Department of Mechanical Engineering Graduate Research Seminar

Friday September 29, 2017

11.00-11.50 AM, Kitson 308

Damage Tolerance Analysis of Full-Scale Components for the Space Launch System Heavy Lift Launch Vehicle

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Design of large curved structures for the Space Launch Systems (SLS) heavy lift launch vehicle must be damage tolerant, in that any undetected and/or unrepaired damage will not jeopardize the success of the mission. Damage can be a result of manufacturing defects and/or impact damage occurring during handling, transportation, assembly and/or integration. A damage tolerance and fracture control plan must be in-place to ensure that the damage is detected and repaired or that the damage will not grow under service loads prior to, during, and after launch of the vehicle. A suitable plan contains design, testing, analysis, inspection, and repair elements. Significant design, analysis, and testing work, part of NASA's damage tolerance plan for the Universal Stage Adapter (USA) and Payload Fairing (PLF) honeycomb sandwich composite SLS structures, has been completed. This work includes investigation into the effect of as-manufactured geometric imperfections on the post-buckling response of large curved panels and a thorough study on the sensitivity to these geometric imperfections. In addition, the influence of facesheet-core interfacial disbonds on the post-buckling response, compressive strength, and propensity for local core crushing of honeycomb sandwich composite panels is studied numerically. The consequence of the presence of a residual facesheet dent, subsequent to a typical "tool-drop" impact, on the post-buckling response and local core stresses has also been studied with computational models. Finally, multiscale modeling, along with characterization and validation testing, is used to reduce the mass of a preliminary design of the Composite-Exploration Upper Stage (CEUS) forward skirt SLS structure by improving the open-hole compression allowable of a carbon fiber reinforced polymer system through the addition of graphene nano-platelets.

Dr. Evan J. Pineda is an Aerospace Research Engineer in the Multiscale and Multiphysics Branch, Materials and Structures Division at the NASA Glenn Research Center. Dr. Pineda's primary research interest is multiscale, progressive damage modeling of composite structures. He is currently one of the lead developers of NASA's ImMAC multiscale software suite as part of NASA's Advanced Composites Project (ACP) and Transformational Tools and Technologies (TTT) programs. Dr. Pineda is also the lead for the damage tolerance lead for the Space Launch Systems (SLS) payload fairing structure. Dr. Pineda's other research interests include nanomaterials, process modeling, lightning strike protection, impact, materials in extreme environments, and integrated computational materials engineering (ICME).