

Advancing Intelligent Additive Manufacturing through Machine Learning in Design and Process Monitoring

Additive Manufacturing (AM) has opened new possibilities for producing geometrically complex, highly customized, and functionally integrated components. However, realizing its full potential at scale requires rethinking both how products are designed and how processes are monitored and optimized. Design for Additive Manufacturing (DfAM) has become a critical area for enabling the development of highly customized, multifunctional, and innovative engineering solutions. Yet, to advance further, DfAM urgently requires novel methods that can integrate process characteristics and manufacturability considerations directly into engineering decision-making—particularly in conjunction with data-driven and intelligent approaches.

This seminar introduces a research program that bridges design theory, geometric modeling, and machine learning (ML) to support the development of intelligent, adaptive, and manufacturable AM solutions. The work explores how ML can enhance not only design conceptualization and optimization, but also in-situ process monitoring—providing new capabilities for identifying, predicting, and responding to defects and process variability.

In parallel, the research discusses foundational challenges in applying ML to AM more broadly, including data scarcity and imbalance, domain heterogeneity, and the gap between model development and real-world deployment. These investigations aim to inform a new generation of methods that are not only innovative in algorithmic design, but also robust, interpretable, and transferable across different AM platforms and contexts.

This research seminar aims to explore how the integration of machine learning with engineering design theories and methods as well as in-process monitoring can shape the future of data-driven and ML-augmented additive manufacturing.



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3:00PM - 4:00PM

Speaker

Professor Yaoyao Fiona Zhao

Professor in Department of Mechanical Engineering
Ram Panda Faculty Scholar in Sustainable Engineering
& Design
McGill University, Montreal, QC, Canada

Dr. Yaoyao Fiona Zhao is a Professor in the Department of Mechanical Engineering at McGill University, where she holds the titles of William Dawson Scholar and Ram Panda Faculty Scholar in Sustainable Engineering & Design. She leads the Additive Design and Manufacturing Laboratory (ADML), a leading research group in additive manufacturing and sustainable design and manufacturing.

Her research spans the intersection of design innovation, advanced simulation, and AI-driven manufacturing, with contributions in areas such as design for additive manufacturing (DfAM), multifunctional and bio-inspired design, numerical modeling of AM processes, manufacturing informatics, and the application of machine learning to intelligent, sustainable, and adaptive manufacturing systems.

Dr. Zhao serves as an Associate Editor of the ASME Journal of Computing and Information Science in Engineering (JCISE) and is a member of the editorial board of Virtual and Physical Prototyping. She has received multiple Best Paper and Outstanding Paper Awards from leading journals and international conferences. Her other major honors include the NSERC Discovery Accelerator Supplement Award (2018) and the ASME Journal of Mechanical Design Associate Editor Award in 2019, 2020, and 2024—recognizing her sustained contributions to the field.

