DEPARTMENT OF MECHANICAL ENGINEERING
WILLIAM MAXWELL REED SEMINAR SERIES

Multi-physics Modeling of the Selective Laser Melting Process

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Abstract: Selective Laser Melting (SLM) is a manufacturing process which can realize significant benefits over traditional manufacturing processes, including significantly shortened time between design and manufacture of parts, and the ability to create parts with much more geometric complexity than has previously been possible or tenable. However, the extreme sensitivity of the results to input parameters results in a process that is difficult to predict, and thus control. Indeed, it is not uncommon for the resulting parts to vary significantly from their as-designed geometry, due to the influence of extreme and inhomogeneous thermal gradients. The goal of this research is to develop a part-scale model to represent this problem, including both the appropriate physics and numerical methods.

The presentation will discuss the modeling strategies that were developed as part of research efforts at LLNL. The material is considered as a multi-physics continuum, with a coupled thermal-solid material model. The thermal model includes features to represent the phase changes, as well as different constitutive parameters to define the behavior of the different solid states (powder vs. bulk). The coupling happens via both the usual mechanisms, as well as the dependence of the material properties on the phase. Also included are studies of the correlation between the numerical solutions and various experimental results. Several experimental configurations have been considered, in an effort to characterize the effect of the process parameters on the final part, with the larger samples being on the centimeter scale. Finally, thoughts about alternative ways to use the model will be discussed.

Bio: Dr. Neil Hodge earned his B.S. in Mechanical Engineering at the University of Nevada, Las Vegas, and his Ph.D. at the University of California, Berkeley, with a focus on theory and modeling as well as numerical methods and computation. His graduate research focused on the theoretical description of surface growth, and its use in the modeling of crawling cells. Upon finishing his Ph.D., he accepted a staff position at Lawrence Livermore National Laboratory, where he quickly became responsible for research and development activities associated with the modeling of the additive manufacturing process known as selective laser melting. He has been invited to participate in a variety of fora, from technical talks (including one at the National Academy of Sciences) to being an organizer of conference symposia. His current research interests include solid mechanics theory, advanced numerical methods and their use in solving a variety of nonlinear and multi-scale PDE-based problems, with a focus on problems in the fields of additive manufacturing and biology.

Date: Friday, November 4th **Time: 3:00 – 4:00 pm** **Place: CB 106**

Meet the speaker and have refreshments
Attendance open to all interested persons

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