Aerospace and Mechanical Engineering Seminar

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Probabilistic Multiscale Fatigue Damage Prognosis of Engineering Materials and Structures

A novel multiscale fatigue damage analysis framework based on a small temporal and spatial scale formulation is presented. The new formulation is different from the classical cycle-based formulation and is directly based on the instantaneous crack growth kinetics within a loading cycle. A multiresolution in situ optical microscopy and scanning electron miscopy fatigue testing is used to verify the model hypotheses. Following this, a coupled hierarchical state-space model is proposed to solve the structural dynamics and material fatigue damage concurrently. This new formulation provides a mathematically rigorous method for coupled multiscale fatigue damage prognosis from nanometer scales to structural systems. Next, a comprehensive uncertainty management methodology is discussed to address the stochastic nature of fatigue. Uncertainty quantification and propagation, model verification and validation, and uncertainty updating are briefly introduced. A generalized maximum-entropy updating framework is discussed in detail for the information fusion in the uncertainty management. Finally, several future research plans are discussed.

Bio

Yongming Liu is an associate professor in the School for Engineering of Matter, Transport & Energy at Arizona State University. He completed his PhD at Vanderbilt University in 2006 and obtained his bachelor's and master's degrees from Tongji University in China in 1999 and 2002, respectively. His research interests include fatigue and fracture analysis of engineering materials and structures, probabilistic methods, diagnostics and prognostics, and risk management. He is the associate editor of ASCE's Journal of Bridge Engineering and serves on the editorial board of the ASCE-ASME Journal of Risk and Uncertainty Analysis.

AME Lecture Hall, Room S212
Thursday, April 13, 2017
4 p.m.
Refreshments and socializing 3:45 p.m. at the east end of the AME Courtyard