting alternatives assessments for all new processes developed in the labs. As part of this effort, TURI has initiated a program of research into exposure issues involved with the use of nanoparticles. Several presentations were made at professional meetings outlining our monitoring results to date, as documented in Section 9. Peer-reviewed journal articles were published that presented the results of Dr. Tsai's research into the performance of laboratory fume hoods when used to handle dry nanoparticles and nanocompounding using a twin-screw extruder. In addition, Dr. Ellenbecker lectured in two nanoparticle courses and gave safety training to students at each of the three campuses.

### Veterans Administration



TURI was awarded a contract for \$31,000 from the VA to evaluate bio-based replacements for floor stripping and hard surface cleaning at the Bedford VAMC (VA Study Site) against products currently in use at that facility.

#### EPA Region I

TURI was awarded a contract for \$16,000 from EPA Region I to work with them to identify small metal finishing companies using trichloroethylene (TCE) in Rhode Island and to assist those companies in reducing or eliminating their TCE use. As part of this project, testing was conducted for thirteen companies and overall TCE use by these companies was reduced by more than 50%.

#### **8. Publications**

Massawe, E., K. Geiser, M. J. Ellenbecker, and J. Marshall, "Health, Safety and Ecological Implications of Biobased Floor Stripping Products," J. Env. Health 69(9): 45-52 (2007).

McKernan, J. L., and M. J. Ellenbecker, "Ventilation Equations for Improved Exothermic Process Control," Annals Occ. Hyg. doi: 10.1093/annhyg/mem016 (2007).

Massawe, E., K. Geiser, M. J. Ellenbecker, and J. Marshall, "Technical Performance Evaluation of Potential Biobased Floor Strippers," J. Cleaner Prod. 16(1): 12-21(<http://dx.doi.org/10.1016/j.jclepro.2006.05.014>) (2008).

Bello, D., A.J. Hart, K. Ahn, M. Hallock, N. Yamamoto, E. Garcia, M.J. Ellenbecker, and B.L. Wardle, "Exposure to Nanoscale Particles during CVD Growth and Subsequent Handling of Vertically-aligned Carbon Nanotube Films," Carbon 46: 974-981 (2008).

Tsai., S., A. Ashter, E. Ada, J. Mead, C. Barry, and M. J. Ellenbecker, "Airborne Nanoparticle Release Associated with the Compounding of Nanocomposites using Nanoalumina as Fillers," Aerosol and Air Quality Research 8(2): 160-177 (2008).

Tsai. S., E. Ada, J. Isaacs, and M.J. Ellenbecker, "Airborne Nanoparticle Exposures Associated with the Manual Handling of Nanoalumina in Fume Hoods," J. Nanoparticle Res. doi: 10.1007/s1 1051-008-9459-z (2008).

Tsai., S., A. Ashter, E. Ada, J. Mead, C. Barry, and M. J. Ellenbecker, "Control of Airborne Nanoparticle Release during Compounding of Polymer Nanocomposites," in press, NANO, 2008.

Ashter, A., S. Tsai, M. J. Ellenbecker, J. Mead, and C. Barry, "Effects of Nanoparticle Feed Location during Nanocomposite Compounding," in press, Polymer Eng. and Science J., 2008.

Onash, J., "Getting the Lead Out One Sinker at a Time," Massachusetts Wildlife, Vol LVIII, No. 1, 2008.



Marshall, J “Choosing a New Cleaning Product Based on Environmental Health and Safety Issues,” Process Cleaning Magazine, March/April 2008, Volume 3 Number 2.

## 9. Conference Presentations

Tsai, S., E. Ada, M.J. Ellenbecker, "Airborne Nanoparticle Exposures Associated with the Manual Handling of Nanoalumina in Fume Hoods," presented at the 3<sup>rd</sup> international Symposium on Nanotechnology, Occupational and Environmental Health, Taipei, Taiwan, August 2007.

Tsai, S., K. Ahn, E. Ada, M.J. Ellenbecker, "Workplace Nanoparticle Exposure Measurement at University Research Centers," presented at the 3<sup>rd</sup> international Symposium on Nanotechnology, Occupational and Environmental Health, Taipei, Taiwan, August 2007.

Tsai, S., K. Ahn, E. Ada, M.J. Ellenbecker, M.F. Hallock, J. Isaacs, "Workplace Nanoparticle Exposure Measurement at University Research Centers," presented at the Campus Safety Health and Environmental Management Association annual meeting, Boston, July 2007.

Ashter, A., S. Tsai, M. J. Ellenbecker, J. Mead, C. Barry, "Effects of Nanoparticle Feed Location during Nanocomposite Compounding," presented at the Fourth International Symposium on Polymer Nanocomposites, Montreal, Canada, October 2007.

Tsai, S., E. Ada, M.J. Ellenbecker, "Measurement of Airborne Nanoparticle Exposures Associated with the Use of Fume Hoods," presented at the annual conference of the American Association for Aerosol Research, Reno, NV, September 2007.

Tsai, S., E. Ada., K. Ahn, M.J. Ellenbecker, "Measured Airborne Nanoparticle Exposures at an NSF Nanoscale Science and Engineering Center," presented at the annual conference of the American Association for Aerosol Research, Reno, NV, September 2007.

Ellenbecker, M.J., "Nanotechnology: Environmental & Occupational health Implications," presented at the Annual Conference of the New England College of Occupational and Environmental Medicine and the Massachusetts Association of Occupational Health Nurses," Bedford, MA, November 2007.

Ellenbecker, M.J., "The Risks: Occupational/Environmental Health and Safety," presented at the Nypro Global Technical Conference, Lowell, MA, November, 2007.

Tsai, S., A. Ashter, E. Ada, J. Mead, C. Barry, M.J. Ellenbecker, "Control of Airborne Nanoparticle Release during Compounding of Polymer Nanocomposites Using Twin Screw Extruder," presented at the International Symposium on Nanotechnology in



Environmental Protection and Pollution, ISNEPP 2007, Ft. Lauderdale, December 2007.

Ellenbecker, M.J., S. Tsai, J. Isaacs, "Guidelines for the Safe Handling of Nanoparticles in University Research Laboratories," presented at the International Symposium on Nanotechnology in Environmental Protection and Pollution, ISNEPP 2007, Ft. Lauderdale, December 2007.

Ellenbecker, M.J., "Exposure to Nanoparticles: Is This Something We should Worry About? If So, What Should We Do About It?," presented at the Conference on Nanotechnology, Literature, and Society, Lowell, MA, December 2007.

Tsai, S., E. Ada, M.J. Ellenbecker, "Measurement of Airborne Nanoparticle Exposures Associated with the Use of Fume Hoods," presented at the American Industrial Hygiene Conference & Expo (AIHCE), Minneapolis, 2008.

Ahn, K., M.J. Ellenbecker, "Nanometer-scale Filtration Efficiency of Ventilation Air Filters," presented at the American Industrial Hygiene Conference & Expo (AIHCE), Minneapolis, 2008.

Luskin, J., "Making Sense of Sustainability: The Business Case for Sustainable Supply Chains," The 18th Annual Cleaner, Sustainable, Industrial Materials & Processes (CSIMP) Workshop, March 17-20, 2008.

Luskin, J., "Sustainable Consumption in North America?," The Canadian Pollution Prevention Roundtable, June 11-13, 2008.

Luskin, J., T. Mansoureh, M. Shuldman, "Using Video Production to Facilitate the Integration of Sustainability in Academic Curricula," UMass Instructional Technology conference.

Eliason, P., "The Massachusetts Toxics Use Reduction Program," the Global Conference on Occupational and Environmental Cancer Prevention, the University of Stirling, Scotland, April 25 – 27, 2008.

Marshall, J., "Biobased Cleaning Products Pilot Study at the Bedford Medical Center," Federal Environmental Symposium. Bethesda, MD, June 2008.

Marshall, J., "Tools for TCE Substitution: Hands-On Training from the TURI Lab," EPA Funded seminar for RI companies, Warwick, RI, March 2008.

Marshall, J., "Services of the Toxics Use Reduction Institute's Laboratory: How We Can Help You," Environmental Compliance Seminar for Coaters, Devens, MA, February 2008.

#### **10. Collaboration with other Centers/Institutes and/or Departments**



### Lowell Center for Sustainable Production

We collaborated with the Lowell Center for Sustainable Production (LCSP) on several fronts. The work funded by the CFCI is described above. In addition to the projects listed below, we continued to work closely with LCSP in a process of strategic planning to help define the future activities of the two centers and to prepare major funding proposals to foundations.

Janet Clark is an advisor to the Toward Tomorrow Project (LCSP), and met with stakeholders for planning.

Pam Civie, Greg Morose and Liz Harriman collaborated with the LCSP on their Clean Tech project.

Pam Civie and Greg Morose participated in the LCSP's Green Chemistry and Commerce Council (GC3). Chemicals, alone or in combination, are the platform upon which key elements of the global economy have been built, and have been incorporated into millions of products used every day. Many chemicals may have inherently harmful characteristics that can impact ecological and human systems as they are used throughout supply chains. A growing number of companies are discovering that the approaches of green chemistry and Design for Environment (DfE) allow for a transition to safer alternatives. The Green Chemistry and Commerce Council provides open conversation about the challenges to and opportunities for this successful transition.

Rachel Massey contributed a chapter on communication of chemical information through the supply chain, to the LCSP's compilation of issues around chemicals policy. The document, "Options for State Chemicals Policy Reform – A Resource Guide," was published in January 2008.

The Institute and the Lowell Center also continue to collaborate on strategic planning, methodology development for alternatives assessment, and state chemicals policy initiatives.

### Plastics Engineering Department and the Nanomanufacturing Center for Excellence

TURI has been an integral part of the university's nanomanufacturing activities, as described above.

### Chemical Engineering Department

The TURI Sustainable Research Fellows program awarded Zhiyong Gu \$20,000 for his project titled "Nanoscale lead-free solders ("nano solders"): synthesis, characterization and reflow properties."

### Chemistry Department

The TURI Sustainable Research Fellows program awarded Dr. Jayant Kumar \$20,000 for his project titled "Greener routes to halogen-free flame retardants."

### Other Collaborations



Jack Luskin collaborated with faculty in Art, English, Economics, Nursing, and Management Departments to incorporate TUR concepts into interdisciplinary courses.

Janet Clark was involved in a series of collaborations across the campus. The Dashboard Project involved the Departments of Computer Science, Regional Social and Economic Development, Management, Biology and Mechanical Engineering as well as UML Buildings and Grounds, EHS, Communications and ARA Food Services. In the area of Environmental Management Systems (EMS) auditing, she worked with LCSP/EMS Consortium at UML. Under Janet's leadership, TURI Partnered with RESD (Sarah Kuhn) for the Student Design Expo. She serves on the Advisor Committee to the New England Waste Management Officials (NEWMOA) software project for materials and financial tracking in facilities.

Michael Ellenbecker worked closely with other faculty members engaged in nanoparticle research in his roles as an investigator for the NSF Center for High-Rate Nanomanufacturing and a member of the Executive Committee of the Nanomanufacturing Center of Excellence.

## **11. Regional/Local Outreach**

### State Government Collaboration

The Institute works closely with other state agencies on TUR, but this has been particularly true in response to new legislation. Our collaborations with the Executive Office of Energy and Environmental Affairs, the Department of Environmental Protection and the Office of Technical Assistance involve weekly meetings and joint publications, training and sector programs.

### Toxics Use Reduction Institute Conferences and Workshops

The Toxics Use Reduction Institute presented nine training events in the last fiscal year:

The TUR Planner Class 41 was held in Waltham, Massachusetts. The 42 hour course was attended by twenty one people.

The Fall Toxics Use Reduction Planner Continuing Education Conference was held on November 7, 2008 in Burlington, Massachusetts. Ninety-one people attended and earned 795 credits for TUR recertification, 57 general continuing education credits.

The Conference offered four sessions:

- Barriers to Sustainable Practices
- Facility Maintenance Using Biobased products; opportunities to Green Your Company
- Recent Developments in Nanoparticle Health and Safety



- Introduction to Tools for Risk Assessment and Control of Chemicals.

The Spring Toxics Use Reduction Planner Continuing Education Conference was held on April 8, 2008 in Westborough, Massachusetts. One Hundred people attended and earned seven hundred and eight credits for TUR recertification and one hundred and ninety-two general continuing education credits.

The Conference offered four sessions:

- Process Water Management Workshop
- Design for the Environment- Solar Photovoltaics Case Study
- Nano Risk Management training Workshop
- Academic Research for Industry TUR.

A basic Resource Conservation Planning Workshop that familiarized planners with the objectives, methods and requirements of Resource Conservation (RC) Planning options available under the new 2006 TURA Amendments was offered three times. The workshops were offered in:

- Marlborough, Massachusetts on December 6, 2007 where forty-seven attendees earned a total of two hundred and sixty-four credits.
- Milford, Massachusetts on January 10, 2008 where thirty-eight attendees earned a total of Two hundred and thirty-four credits.
- Waltham, Massachusetts on May 6, 2008 where twenty-five attendees earned a total of one hundred and fourteen credits.

Day Two Resource Conservation Asset Specific training was presented on January 24, 2008 in Marlborough, Massachusetts. This training focused on Technical Options and Asset Specific planning. Four 3-hour asset specific training sessions were offered: energy efficiency, water conservation, reducing toxics in products/articles and reducing materials in solid waste. Eighty people attended and earned a total of four hundred and fifty credits for TUR recertification.

Environmental Management Systems (EMS) for Planners is a two day training designed to give TUR Planners the knowledge they need to certify that a company's TURA EMS satisfies the requirements of the Toxics Use Reduction Act. The training was offered on January 30<sup>th</sup> and February 5, 2008 in Boxborough, Massachusetts. Thirty-four people attended the training and earned a total of four hundred and eight credits for TUR recertification and one hundred and forty-four general continuing education credits.

Toxics Use Reduction Planning for Environmental Management Systems Professionals training was designed to give EMS Professionals the knowledge they need to certify that a company's TURA EMS satisfies the requirements of the Toxics use Reduction Act. The two day training was presented on February 13<sup>th</sup> and February 20, 2008 in Norwood. Fifteen people earned a total of one hundred and fourteen credits.



Introduction to Tools for Risk Assessment and Control of Chemicals – An On-Line continuing education course was offered from May 15 to May 30. Nine people participated in the course.

**Regional/Local Outreach:**

Staff conducted a training for City Year Corps members on toxics in household products. The Corps members then presented sessions to elementary school students at 4 sites in Boston.

Staff developed a website, [Toxfreehome.org](http://Toxfreehome.org), for general information on toxics in household products

Joy Onash made the following presentations to community groups:

October 2, 2007: Toxics in Our Community presentation to Worcester Youth Center Peer Leaders.

October 14, 2007: Hosted wet cleaning demonstration day for dry cleaners across the state to teach them about new technologies in the garment cleaning sector.

October 24-25, 2007: Massachusetts Health Officers annual meeting. Display and outreach to health offices across MA about toxics and grant funding availability.

December 3, 2007: Visiting lecture at Mass Maritime Academy, Environmental Health and P2 course, on toxics in communities and TURA.

March 4, 2008: NEWMOA webinar trainer on wet cleaning, presenting to northeast regulatory and P2 entities.

March 30, 2008: Presenter at D2E Boston Event at Hynes Convention Center. Toxics in Daily Life. 100+ in attendance.

March 31, 2008: City of Lowell Green-up event participant. Community outreach event.

April 22, 2008: EPA Vendor Fair in Boston MA. Community educational materials including non-lead sinkers and wet cleaning.

April 24, 2008: Worcester Ecotarium Earth Day event, co-sponsored by the Regional Environmental Council of Central Massachusetts and the Ecotarium.



April 29, 2008: City of Lowell Economic Development Office Small Business Fair participant, Lowell, MA. TUR in small business outreach.

June 18, 2008: Toxics in Our Community presentation to Motorola (3 time slots) in Lowell, MA.

TURI honored our industry and community partners at a large statehouse event in June.

Janet Clark served as Advisor for the NEWMOA (New England Waste Management Officials Association) Energy and Materials Flow and Cost Tracker (EMFACT) Project.

Janet Clark arranged for Marcia Deegler (Massachusetts Environmentally Preferable Purchasing Program manager) to offer a workshop for TURI, LCSP and UML teams

Janet Clark participated in the Distinct Identity Campaign of the University President's Office; she also lectured at Clark University on TUR.

Our Community Grant Boy Scout, Michael Browne, received Field and Stream Magazine's Hero of Conservation Award for his work to eliminate lead fishing sinkers in Massachusetts.

#### Articles in the Popular Press

##### [Designing "green" Plasticizers](#)

7/8/08 article in Environmental Science and Technology journal with quotes by Pam Eliason, TURI Industry Research Program Manager.

URL: <http://pubs.acs.org/cgi-bin/sample.cgi/esthag/asap/html/es801828p.html>

##### [Lawns Get Greener Without Chemicals](#)

7/9/08--UML ENews article about the University's organic lawn care program that includes quotes from Joy Onasch, TURI Community Program Manager.

URL: [http://www.uml.edu/Media/eNews/Organic\\_lawn\\_care.html](http://www.uml.edu/Media/eNews/Organic_lawn_care.html)

##### **Milton Youth Keeps Lead Sinkers out of State Waters**

6/15/08 Berkshire Eagle article about Eagle Scout Michael Browne who received a TURI community grant to educate the public about using non-lead sinkers for fishing.



### **Sen. Resor Honored for Helping Environment**

6/11/08 Lowell Sun article about recognizing Senator Resor at TURI's Champions of Toxics Use Reduction event for her years of dedication to the environment.

URL: [http://www.lowellsun.com/ci\\_9549432?IADID=Search-www.lowellsun.com-www.lowellsun.com](http://www.lowellsun.com/ci_9549432?IADID=Search-www.lowellsun.com-www.lowellsun.com)

### **Townsend Stressing Organic Lawn Care in Community**

6/5/08 Lowell Sun article about the Town of Townsend's organic lawn care project, funded by a community grant from TURI.

URL: [http://www.redorbit.com/news/science/1418894/townsend\\_stressing\\_organic\\_lawn\\_care\\_in\\_community/](http://www.redorbit.com/news/science/1418894/townsend_stressing_organic_lawn_care_in_community/)

### **WCVB-TV 5 News Report "For Some Cleaners, Wet is the New Dry"**

11/20/07--Jason Marshall of the TURI Laboratory was interviewed for this WCVB-TV Channel 5 news report on dry cleaners replacing perchloroethylene with wet cleaning.

URL: <http://www.thebostonchannel.com/environmental/14650199/detail.html>

### **WBZ-TV 4 News Report "Chemicals Prompt Concern about Mattress Standard"**

11/08/07 Deputy Director of TURI Liz Harriman was interviewed by WBZ TV 4 about the Consumer Product Safety Commission's new regulations that require more chemical additives to mattresses.

URL: [http://wbztv.com/specialreports/local\\_story\\_312161349.html](http://wbztv.com/specialreports/local_story_312161349.html)

### **WBZ TV-4 News Report "Dangerous Lead in Household Items Deserves Warning"**

9/12/07 WBZ TV report about lead in household products includes comments from TURI Deputy Director Liz Harriman.

URL: [http://wbztv.com/consumer/local\\_story\\_255211439.html](http://wbztv.com/consumer/local_story_255211439.html)

### **UML bestows grants to eco-minded organizations**

9/2/07 Lowell Sun article about TURI's 2008 Community Grant Recipients

URL: [http://www.uml.edu/Media/News%20Articles/UML\\_bestows\\_grants\\_t.html](http://www.uml.edu/Media/News%20Articles/UML_bestows_grants_t.html)

### **Upcoming Boston Lead-Free Conference**

May 24th article in Surface Mount Technology magazine, Greg Morose of TURI is the



keynote speaker at SMTA's "Successful Lead-free/RoHS Strategies" conference, June 20–21 in Boxborough, Mass.

URL: [http://smt.pennnet.com/display\\_article/293601/35/ARTCL/none/HMST/Upcoming-Boston-Lead-free-Conference/&reason=0](http://smt.pennnet.com/display_article/293601/35/ARTCL/none/HMST/Upcoming-Boston-Lead-free-Conference/&reason=0)

### **Pb-free PTH Rework on a Thick, Heavy Assembly**

August 2007 Cover Story in Circuits Assembly magazine about the New England Lead Free Consortium's rework on lead-free boards with minimal copper dissolution.

URL: <http://circuitsassembly.com/cms/content/view/5201/95/>

## **12. Proposals Submitted/Awarded 2007/2008**

Toxics Use Reduction Program core funding, Commonwealth of Massachusetts, \$1,667,000 (awarded).

Regional Mobile Surface Cleaning Laboratory, submitted to the Cabot Foundation, \$70,000.

Support for Wet Cleaning Demonstration Project, submitted to National Grid, \$5,000 (awarded).

Supporting Entrepreneurial Opportunity in Innovation for Safer Product Design, submitted to the Ewing Marion Kauffman Foundation, \$70,000.

Creating a Sustainable Project Dashboard, submitted to the EPA, \$10,000 (awarded).

Veterans Administration, evaluate bio-based replacements for floor stripping and hard surface cleaning, \$31,000 (awarded).

EPA Region I, identify small metal finishing companies using trichloroethylene (TCE) in Rhode Island and to assist those companies in reducing or eliminating their TCE use, \$14,000 (awarded).



### 33. TSONGAS INDUSTRIAL HISTORY CENTER

#### **Annual Report 2007-2008**

##### **1. Mission Statement:**

The Tsongas Industrial History Center is an educational project of the UMASS Lowell Graduate School of Education in cooperation with Lowell National Historical Park. Within the overall mission of UMass Lowell to develop a vigorous and sustainable regional economy, improved schools, and a high quality of family, work and community life, the mission of the Tsongas Industrial History Center is to (1) encourage K-12 teachers, students, and youth groups to study the social, economic, and environmental causes and consequences of industrial development, decline, and renewal; (2) assist the University and schools to strengthen public education in the region, and (3) assist National Parks to expand their educational partnerships and programs.

*- Approved by the Dean, Graduate School of Education, UMass Lowell and Superintendent, Lowell National Historical Park, September, 2001*

##### **2. General Description and Goals:**

The Tsongas Industrial History Center (1) provides hands-on learning experiences and tours of Lowell's industrial history sites for more than 60,000 students annually which are organized around themes carefully linked with national and state curriculum standards at specified grades, (2) serves as a lab school for teachers-in-training and as an in-service professional development center for teachers by providing graduate courses on industrial history and curriculum development, (3) provides hands-on activities as part of the National Park's programming for youth groups and families, and (4) serves as a case study of a stable, successful educational partnership between a University and a National Park and as a training center for Park Service leaders anxious to expand education programs and partnerships. Under a written cooperative agreement between UMASS Lowell and Lowell National Historical Park, the Center is governed by the Chancellor of UMASS Lowell through the Dean of the Graduate School of Education, with concurrence from the Superintendent of Lowell National Historical Park. University and Park Service staff works closely to develop strategic plans that reflect the strategic priorities of both organizations. A standing Teacher Advisory Board provides advice and assessment of the Center's programs.

##### **3. Research and Programming Focus Areas:**

- Support for a Greater Lowell Regional Environmental Education Alliance to expand environmental programming for Merrimack Valley students in grades 3-12.
- Support for after school programming at the Rogers School.
- Support for the expanded outreach to position the Tsongas Industrial History Center as a STEM resource.
- Expand partnership opportunities with UML departments and centers.

##### **4. Associated Personnel (Faculty, Staff) in 2007-2008:**

**Graduate School of Education:** Dr. Anita Greenwood, Dr. Patricia Fontaine, Dr. David Lustick, Dr. Michelle Scribner-McLean, Dr. Judith Boccia, Dr. Brenda Jochums-Slez



(emerita), Dr. Jill Lohmeier, Dr. MinJeong Kim; have had exploratory conversations with Dr. Elizabeth Ambe, Dr. Jay Simmons, and Dr. Regina Panasuk.

**History Department:** Dr. Chad Montrie, Dr. Jonathan Leibowitz.

**Community Health and Sustainability:** Dr. Joel Tickner.

**College of Engineering:** Dr. John Duffy, Dr. David Kazmer, Dr. Robert Tuholski, Dr. Glenn Sundberg.

**English and American Studies:** Dr. Melissa Pennell, Dr. Diana Archibald, Dr. Bridget Marshall, Dr. Marlowe Miller, Dr. Paula Haines.

**Environmental, Earth, and Atmospheric Sciences:** Dr. Arnold O'Brien.

**Center for Women and Work:** Dr. Meg Bond, Dr. Michelle Haynes.

**Center for Family, Work and Community:** Dr. Linda Silka, Robin Toof.

**Labor Extension Program:** Dr. Charlie Richardson, Michael Prokosch, Susan D'Amore, Susan Winning.

**RESD:** Dr. Bob Farrant, Dr. William Mass, Dr. Sarah Kuhn.

**Work, Environment, and Health:** Dr. Laura Punnett.

**Cultural Studies:** Dr. Marie Frank.

## 5. New Faculty Affiliations:

In September 2007 Dr. Beryl Rosenthal became the Center's new director. Rosenthal was most recently the Director of Exhibitions and Public Programs for the MIT Museum. Previously, she has served as Director of Museum Education for the Robert S. Peabody Museum of Archaeology at Phillips Academy, Science and Galleries Director at the St. Louis Science Center, and Director of Resources, Education in Arts, Culture, and History (REACH) at the Indiana Historical Bureau. She holds a Ph. D. in Anthropology from the State University of New York at Buffalo and a Bachelor of Fine Arts degree from the Parsons School of Design/The New School for Social Research. She brings a variety of experience in museum education, programming for K-12 students, strategic planning, grant writing and other fund raising, and work with multicultural communities (including fluency in Spanish).

## 6. Students Supported:

Since the Tsongas Industrial History Center is a University Service Center, CFCI funding was not used to support graduate students, but rather to support a grant-funded project assistant, Dr. Timothy LaVallee, who develops and coordinates an after school program on environmental stewardship for Rogers School which reaches 20 students during the regular after school program and 200 people at Earth Fest, the culminating event. Dr. LaVallee was also supported in his role as the coordinator of the Merrimack Watershed Youth Congress, and various outreach environmental activities at local schools, Woburn, Greater Lowell Regional Tech, Lowell schools, reaching approximately 500 students annually.

The Tsongas Industrial History Center also serves as an internship and work-study site for university-level students. This year, we supported two UMASS Lowell undergraduates, one Fitchburg State College undergraduate and one Tufts graduate student:

- Melanie Schwebke (Grad Prog in Museum Studies at Tufts). Melanie has worked in museums and has an interest in program development and evaluation for school groups. She shadowed staff on all programs, has developed sufficient knowledge to serve as a "second hand" on the floor. She reported directly to Dr. Beryl Rosenthal, who provided her with a lengthy reading list, and also engaged her in the evaluation



of three programs, River of Death, Inventions, and a sub-contracted St. Gaudens curriculum project.

- Jasmine Burke (College of Management; also reported to Dr. Beryl Rosenthal) developed a marketing plan for the Tsongas Center as part of her coursework.
- Andy Pearson (History/English; reported directly to Sheila Kirschbaum) wrote text for interpretive panels for the Tsongas Center and assisted with a joint project of the Center, History Department (Dr. Chad Montrie), and Lowell Parks and Conservation Trust to prepare text panels for the Concord River Greenway Park.
- Jennifer Ripley (Fitchburg State College) assisted in the weave room on Fridays. She served as an assistant during programs, and was responsible for insuring that the weavings produced by students as part of their fieldtrips were mailed to their schools.

### **7. Current Research Projects:**

The Tsongas Industrial History Center worked with UML's College of Engineering and MCC's Psychology Department students on visiting student attitudes toward recycling; they deduce attitudes and created projects that would either increase recycling awareness or assist the Park in devising a better system to encourage more recycling. Dr. Donna Duffy, Dr. Tim LaVallee, and Sheila Kirschbaum have already met to discuss service-learning collaborations for MCC students for the 2008-2009 school year.

The Tsongas Industrial History Center is UMASS Lowell's only direct-service community outreach entity. As such, it is not primarily a research entity in the manner of other University departments. However, faculty members are encouraged to work in collaboration with the Center on appropriate research projects, and it is one of the Director's goals to increase the number of such collaborations, particularly in STEM areas, and within the Graduate School of Education.

### **8. Publications in 2008:**

Dr. Beryl Rosenthal:

2008, "A Museum Learning Lab". *Science Teacher*, April/May: 41-43. National Science Teachers Association. K. Vandiver, J. M. Bijur, A.W. Epstein and D. Stidsen, coauthors.

2007, "Attracting Faculty: Getting Researchers Involved with a University Museum". In *Dimensions*, the journal of the Association of Science and Technology Centers (ASTC).

### **9. Presentations:**

Tsongas Industrial History Center Staff made several presentations at professional meetings:

Sheila Kirschbaum

2008, "Closing the Circle: Creative Ways of Teaching History in the Language Arts Classroom" (with LPS instructional specialist Deborah Romeo). At "Reading, Writing & History," a conference sponsored by the John F. Kennedy National Historic Site and the John F. Kennedy Presidential Library and Museum, March 17.

Dr. Beryl Rosenthal

2007, Presentation to Tufts Museum Studies class on audience-specific programming. October.



2007, "Technology: It Isn't Always Rocket Science". National Park Service North East Region Interpretation and Education Renaissance Workshop. Providence, RI, December 3-7.

Michele Turocy

2007, "Bringing the Industrial Revolution to Life in Your Classroom." The New Hampshire Council for the Social Studies Conference, October 30.

*NB: Frank Clark's NERC (North East Regional Conference on Social Studies) proposal to conduct a videoconferencing session in Hartford, CT was accepted but unforeseen circumstances prevented him from attending.*

#### **10. Collaboration with other Centers/Institutes and/or Departments:**

- UML History Dept. (Dr. Chad Montrie, Dr. Joseph Lipchitz) and Dr. Beryl Rosenthal: co-developed a 3-credit, 400-level practicum on Public History.
- UML History Dept. (Dr. Chad Montrie) and Sheila Kirschbaum, assisted Lowell Parks and Conservation Trust on creation of waysides based on Prof. Montrie's research.
- UML History Dept. (Dr. Chad Montrie) and Sheila Kirschbaum, with Lowell Parks and Conservation Trust: collaborated on a successful UMASS Creative Economy proposal to fund the creation of a lower Concord River interpretive tour and student program.
- UML professors presenting sessions as part of NEH Summer Teacher Workshops: Dr. Robert Farrant, Dr. Melissa Pennell, Dr. Bridget Marshall, Dr. Chad Montrie (co-director), Dr. William Mass (online follow-up).
- UML English Dept. (Dr. Marlowe Miller) and Sheila Kirschbaum: created a directed study for student Andrew Pearson.
- American Studies Committee: Sheila Kirschbaum is a member of the committee.
- Committee on Industrial Theory and Awareness: Sheila Kirschbaum represented the Tsongas Center.
- Graduate School of Education (with Dr. Michelle Scribner-MacLean): submitted proposals to support a technology-enhanced learning project. Reconfiguring proposal for professional conference presentation.
- Graduate School of Education (Dr. David Lustick and Dr. Jill Lohmeier): Dr. Beryl Rosenthal served as an adviser on a public engagement with science proposal to NSF.
- Graduate School of Education (Dr. MinJeong Kim): Dr. Beryl Rosenthal, currently developing a proposal to utilize the Tsongas Industrial History Center as a site for English Language Learners and family literacy through the Lowell Family Support Center.
- Center for Women and Work (Dr. Meg Bond) and Dept. of Psychology (Dr. Michelle Haynes): in collaboration with Dr. Beryl Rosenthal, Sheila Kirschbaum and David Blackburn (NPS), submitted proposals to support an immigration project based on National Public Radio's StoryCorps program.
- Center for Family, Work and Community (Dr. Linda Silka and Robin Toof): Dr. Beryl Rosenthal serves on the Summer Learning Loss steering committee.
- Women in Science and Engineering: Dr. Beverly Perna serves as a member of the association.



- Initial conversations with Charley Richardson (Labor Extension), Dr. Chad Montrie (History), Dr. Laura Punnett (Work, Environment and Health) and David Blackburn (NPS) on Health and Safety in the Workplace public programming (prototype).
- Offered Tsongas Center workshops and museum tours for attendees of the Sixth International Scientific Conference on the Prevention of Work-Related Musculoskeletal Disorders (PREMUS), co-sponsored by Laura Punnett and the Dept. of Work, Environment, and Health.
- Created and disseminated a matrix of student internship or directed-study possibilities for working with the Tsongas Center or Lowell National Historical Park.
- Collaborating with Dr. Fred Martin (Computer Science) and Dr. Sarah Kuhn's (RESO) iSense summer teacher institute on utilizing sensors in the classroom.

#### **11. Regional/Local Outreach (Other Institutes of Higher Education, Industries, Government Agencies, Schools, etc.):**

- Engagement with Schools and Experiential Learning. The Tsongas Industrial History Center served 60,000 teachers and students through direct-service educational programs, special events, and teacher institutes in partnership with Lowell National Historical Park. The Tsongas Industrial History Center has an annual contract with Lowell Public Schools to support visits by all students in grades 3, 4, 8, and 9; an estimated 3,625 Lowell P.S. students participated in programs at the Park or in their school. Many of the Center's school bookings have come from teachers who have attended our Professional Development workshops.
- Exhibits and Programs. Tsongas Center staff are working with David Blackburn of the National Park Service (NPS) on the development of a series of programs/redesign of exhibits on immigration through the "Sites of Conscience" project. The Center is also working with Dr. Sarah Kuhn (RESO), Ted Davis (NPS), David Blackburn (NPS) and Megha Sunny (undergraduate student in Electrical Engineering) on a "green" project to interpret the photovoltaic panels being installed on the roof of the Boott Mill to run the lights in the TIHC. This will be tied to curriculum frameworks on energy. Finally, the Tsongas Industrial History Center and Lawrence Public School teachers collaborated on a two-year project to develop materials for 3<sup>rd</sup> grade history and language arts curriculum. So far, nearly 700 students have visited as a result of this work.
- Member, UML Community-University Partnership Task Force.
- Three Teacher Institutes funded by the National Endowment for Humanities. The Tsongas Industrial History Center received just under \$225,000 each year from its three consecutive "Landmarks of American History and Culture" grants from NEH (2006, 2007, 2008). The Center offered three week-long summer workshops for teachers, education administrators, and personnel from around the country. The workshops, titled "Inventing America: Lowell and the Industrial Revolution," welcomed to Lowell a total of 260 teachers over both years with another 134 enrolled for 2008, totaling 394 participants from around the country. The Center received 197 applications from 35 states for the 270 slots available. A part of NEH's "We the People" project, "Landmarks" grants promote the teaching, study and understanding of American history and culture through the exploration of significant events and themes in American history. Program Coordinator Sheila Kirschbaum and Tsongas Industrial History Center staff members Ellen Anstey, Sheli Turocy, Maryann Zujewski and MaryBeth Clark, and History Dept. faculty member Dr. Chad Montrie organized scholarly presentations and living history performances with on-site investigations of canals, mills, worker housing, and



Lowell National Historical Park exhibits. In addition to the landmarks of Lowell, the program also included field studies at Old Sturbridge Village, Walden Pond, and Concord, MA. NEH Landmarks program activities have continued into each school year, with teachers submitting curriculum projects and engaging in an online class built around the Center's curriculum packet "Cotton, Cloth, and Conflict: The Meaning of Slavery in a Northern Textile City," co-authored by Sheila Kirschbaum and Gray Fitzsimons. Teachers also join an online discussion on globalization of textiles, led by Dr. William Mass, UML Center for Industrial Competitiveness / RESD. The workshop has raised teacher awareness of the Tsongas Center programming, and resulted in "trickle down" visitation. Approximately 10 teachers who participated in the workshop are now booking school visits to the Center; this includes a school from New Mexico who had formerly engaged with the Center through the distance learning program. This does not include teachers who were already coming or teachers who found out about NEH because they were already coming.

- National Teaching American History contracts. The Tsongas Industrial History Center provided programming to six Teaching American History teacher groups from 4 different states in FY 08 (3 from California, 1 from Rhode Island, 1 from Utah, 1 from Massachusetts).
- Museum Institute for Teaching Science (summer teacher professional development). The 22nd and 23rd two-week annual events were held throughout the state at 11 different host sites, the Tsongas Industrial History Center and Lowell National Historical Park being the lead museum for the Merrimack Region with Dr. Beverly Perna coordinating the event and serving as the Lead Teacher for the region. Six teachers attended the local institute where the theme was Measuring Up to STEM (Science, Technology, Engineering and Technology). The cooperators in the Merrimack Region include the American Textile History Museum, Department of Conservation & Recreation, The New England Quilt Museum, and Amoskeag Fishways in Manchester, NH. Participants spent two weeks in July attending workshops presented by all the partners and studied such topics as waterpower, simple machines, Fibonacci numbers, weaving technologies, water cycle, and succession in nature. Tsongas Industrial History Center instructors included Dr. Beverly Perna, Dr. Tim LaVallee, Martha Barrett and Michele Turocy. The 2008 workshop will be starting on July 7 with 12 teachers enrolled thus far; the theme this year is Headline Science.
- New England Groundwater Institute (teacher professional development). The Tsongas Industrial History Center served 23 teachers from all New England states and has 23 enrolled for this year's institute, July 21 and 22.
- Teacher-to-Teacher Institute (teacher professional development). The Tsongas Industrial History Center collaborated with the U.S. Department of Education to serve 75 teachers from 12 states.
- TRITEC (Tri-city Technology Education Collaborative) Teachers Institute. The Tsongas Industrial History Center served 26 teachers from Malden, Medford, Everett and Revere.
- Contracted Projects (Exporting expertise via National Park Service ranger professional development). In cooperation with Elizabeth Hoermann (NPS Program Development and Evaluation, Northeast Region Office of Interpretation and Education) the Tsongas Industrial History Center develops ranger/site educator professional development programs and associated curriculum materials to franchise the Tsongas Center model nationally throughout the National Park Service.



- Summer Camp (five one-week sessions of three different summer day camps in 2007. These camps were attended by 87 local girls and boys, ages 8-12. An additional 12 boys and girls, ages 13-18 served as Junior Counselor Volunteers, contributing a total of more than 175 hours of service to help run the camp program. Camps included National Park Adventures, Boott Camp, and Wonders of Water). We have already begun our 2008 season. As a result of more aggressive advertising, enrollments this year have increased and all sessions have waiting lists.
- Distance Learning Workshop: Developing Terrific Teacher Workshops: Under a contract between the Northeast Region of the National Park Service and the Tsongas Industrial History Center/UMass Lowell, Tsongas Center staff created an innovative website for Education Rangers in National Parks entitled Developing Terrific Teacher Workshops. Using the Tsongas Center's long experienced with teacher workshops and institutes, the website provided a variety of "nuts and bolts" information, "quick tips," and examples of workshop schedules and flyers related to the design and marketing of park-based workshops for teachers that would be especially helpful to rangers new to teacher workshops. But experienced rangers who reviewed the new website said that they found it to be extremely helpful - particularly in designing a workshop strategy that would lead to the development of partnerships with school systems.  
Under a second contract, Elizabeth Hoermann and Peter O'Connell taught a four-session online course over a six week period with the same name as the website - Developing Terrific Teacher Workshops. Ten rangers from Acadia National Park in Maine to Colonial National Historical Park in Virginia participated in the course, including rangers from Fort Stanwix National Monument, Martin Van Buren NHS, and Saratoga Battlefield NHP in Upstate New York, St. Gaudens National Historical Site in New Hampshire, Boston NHP, Independence NHP in Philadelphia, Fort McHenry National Monument and Historic Site and Hampton NHS in Maryland. Each of the rangers drew on the readings from the website to complete assignments that gradually built a series of workshops for their Park that targeted teachers in specific grades in particular school districts with which the park wished to form educational partnerships. Ellen Anstey and the staff of UMass Lowell's online programs provided excellent administrative support. Participants gave very positive evaluations to both the website and the course.
- Distance Learning Virtual Visits: The Tsongas Industrial History Center launched broadcasts of two-way video-conferencing programs for middle and high school classrooms from the Weave Room at the Boott Cotton Mills Museum in Lowell National Historical Park. Funding for this project was provided by a Federal Parks as Classroom Grant (10 programs conducted over 5 different days serving 312 8<sup>th</sup> grade students and 30 senior adults in 3 different schools from 2 different states. Most recently, four classes in New Mexico participated in a virtual visit. The Center is continuing to work with teachers and other distance learning providers.)
- Enterprise Bank Nonprofit Collaborative (Community involvement): Dr. Beryl Rosenthal, member.
- Citywide Parent Council, Lowell Public Schools (Community involvement): Sheila Kirschbaum, member.

## 12. Proposals Submitted 2007-2008 (selection):

- National Endowment for the Humanities 10/07-9/08.



**\$224,000.** To plan, implement, evaluate 3 national institutes for 135 teachers annually: Inventing America - Lowell and the Industrial Revolution, Summer 2008.

**\$224,000.** To plan, implement, evaluate 3 national institutes for 135 teachers annually: Inventing America - Lowell and the Industrial Revolution Summer 2009 (notification pending).

- Massachusetts Cultural Council 7/1/05-6/30/08.  
**\$18,000.** Operating support (\$6,000 per year) – in final year.  
**\$21,000.** Operating support (\$7,500 per year) for 7/1/08-6/30/11 (notification pending).
- UMASS Lowell Healey Grant proposal with Dr. Michelle Scribner MacLean (Graduate School of Education) for 2009 (Failed).  
**\$4,871.** To engage secondary science and history pre-service teachers in the development of MP4 modules that can be used at the Tsongas Center to enhance high school students' experiences and enable them to learn about STEM connections within the Lowell industrial movement. This project fits into NPS initiatives to improve visitor experience. Currently, we are retooling for other funders/professional presentations.
- UMass Lowell Community Service Initiative proposal.  
**\$4,900.** To support Earth Fest and the Rogers School after school environmental education program.
- COOL (Cultural Organizations of Lowell).  
**\$500.** To support "Making History Come Alive", a public/professional development program including a play on the Irish community living in the Acre, curriculum materials, displays, dinner, etc.  
**\$800** to support the Earth Fest and Rogers after school program.
- Greater Lowell Community Foundation.  
**\$3,800.** To support community environmental activities through the Greater Lowell Environmental Education Alliance.
- Labor union locals affiliated with the AFL-CIO.  
**\$5,000.** To support scholarships for schools otherwise unable to visit the Center.
- Theodore Edson Parker Foundation (notification pending).  
**\$150,000** over two years. To bring National Public Radio's StoryCorps to Lowell; with Dr. Meg Bond (Center for Women and Work), Michelle Haynes (Psychology) David Blackburn (NPS). Leveraging against the "Sites of Conscience" adult programming as a component. Dr. Linda Silka (Center for Family, Work and Community) contracted to conduct the evaluation component.
- Contract work: In cooperation with Elizabeth Hoermann (NPS Program Development and Evaluation, Northeast Region Office of Interpretation and Education) to arrange contracts to franchise the Tsongas Center model:
  - **\$5,000** webtool on planning school visits.
  - **\$5,300** webtool on teacher workshops.



- **\$10,000** project involves writing 5<sup>th</sup> grade curriculum/teaching materials tying Lowell National Historical Park, Hampton National Historical Site and New Bedford National Historical Park together around the subject of slavery and abolitionism.
- **\$5,000** Weir Farm project involves writing environmental curriculum for grades 7-10 with applications for adults.
- **\$5,000** Augustus Saint-Gaudens project involves writing teacher guide and curriculum to accompany the new PBS film.
- **\$17,000** training module in leadership succession in development stage
- **\$5,000** two-day workshop for education site building
  
- Essex National Heritage Commission Partnership Grant. Completed the second year of two-year grant.

**\$1,500.** To enable over 400 Lawrence Public Schools third-grade students to visit the Center. Center staff and Lawrence teachers collaborated to develop materials and methods that help teachers apply field-visit learning to the grade-three history and English Language Arts curriculum.