EPSTEIN INSTITUTE SEMINAR ISE 651

TOWARD MILD ADDITIVE MANUFACTURING FOR EXTREMES

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ABSTRACT

Future deep space exploration will face significantly harsher environments, necessitating the design and manufacturing of human-made space structures and propulsion systems with more complex geometries, compositions, and enhanced performance. While additive manufacturing (AM) opens up new possibilities for innovative structures and materials suitable for such harsh environments, the unique properties (e.g., high chemical stability in ceramics, high reactivity in energetics) of these materials pose challenges for their fabrication using existing AM technologies. Ceramics, for instance, demand substantial thermal input to overcome their extreme chemical stability, and energetics require specialized process control and monitoring to prevent accidental ignition during manufacturing, handling, and storage.

Our research is dedicated to the development of novel AM technologies operating under milder conditions than those currently required for extreme materials. In the first part of the talk, I will introduce our work on a mild AM technology for ceramic materials, inspired by the natural rock formation process occurring under ambient temperature. In the second part, I will present our study on a mild AM technology for energetic materials, including propellants and explosives. This technology allows for the fabrication of energetics with switchable sensitivity, mitigating the risk of unintentional ignition during handling while maintaining precise control over energetic performance as needed.

SPEAKER BIO

Xuan Song is an Associate Professor and James A. Chisman Faculty Fellow in the Department of Industrial and Systems Engineering at the University of Iowa (UIowa). He earned his PhD degree in industrial engineering from the University of Southern California (USC) in 2016 under the supervision of Prof. Yong Chen and a master's degree in computer science also from USC. Dr. Song's research focuses on the development of additive manufacturing (AM) methods for extreme materials. His current research investigates how gentle material forming processes found in nature can be leveraged to enable mild-temperature AM of novel ceramics and composites suitable for high temperature and strain-rate environments. He is a recipient of multiple awards, including the Air Force Office of Scientific Research (AFOSR) Young Investigator Award in 2024, the National Science Foundation CAREER Award in 2023, the Early Career Faculty Excellence Award in the College of Engineering at UIowa in 2023, and the Society of Manufacturing Engineers (SME) Outstanding Young Manufacturing Engineer Award in 2022, among others.

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