Machining in Additive Manufacturing: Enhancing Surface Integrity and Performance

Abstract
Additive Manufacturing (AM) of metal alloys provides significant advantages for the production of near-net-shape components with complex geometries, enabling considerable material savings and design flexibility. However, despite these benefits, achieving the desired in-service performance of AM parts often requires post-processing, particularly of functional surfaces. Surface finish and dimensional tolerances directly influence properties such as fatigue resistance, wear behavior, and corrosion performance, critical to a component's operational reliability.

Among the various post-processing options, machining with tools of defined geometry remains a key finishing process for AM metal parts. However, this introduces unique challenges due to the distinct microstructural characteristics of AM-produced alloys, which differ markedly from their wrought counterparts, even when the chemical composition is identical. These AM-induced microstructures, including variations in grain morphology, porosity, residual stress, and anisotropy due to build orientation, can significantly impact material machinability, particularly in terms of tool wear, chip formation, and surface integrity. I will highlight the link between these machining outcomes and the final in-service behavior of the part, demonstrating that surface integrity—affected during machining—can dictate performance under real-world loading, fatigue, or corrosive environments. This underlines the importance of integrating machinability considerations into the AM process chain design, not merely as a finishing step, but as a strategic phase in tailoring the performance of the final component. The goal is to foster a holistic view of AM-based production, where each stage—from printing to finishing—is optimized to ensure that the part reliably meets its functional requirements throughout its service life.

At the beginning of my talk, I will briefly introduce my university,department, and the research focus of my group, which centers on advanced manufacturing technologies.

Speaker Bio
Stefania Bruschi, PhD, is a professor of Manufacturing Technologies at the Department of Industrial Engineering at the University of Padova, Italy, and is a member of the Board of Directors of the University. Her major research areas include sheet and bulk metal forming, additive manufacturing and machining of metal alloys, focusing on material behavior, process, and product performance. The research activities are carried out in the framework of EU and Italian-funded projects and research contracts with Italian and European manufacturing companies. She is a fellow of CIRP (The International Academy for Production Engineering), and elected Chair of the CIRP Scientific Technical Committee "Forming". She is a member of the Board of Directors of the North American Manufacturing Research Institution, where she now serves as Chair-elect of the Scientific Committee. She is a co-author of more than 300 Scopus-indexed publications.

Stefania Bruschi
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Monday, June 9
11:30 a.m.- 12:30 p.m.

(1 - hour seminar with lunch and discussion).

In-Person Only:
Location: GGB 2540 - Grand Conference Room

G.G. Brown Building
2350 Hayward St, Ann Arbor

Hosts and Organizer
Miki Banu
Professor,
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Jing Tang
Assistant Professor,
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