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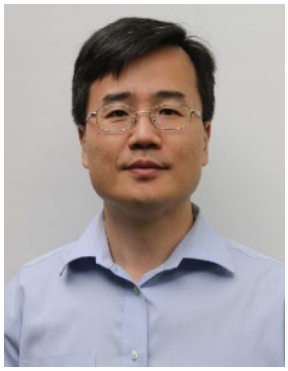

Spring 2024 Seminar Series

Dr. Ho Yeung

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Pointwise Control for Laser Powder Bed Fusion Additive Manufacturing Process

Thursday – April 11, 2024 | 1:30pm | WTHR – Room 104

ABSTRACT

The metal laser powder bed fusion (LPBF) process is a widely used metal additive manufacturing (AM) method, renowned for its ability to create complex features, optimized geometries, lightweight parts, and intricate designs. Despite advancements, LPBF has not fully realized its potential due to quality issues arising from inadequate process control that fails to adjust to the dynamically changing thermal conditions dictated by scan sequences and part geometries. To address this, a novel pointwise control technique employing time-stepped digital commands has been introduced, enabling precise synchronization of laser power and diameter at each point along the interpolated scan path. This technique exceeds the capabilities of conventional line-wise control by allowing continuous variations in laser power, diameter, and speed, which facilitates the implementation of model-based scan strategies and digital twin-based real-time process control. Additionally, pointwise control assures complete synchronization between processing commands and monitoring data. It also offers a platform-independent, unambiguous description of the scan strategy and control, and quality traceability. An open-platform AM control framework based on pointwise control has been developed, resulting in several testbeds, including one with synchrotron X-ray measurement integration. Case studies on various advanced scan strategies and in-situ process monitoring on these platforms are presented. A digital twin framework, built upon pointwise control, has been proposed, comprising digital twins of process design, control, monitoring, and the printed part for LPBF process optimization and quality assessment. These advancements edge us closer to unlocking the full potential of AM, enhancing part quality and process efficiency.

BIO

Ho Yeung is an electronics engineer at the National Institute of Standards and Technology (NIST). He leads the additive manufacturing process control project at NIST and has been a significant contributor to the Department of Commerce's Gold Medal Award-winning Additive Manufacturing Metrology Testbed (AMMT). Ho Yeung began his career as an entrepreneur after obtaining his Bachelor's and Master's degrees in Electrical Engineering from Purdue University. As a co-founder and director of Viekey Company Limited, he helped develop technology for the telecommunication sector. With over a decade of experience working for information technology companies like Hewlett Packard and Sun Microsystems, Ho Yeung honed his skills in the industry before pursuing his PhD in Industrial Engineering at Purdue University, where his research focused on machining processes and large plastic deformation. Utilizing his expertise in electrical engineering, Ho Yeung modified and instrumented conventional machines to enhance machining quality. These insights into machine tool control have enabled him to excel in his current role at NIST, where he leads the development of next-generation additive manufacturing controls. In addition to his work at NIST, Ho Yeung also imparts his knowledge as an instructor in the Mechanical Engineering Department at the University of Maryland, where he teaches manufacturing processes.

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