

Materials Science & Engineering and Metallurgical Engineering Graduate Seminar

Wednesday, October 31 2018, 4:10-5:00PM, WEB 1230

Dr. Ashley Spear

Assistant Professor, Department of Mechanical Engineering, University of Utah

A multi-scale, multi-physics modeling framework to predict spatial variation of properties in additive-manufactured metals

The microstructure of additively manufactured (AM) metals has been shown to be quite heterogeneous and spatially non-uniform when compared to conventionally manufactured metals. Consequently, the effective mechanical properties of AM-metal parts are expected to vary both within and among builds. This talk will present a framework for simulating process-(micro)structure-property relationships of AM metals produced via direct laser deposition (DLD). The framework predicts grain nucleation and competitive growth as a function of thermal history for a multi-pass, multi-layer DLD process. The resulting three-dimensional microstructure is automatically sub-sampled to perform virtual mechanical testing throughout the build domain using a parallelized elasto-viscoplastic fast Fourier transform code, accounting for grain-boundary strengthening. The effective stress-strain response of each sub-sampled volume is automatically analyzed to extract effective mechanical properties, which are used to generate property maps showing the spatial variability of effective mechanical properties throughout the simulated build volume. As a demonstration, the framework is applied to different DLD stainless steel 316L build volumes having different process-induced microstructures. The multi-physics modeling framework and property maps offer a path toward design and qualification of AM-metal parts for structural applications.

Dr. Ashley Spear directs the Multiscale Mechanics & Materials Laboratory in the Department of Mechanical Engineering at the University of Utah, where her group specializes in 3D deformation, fatigue, and fracture in polycrystalline alloys. Spear received her B.S. in Architectural Engineering from the University of Wyoming and her Ph.D. in Civil Engineering from Cornell University. She has received numerous teaching awards, the Young Investigator Award from the U.S. Air Force Office of Scientific Research, and the Faculty Early Career Award from the National Science Foundation.