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ENERGY INNOVATION FORUM

RESEARCH AREA

- Infrastructure Monitoring and Damage Diagnosis
 - Structural Health Monitoring
 - Uncertainty Quantification and Decision-Making
 - Advanced Structural Integrity Testing
- Applications in Energy Infrastructures



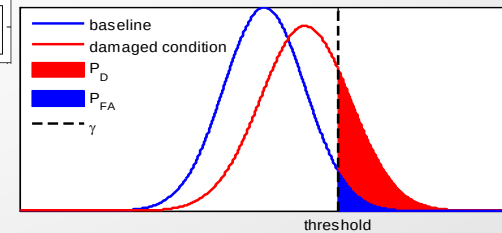
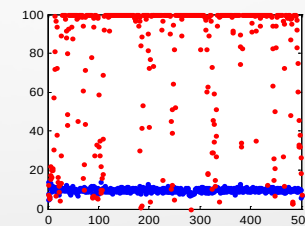
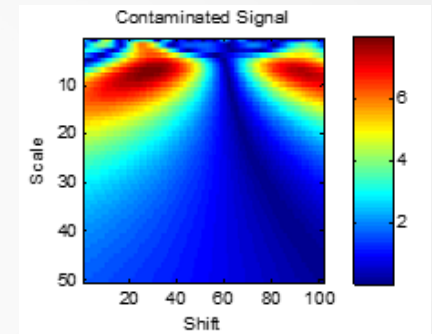
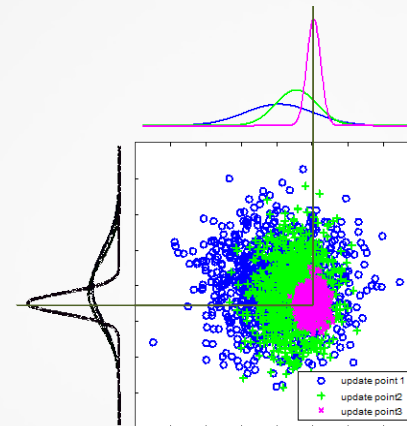
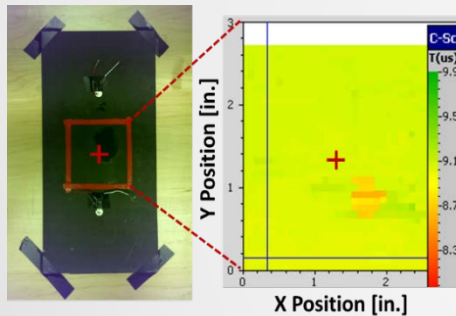
MASSACHUSETTS
CLEAN ENERGY
CENTER



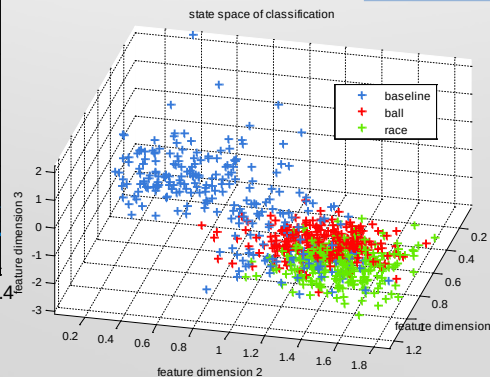
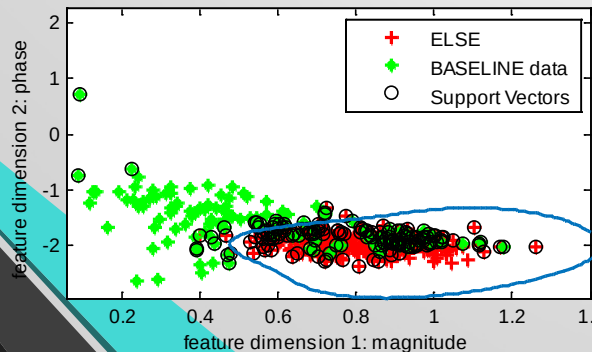
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RESEARCH AREA

Structural Health Monitoring and Uncertainty Quantification



Occurrence ➡ Type/Location
➡ Severity ➡ Remaining Useful Life



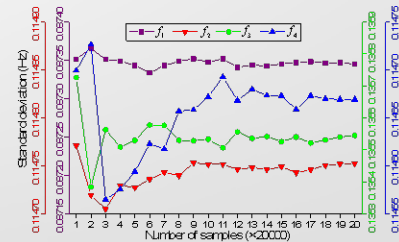
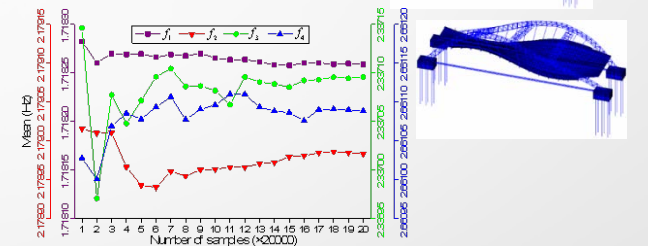
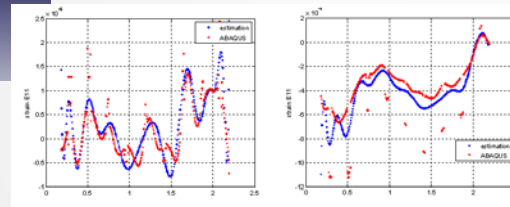
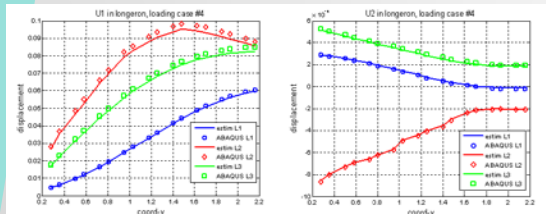
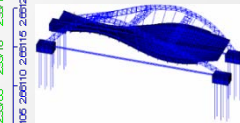
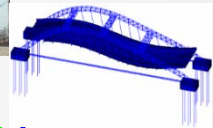
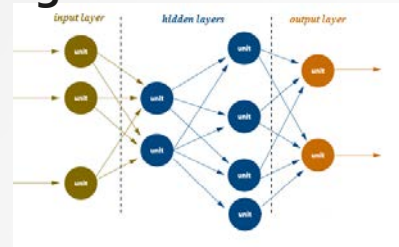
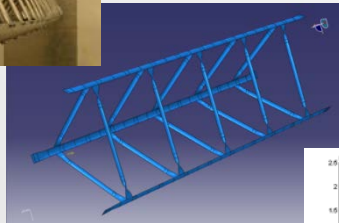
$$p_{|\hat{h}|}(h) = \frac{\gamma}{\pi\alpha} \cdot e^{-\frac{1}{2(1-\rho^2)}\left(\frac{\mu_A^2}{\sigma_A^2} - 2h\frac{\mu_A\mu_C}{\sigma_A\sigma_C} + \frac{\mu_C^2}{\sigma_C^2}\right)} + \frac{\beta}{\sqrt{2\pi}\alpha^{3/2}} \cdot e^{-\frac{(h\mu_A - \mu_C)^2}{2\alpha}} \cdot \text{Erf}\left(\frac{\beta}{\sqrt{2\alpha}\gamma}\right)$$

$$p_{\square\hat{h}}(\theta) = \frac{e^{\frac{\mu_R^2 + \mu_C^2}{2\sigma^2}}}{2\pi} + \frac{\eta \cdot e^{\frac{(\mu_R \sin(\theta) - \mu_C \cos(\theta))^2}{2\sigma^2}}}{2\sqrt{2\pi}\sigma} \left(1 + \text{Erf}\left(\frac{\eta}{\sqrt{2}\sigma}\right)\right)$$

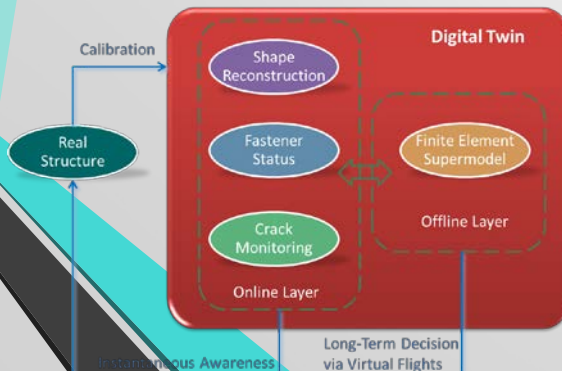
ENERGY INNOVATION FORUM

RESEARCH AREA

Machine Learning



- Artificial Neural Networks for 3D Shape Reconstruction ↑
- Gaussian Process Metamodeling →
- Real-Time Updated Hierarchical Digital Twin ←



Surrogate Modeling
for Complicated
Infrastructures

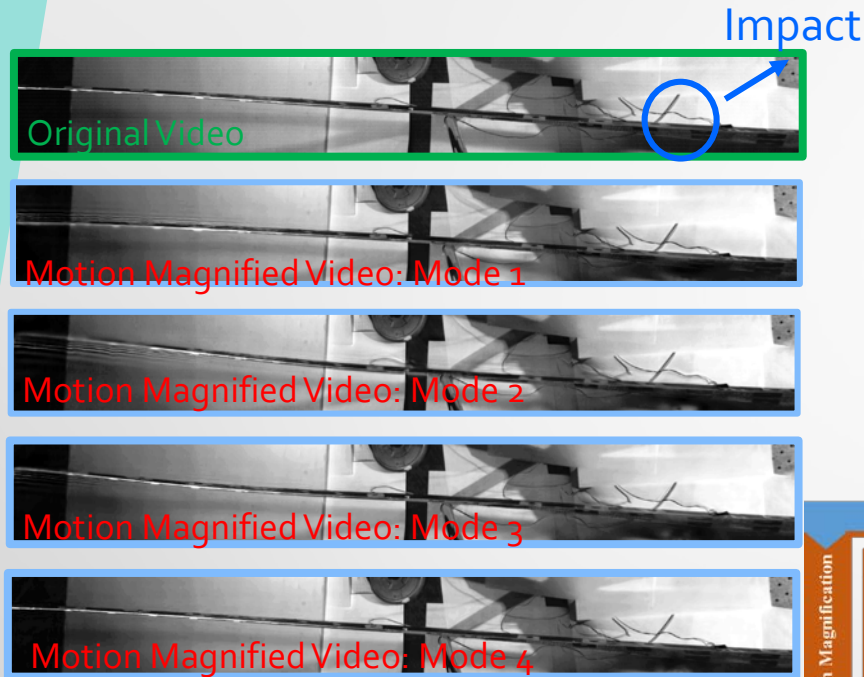


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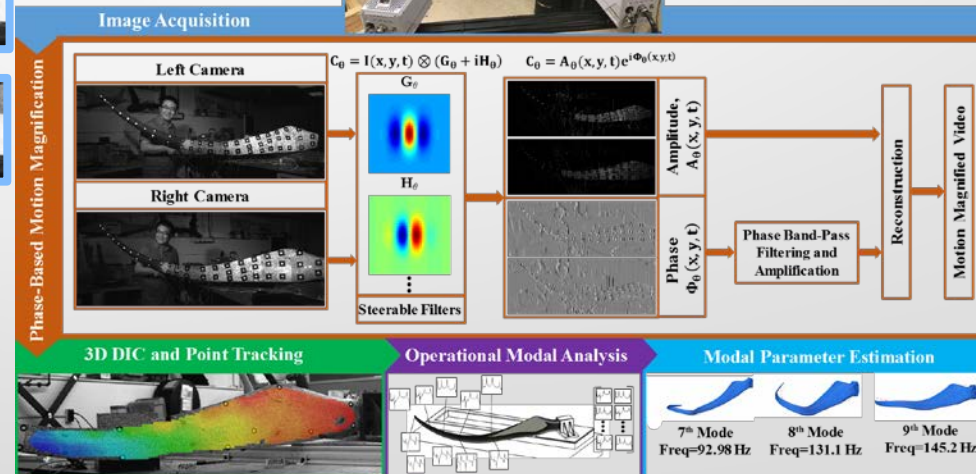
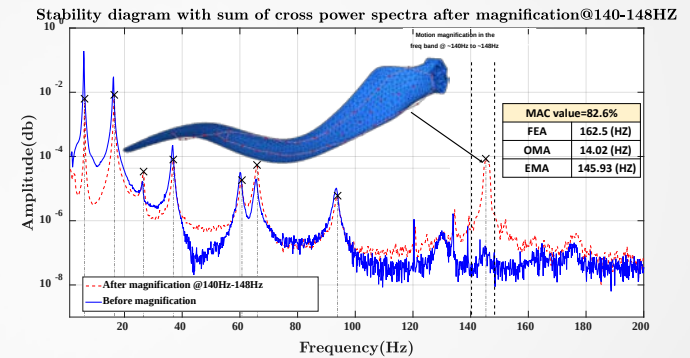


ENERGY INNOVATION FORUM

RESEARCH AREA



Phase-Based Motion Magnification for Wind Energy Structural Testing



ENERGY INNOVATION FORUM

NEXT STEPS AND NEEDS

- Exploring more applications and realistic scale of energy infrastructure systems
- Considering the decision cost from the industry's point of view
- Applying the research findings to interpret big data from realistic operations