SYMPOSIUM

School of Aeronautics and Astronautics

The 2014 Research Symposium Series

*** Free Pizza ***

Monday, March 3, 2014

4:30 pm in ARMS 1021

Hypersonic Instability Measurements Outside the Boundary Layer

Roger Greenwood

Predicting the onset of boundary layer transition is critical in hypersonic flight. The three to eight-fold increase in heat transfer with its added thermal protection requirements and the significant change in body forces necessitate accurate transition prediction. It is critical to understand the underlying mechanisms that cause transition in order to improve transition prediction methods. Entropy-layer instabilities from outside the boundary layer may enter the boundary layer and have a significant effect on transition. Entropy-layer instabilities are of particular interest in the design of blunt reentry and other supersonic and low-hypersonic vehicles because of possible interaction between the entropy and boundary layers. There is little experimental data of entropy-layer instabilities. Hot-wire measurements have been made above the surface of a cone-ogive-cylinder in the Boeing/AFOSR Mach-6 Quiet Tunnel. These measurements show the location, frequency, and relative magnitude of what are believed to be entropy-layer instabilities. Measurements using interchangeable cone-ogive portions with various tip angles show a smooth change in instability frequency and location due to the change in shock shape for each configuration. Surface pressure sensors at several axial locations were used to show the effect the apparent entropy-layer instabilities have upon the boundary layer.

Enhanced Interlaminar Toughness in Fully Cured Composite Laminates by Through-Thickness Rod Reinforcement

Sergii Kravchenko

An experimental investigation of a newly proposed through-thickness rod reinforcement approach aimed to increase interlaminar toughness of laminated composites is presented. The approach alters conventional methods of creating three-dimensional fiber-reinforced polymer composites in that the reinforcing element is embedded into the host laminate after it has been cured. The resulting composite is shown to possess the benefits of a uniform surface quality and consolidation of the original unreinforced laminate. This technique was found to be highly effective in suppressing the damage propagation in delamination double-cantilever beam (DCB) test samples under mode I loading conditions. Pullout testing of a single reinforcing element was carried out to understand the bridging mechanics responsible for the improved interlaminar strength of reinforced laminate and stabilization and/or arrest of delamination crack propagation. The mode I interlaminar fracture of reinforced DCB samples was modeled using two-dimensional cohesive finite-element (FE) scheme to support interpretation of the experiments. The interfacial shear stress transfer between the parent laminate and reinforcing rod was studied by elastostatic mesomechanical stress analysis based on FE method. The significance of interlaminar rod aspect (length/diameter) ratio for improved performance of reinforced laminates against mode I delamination fracture was discussed and verified experimentally

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