Department of Mathematics

University of Houston

Scientific Computing Seminar

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Discrete particle based computational techniques for investigating the role of hemodynamics in stroke and thrombosis

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1:30 PM- 2:30 PM
Room 646 PGH

Abstract: Stroke and thrombosis comprise the majority of all cardiovascular diseases, amounting to significant morbidity, mortality, and economic impacts. In addition to disease scenarios, stroke during surgical treatment and medical device induced thrombosis comprise major concerns for patient health and recovery. The underlying mechanics for these disease scenarios are considerably complex, where blood flow and hemodynamic forces play a critical role. However, predictive understanding of the interaction of a realistic thrombus or embolus of arbitrary shape and microstructure with complex hemodynamics in real human anatomy poses several challenges. Computational techniques have rapidly emerged as a valuable non-invasive modality for studying such physiological events. In this talk, I will discuss some of my recent work on computational approaches to elucidate key features of the role of hemodynamics in stroke and thrombosis. The talk will comprise two core components. First, I will discuss a computational framework that I developed for modeling embolus transport in patient-specific arterial network. I will present some key findings pertaining to characterizing embolic stroke risks, and understanding the chaotic advection of emboli through unsteady hemodynamics in human vasculature that complicates diagnosis of stroke in a number of cases. Implications for peripheral artery disease due to embolisms will also be discussed. Second, I will present a hybrid particle-continuum approach that I devised for modeling hemodynamics, and flowmediated transport phenomena, in a thrombus neighborhood. Using this approach, I will illustrate how flow organizes transport phenomena in the vicinity of large arterial clots. Finally, the resolution of flow-induced loading on realistic thrombi and subsequent thrombus mechanical response will be briefly illustrated.