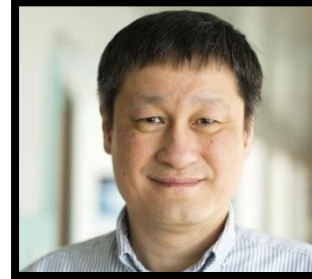


# EPSTEIN INSTITUTE SEMINAR ▪ ISE 651

## Direct Ink Writing Additive Manufacturing of Polydimethylsiloxane (PDMS): Model-based Toolpath Control and Applications in Soft Sensors and Actuators

**ABSTRACT** - The research of direct ink writing (DIW), one of the material extrusion additive manufacturing processes, of the one-part and two-part Polydimethylsiloxane (PDMS) is presented. The DIW of one-part moisture cure PDMS of thin-wall structure with overhang for soft pneumatic actuators is first presented. The extrusion conditions to achieve low extrusion force to build tall thin-wall structures are then investigated. The research is continued to two-part hydrosilylation (catalyst) cured PDMS based on the dual cavity progressive cavity pump and static mixer for energy-efficient mixing and accurate control of flow. The viscous non-Newtonian transient fluid flow in DIW is characterized using the continuity and momentum equations, which are numerically solved using the characteristic method (CM) and boundary conditions to accurately predict the transient volumetric flow rate for the DIW system. The flow for DIW is controlled using the feedforward error correction control (FECC), which combines the trapezoidal motion planning, CM-based transient fluid flow model, machine learning, and iterative quadratic linear regulator (iLQR) controller. The FECC is applied to optimize the quality at corners with 90-degree turns and U-turns and has been demonstrated to reduce the bulging at the corners, material build-up at the edges of infill, and gaps in the infill for enhanced quality of DIW parts.



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**SPEAKER BIO** – Albert Shih is a Professor in Mechanical Engineering, Biomedical Engineering, and the Institute of Gerontology at the University of Michigan. He received PhD from Purdue University in 1991 and was a manufacturing engineer at Cummins and an Associate Professor at NC State University before joining the University of Michigan in 2003. He served in the Advanced Manufacturing National Program Office in 2017 and was the President of NAMRI SME in 2019-2020. Dr. Shih is a pioneer in biomedical manufacturing. He is the recipient of the Fulbright Scholar, SAE Teetor Educational Award, SME Taylor Research Medal and Education Award, and ASME Shaw Manufacturing Research, Blackall Machine Tool & Gage Award, and Ennor Manufacturing Technology Award. Professor Shih is the Fellow of ASME, SME, and CIRP.

**USC Viterbi**

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**TUESDAY, MARCH 1, 2022**

**3:30 PM – 4:50 PM**

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