

Johns Hopkins University

Center for Environmental & Applied Fluid Mechanics

3:00 PM, Friday, April 10, 2026

Gilman Hall 50

Zoom: <https://wse.zoom.us/j/93762992307>

[Link for Spring 2026 recordings](#)



Prof. Vijay Vedula

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“Multifidelity Models of Blood Flow: From Lab to Clinic”

Abstract: Computational models of blood flow have been developed to leverage their predictive capabilities and have been instrumental in elucidating mechanisms underlying flow-mediated disease progression, evaluating alternative surgical designs, and guiding treatment planning. However, limited success was achieved in translating these advances into clinical workflow. This is likely due to (i) data scarcity, which often leads to model generalization and reduces its patient-specificity, (ii) not accounting for the uncertainty in the model input, especially when the stakes are high, or (iii) the inadequacy of the methods in capturing the multifactorial nature of the disease or the therapy, including disease complexity, multiphysics interactions, and regulation and remodeling. In this talk, I will describe three applications of predictive blood flow models of varying fidelity, depending on the criticality, to guide clinical management and plan treatment. First, we will show how simple reduced-order models of whole-body circulation can be leveraged to enable pediatric heart surgeons to make informed, confident decisions in neonates born with undersized hearts. Second, we will employ high-fidelity Navier-Stokes-based

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blood flow models over moving domains to investigate the role of heart muscle motion in coronary blood flow in health and disease, with implications for the clinical management of coronary artery disease, which accounts for about 10% of all heart disease-related deaths. Lastly, we will use complex fluid-structure interaction models to analyze blood flow through the repaired aorta in patients with aneurysms, with the ultimate goal of planning the surgery to restore a normal ascending aortic shape and hemodynamic function, while mitigating the risk of disease recurrence.

For more details, visit: <https://www.me.columbia.edu/faculty/vijay-vedula>

Hosted by: Prof. Rajat Mittal (MechE)