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Frontiers in Advanced Computing, Mathematics, and Data

Seminar Series

Modeling the Effects of Cure-induced Chemo-mechanical Processes on the Strength of Fiber-reinforced Composites

Anthony M. Waas

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Professor of Aerostructures
Chair, Department of Aeronautics and Astronautics
University of Washington

Friday, August 26, 2016
10 AM ◆ CSF Darwin Room (1007)

Professor Waas' research interests are related to computational modeling of lightweight aerostructures with a focus on automated manufacturability; structural integrity; and damage tolerance, mechanics of textile composites, and stitched and three-dimensional composites. Recently, his group has been developing computational methods associated with Integrated Computational Materials Engineering (ICME) of fiber-reinforced composites. Prior to joining the University of Washington in January 2015, Professor Waas was the Felix Pawlowski Collegiate Professor of Aerospace Engineering and Director, Composite Structures Laboratory at the University of Michigan (1988-2014). He is the author or co-author of more than 230 refereed journal papers and numerous conference papers and presentations. He also is a recipient of several Best Paper awards; the 2016 AIAA Structures, Structural Dynamics, and Materials award; the AAM Jr. Research Award; AIAA Sustained Service Award; the ASC Outstanding Researcher Award; and several distinguished awards from the University of Michigan, including the Stephen Atwood Award, the highest recognition for a professor in the College of Engineering.

In his talk, Professor Waas will introduce a novel computational model to analyze the effect of the curing process on the in-service performance of fiber-reinforced composite structures. A polymer curing model based on the notion of polymer networks that are continuously formed in a body of changing shape due to changes in temperature, chemistry, and external loads is used in conjunction with multiple fiber representative volume elements (RVE) to assess the strength of the RVE when subjected to mechanical loads after virtual curing. Nonlinear material behavior, including damage and failure, is incorporated through continuum damage mechanics in conjunction with the mesh-objective crack band model. It is shown that significant stresses can develop during cure, and, depending on the cure cycle, the matrix material can be subjected to damage prior to insertion in service. The notions of composite strength are reexamined in light of the results obtained. As part of his talk, Professor Waas will present examples from continuous fiber-reinforced polymer matrix and textile composites.

Host: Xin Sun, ACMD Division Computational Engineering, 509-372-6489

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