ME - Postdoc Work Presentations

Particle-laden flows in metal additive manufacturing and freeform finishing processes

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Meeting link: Click here to join meeting **(Microsoft Teams)**

ABSTRACT

Particle-laden fluid flows arise in several domains of manufacturing research. In this work, we focus on two such occurrences – powder flows in metal additive manufacturing and abrasive-laden fluid flows in polishing processes. In the first part of this presentation, we will present investigations of the gas-driven powder delivery system for an in-house laser-based metal 3D printer developed in our lab. Metal additive manufacturing, or 3D printing, allows us to build non-trivial complex geometries, varied material compositions and even intricate internal structures. We explore the effects of using non-spherical powders in this setup, inspired by the urgent commercial need for employing lower-grade powders and potential material recycling. Powder deposition quality is affected by the particle morphology, delivery system geometry, nozzle tilt angle, and interaction of powder particles with carrier and shield gas. To quantify these effects numerically, a viscous, compressible, turbulent solver with a two-way coupled discrete phase model is employed. The numerical results are compared with experimental measurements to determine stand-off distance, powder velocities and spatial distribution on the focal plane for both spherical and non-spherical particles. The non-spherical particles exhibit higher velocities, and greater deposition track width, compared to spherical particles.

In the second part of this talk, we will focus on surface finishing of constrained geometries with abrasive-laden fluids. The volume fraction of these abrasives inside fluid decides whether the flow is granular or dilute, with significant implications for the flow physics. Preliminary experiments are performed for both of these regimes. A customized test-bed with a camera-integrated workpiece is being designed for in situ abrasive flow visualization, for guided and unguided mass finishing. This configuration is of industrial relevance for optimizing slurry-based polishing of internal surfaces, and surface finishing of optics.

ABOUT THE SPEAKER

Richie Garg is a post-doctoral researcher working at the Laboratory for Advanced Manufacturing and Finishing Processes (LAMFiP). As a doctoral student, she worked with Prof. Amit Agrawal, Microfluidics lab, Indian Institute of Technology Bombay. Her thesis is focused on subsonic choking, surface texturing, and chemical roughening influence of gas flows on microchannels. She has experience in microfabrication, surface characterization, temperature, pressure measurements, and simulations on gaseous slip flows. Her current interests are in gas-driven powder flows for additive manufacturing, and abrasive-laden fluid flows for surface finishing.