OFFICE OF THE SENIOR VICE PRESIDENT AND PROVOST
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# Modeling and Control of Laser Metal Deposition Processes

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**Felgar Hall #214, Hitachi Conference Room**
**Zoom Meeting**
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Laser Metal Deposition (LMD) is a metal blown powder bed Additive Manufacturing (AM) process capable of fabricating large parts and parts with graded materials, adding engineering features onto parts, and cost-effective part repair. Unfortunately, as compared to the more popular metal powder bed AM processes, it is quite challenging to regulate the morphology of LMD builds. There are a variety of sources that cause variation in the process and can lead to builds of high-value parts failing. Process control is seen as a means to account for variations such that high-value parts can be certified, which is critical for the aerospace, defense, and biomedical industries. A number of research studies have investigated the use of feedback control where a process parameter is automatically adjusted to regulate a measurement signal. While some success has been demonstrated in the laboratory, most additive manufacturing machines have closed control architectures, limiting the usefulness of these approaches. Our research concentrates on layer-to-layer control where measurements gathered during and immediately after the fabrication of a layer are used to automatically adjust the process parameters for the subsequent layer. These algorithms can be easily implemented on industrial machines. In this talk we will describe our work in the two-dimensional (space and layer) modeling of the LMD process. The models characterize the important features of the LMD process needed to understand the part's fabricated morphology and elucidate critical dynamic properties. Layer-to-layer control strategies are constructed for the LMD process to regulate the part morphology. Experiments are conducted to identify critical process model parameters, stability is analyzed, and the control strategies are applied to an LMD process.

Dr. Robert G. Landers (landersr@mst.edu) is the Advanced Manufacturing Collegiate Professor in the Department of Aerospace and Mechanical Engineering at the University of Notre Dame. He was previously a Curators' Distinguished Professor at the Missouri University of Science and Technology and served for three years as a program manager at the National Science Foundation working in the Dynamics, Controls, and System Diagnostics, Foundational Research in Robotics, Cyber Physical Systems, Future Manufacturing, and Leading Engineering for America's Prosperity, Health, and Infrastructure (LEAP HI) programs. He received his Ph.D. degree in Mechanical Engineering from the University of Michigan in 1997. His research interests are in the areas of modeling, analysis, monitoring, and control of manufacturing processes, and in the estimation and control of lithium ion batteries and hydrogen fuel cells. He received the Society of Manufacturing Engineers' Outstanding Young Manufacturing Engineer Award in 2004, the ASME Journal of Manufacturing Science and Engineering's Best Paper Award in 2014, and the ASME Journal of Dynamic Systems, Measurement, and Control Best Paper Award in 2020. He is a Fellow of ASME, and a senior member of IEEE and SME.