The Department of Mechanical Engineering/College of Engineering and Applied Sciences

Stony Brook University

Mechanical Engineering Seminar

Faculty Candidate

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Universal Technology Corporation, Ohio

Lecture Title: In Plane Response and Mode I Fracture Response of Z-Pin Shaven Composites

Monday, April 29, 2013 at 2PM, Room 173 Light Engineering Building

Abstract

Textile composites are proven to be an attractive choice over traditional pre-preg based composites because of reduced manufacturing costs and improved transverse mechanical properties. However, similar to traditional pre-preg composites, 2D laminates consisting of multiple layers of laminae still suffer from delamination under impact or transverse loads. Z-pin (carbon fiber of small diameter inserted in the thickness direction-z) composites are a means to provide higher through-the-thickness stiffness and strength that 2D woven composites lack. In this thesis, the influences of Z-pin density and Z-pin diameter on the response of Z-pin under in-plane loads (compression) and transverse loads (mode II fracture) are examined. Both experiments and numerical simulations were performed to address the problems. Compression tests were conducted first and failure mechanisms in each loading scenario was identified, through optical and mechanical measurements, during and after the tests. This was followed by the development of different numerical models of varying degree of sophistication, which include in-plane 2D models, (used to study fiber distortion and damage due to Z-pin insertion), multi-layer 2D models, (used to provide an inexpensive multi-layer model to study the effect of phase difference due to stacking consolidation), and multi-layer-multi-cell models (used to provide a full 3D multi-layer and multi-representative unit cell description). The second part of this thesis investigates the mode II fracture response under static and dynamic loading. Discrete Cohesive Zone Model (DCZM) was adopted to obtain the fracture toughness in conjunction with experimental data. In dynamic test, a crack advance gage (CAG) was designed to capture the exact time when the crack begins to propagate. By use of these CAGs, the corresponding crack propagation speed between different CAGs can be computed accordingly. These observations are supplemented through high speed optical images that capture the dynamic event.

Biography

Dr. Huang graduated from University of Michigan in 2008. After graduation, he went to work in industry. He was in charge of sub-system and system level of aircraft analysis as well as bonded joint analysis while working in the structural group at General Atomic Aeronautical Systems Inc. After that, he joined Air Force Research Lab as an on-site contractor where he worked on thermal transport problems, such as heat transfer between aluminum and water, development of multi-scale models for heat transfer of pitch based carbon fibers. He is a member of American society of Mechanical Engineering.

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