Department of Biomedical Engineering
UNIVERSITY OF WISCONSIN–MADISON
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Spring 2025 Seminar Series

Vascular Dysfunction in Disease: Engineering Mechanobiology Holds the Solution

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Abnormalities in blood vessel and blood flow properties are key drivers of severe cardiovascular and cerebrovascular pathologies. The remarkable ability of the vasculature to sense and respond to mechanical and biochemical signals across multiple scales presents both a challenge for understanding disease progression and an opportunity for therapeutic intervention. In this talk, I will first present our recent findings on uncovering novel mechano-biochemical feedback loops that drive endothelial dysfunction in atherosclerosis. I will highlight how blood flow profiles trigger transcriptional control of force-sensitive proteins, which mediate cytoskeletal crosstalk and cellular adaptation during endothelial dysfunction. Second, building on these mechanistic insights into molecular feedback and cellular structural rearrangements, I will describe our development of one of the first 'biologically-informed' ML models for predicting tissue-scale function in health and disease. This work opens new avenues for decoding mechano-biochemical feedback across scales in cardio- and cerebrovascular diseases. Finally, I will outline how this integrated approach enables engineering of physiological vascular tissue function and AI-mediated discovery of disease drivers, with the ultimate goal of targeting vascular functions to reverse disease progression.

ABOUT the SPEAKER

Shailaja Seetharaman is a postdoctoral researcher in the James Franck Institute and Department of Physics at the University of Chicago. She received her PhD in Cell and Developmental Biology from Institut Pasteur and Université de Paris, France. Prior to this, she completed her Master's in Biomedical Sciences from King's College London. Her research focuses on unraveling the key drivers of vascular disease progression by building and employing approaches from cellular biophysics, bioengineering, and computational biology. She is a recipient of the Eric and Wendy Schmidt AI in Science Postdoctoral Fellowship, the American Heart Association Postdoctoral Fellowship, UChicago Yen Postdoctoral Fellowship, Marie Curie PhD Fellowship, and the French Medical Research Foundation (FRM) PhD Fellowship. She was also featured in the Future Leaders in Mechanobiology by the NSF Center for Engineering MechanoBiology.

Thursday, February 13 at Noon
3210 Mechanical Engineering