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Date: **Monday, June 22, 2015, 1:00 pm - 2:00 pm**

Location: **Latrobe Hall 106**

Speaker: **Dr. Ashley Spear**
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Multi-Scale Modeling of Microstructurally Small Fatigue Cracks in Aluminum Alloy from Synchrotron-Based Measurements

Advancing the state of materials design and high-fidelity structural prognosis will require a synergistic coupling between multi-scale experimental characterization and numerical modeling approaches. This talk describes recent efforts to couple synchrotron-based measurements of microstructurally small fatigue cracks with multi-scale modeling (mesoscale to macroscale) using 3D finite-element simulations. Ex-situ techniques are employed to characterize fatigue-crack propagation within the microstructure of an aluminum alloy. The experimental characterization involves X-ray tomography along with near-field high-energy X-ray diffraction microscopy (HEDM), which provides a 3D map of the grain morphologies and orientations adjacent to fatigue-crack surfaces. The experimental data are then used to digitally reconstruct and model the measured polycrystalline volume and fatigue-crack morphologies as a way to reproduce the observed crack evolution and thereby compute response fields in the neighborhood of observed crack fronts. Cracks are represented explicitly through the underlying geometry of the finite-element mesh. A concurrent multi-scale modeling technique is employed, whereby a model of the measured polycrystalline volume is embedded within a model of the global fatigue specimen. The mesoscale and macroscale regions are modeled using crystal plasticity and von Mises plasticity, respectively. The simulation results will be used to inform quantitative relationships among local, microstructure-sensitive fields and the variability of 3D crack-growth rates.

About the Speaker

Dr. Ashley Spear is an Assistant Professor of Mechanical Engineering at the University of Utah and the Director of the Multi-Scale Mechanics & Materials Laboratory. She specializes in 3D deformation, fatigue, and fracture in polycrystalline aluminum by coupling diffraction-based characterization with crystal-plastic finite-element modeling. She received her Ph.D. in Civil Engineering from Cornell University, where she was a member of the Cornell Fracture Group and an NSF Graduate Research Fellow. She is a recent recipient of the Young Investigator Award from the Air Force Office of Scientific Research.

Faculty Host: Prof. Somnath Ghosh, Latrobe 203, 410-516-7833, sghosh20@jhu.edu

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