MECHANICAL & MATERIAL COLLOQUIUM

Design for Additive Manufacturing: Integrating Topology Optimization and Process-Aware Design Checks

by Tony Thomas (MME/FIU)

Additive Manufacturing (AM) has redefined the boundaries of product design and fabrication by enabling unprecedented geometric freedom. However, despite rapid advancements in powder bed fusion technologies, the **standardization of design methodologies for AM remains limited** compared to well-established conventional manufacturing practices. This talk explores the evolving landscape of **Design for Additive Manufacturing (DfAM)** with a particular emphasis on **topology optimization** and its integration into the AM workflow. The presentation highlights how **mesh-based topology optimization techniques**, including adaptive mesh refinement and lattice morphing—can be leveraged to achieve optimized lightweight structures while maintaining manufacturability within powder bed constraints. These techniques serve as the foundation for **generative design**, where computational intelligence converges with material and process physics to yield high-performance geometries.

Bridging academic concepts with industrial needs, the talk further introduces **design verification and defect-prevention strategies** that enable engineers to produce printable, distortion-free components **without extensive Finite Element Analysis (FEA) expertise**. Emphasis is placed on practical **design check methodologies**, such as orientation-based support prediction, thermal stress evaluation, and feature accessibility assessment, which ensure robust and repeatable part quality. By combining optimization theory, process-aware design rules, and manufacturability checks, this talk aims to advance the discussion toward a **standardized framework for DfAM**, aligning academic research innovation with the practical realities of industrial additive manufacturing.

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Dr. Tony Thomas is an Assistant Teaching Professor in the Department of Mechanical and Materials Engineering at Florida International University (FIU), where he has been a faculty member since 2020. He teaches a wide range of undergraduate and graduate courses, including Manufacturing Processes, Mechanical Design, Finite Element and Volume Methods, and serves as core faculty for the senior capstone design sequence. In addition to his teaching role, Dr. Thomas holds Graduate Faculty Status, supervises master's theses, serves on multiple PhD committees, and advises the FIU student chapter of the Society of Manufacturing Engineers. He was elected a Senior Member of the National Academy of Inventors (2024) and has received multiple awards for excellence in teaching, including the FIU Faculty Senate Award for Excellence in Teaching (2024).

Dr. Thomas's research expertise lies at the intersection of advanced manufacturing, materials science, and corrosion science. His work spans additive manufacturing, porous ceramic and composite processing, and biomedical scaffolding, with applications in aerospace, energy, and regenerative medicine. He has co-authored more than 25 peer-reviewed journal articles and is the inventor on eight U.S. patents, with two currently under licensing. His contributions to externally funded projects include serving as Co-Principal Investigator on a multi-phase Honeywell Federal Manufacturing & Technologies grant examining the corrosion behavior of additively manufactured stainless steel and titanium alloys, and as Principal Investigator on an NASA-supported senior design initiative.

Prior to his current role, Dr. Thomas was a Postdoctoral Research Associate at FIU's NSF Engineering Research Center for Cellular Metamaterials (Cell-Met), where he advanced 3D printing technologies for cardiovascular applications. He earned his Ph.D. in Mechanical Engineering and MSc in Engineering Design from the University of Bath, United Kingdom, and his MS in Materials Science and Engineering from West Virginia University. His early research on Ti2AlC ceramics and fuel cell materials established a foundation for his continuing interest in developing novel materials and processes for high-performance, sustainable, and biomedical applications.

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2:00-3:00PM

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https://mme.fiu.edu/seminar-schedule

For questions or suggestions, contact Colloquium Organizers Dr. Jiuhua Chen (chenj@fiu.edu) or Dr. Pezhman Mardanpour (pmardanp@fiu.edu)