DEPARTMENT OF MECHANICAL ENGINEERING COLLOQUIUM

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The Department of
Mechanical Engineering
PRESENTS

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Project Leader of the Accelerated Certification of Additively Manufactured Metals Project at LLNL

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WCH Room 205/206
11:10-12:00PM

Achieving "Just Press Print" for Metal Additive Manufacturing

Abstract:
Part qualification for critical applications can be costly and take a long time—attributes that offset the speed, versatility, and adaptability of additive manufacturing. The challenge is to replace the experience-based approach presently used to produce parts with a science-based approach that can be implemented on the factory floor. Today, we use extensive, iterative experimentation to optimize input parameters for the process. However, because the thermal boundary conditions change as a function of the part geometry, the parameters required to achieve desired part quality will also be a function of geometry. During the build, data is collected from in situ process sensors. In situ sensors and feedback schemes aid with process control. But, feedback works best when the input parameters are close to optimal for the given geometry. Achieving the needed control throughout a part build requires voxel-by-voxel control of the input parameters. The vision of achieving a precise, optimized 3D map of input parameters is referred to as a priori or intelligent feed forward control. In this methodology, the simulation will be used to teach the additive manufacturing machine how to build the part on a voxel-by-voxel basis and at the same time predict the output of the process sensors. Because we cannot expect the simulations to be perfect, feedback control will be used to correct the simulation-based build. After the build is complete, the sensor data will be compared with the simulation's prediction. If the prediction and the experiment agree within some specified uncertainty, we believe that it will be possible to establish confidence that the material is of the required quality to fulfill mission requirements. The intelligent feed-forward approach, when successfully implemented, will ensure "right every time" production or early automated rejection, thus buying down risk.

About the Speaker:
Wayne King currently serves as Project Leader of the Accelerated Certification of Additively Manufactured Metals Project at LLNL (http://acamm.llnl.gov). This project is focused on developing physics-based models relating microstructure, properties, and process to performance of materials and includes predictive models for the laser powder bed fusion process. The project also focuses on using integrated in-process sensing, monitoring, and control technologies to accelerate part qualification. He has 30 years of experience at Lawrence Livermore National Laboratory ranging from fundamental materials research and programmatic science to research management. Dr. King received his B.A. degree from Thiel College in Physics and Mathematics and his Ph.D. from Northwestern University in Materials Science and Engineering. He has worked in the areas of radiation effects, high temperature oxidation, atomic structure of interfaces, grain boundary engineering, and additive manufacturing. He is author or co-author of over 100 peer reviewed publications and is founder of the Frontiers of Electron Microscopy in Material Science series of international conferences.