CRUNCH Seminars at Brown, Division of Applied Mathematics

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Data-Driven Multiscale Modeling in Physical and Biological Systems

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Inspired by the recent developments in physics-informed deep learning framework, I will introduce a novel Navier-Stokes informed neural networks that encodes the governing equations of fluid motions i.e., mass, momentum, and transport equations and infer hidden quantities of interest such as velocity and pressure fields merely from spatiotemporal visualizations of a passive scaler (e.g., dye or smoke) transported in arbitrarily complex domains. Our approach towards solving the aforementioned data assimilation problem is unique as we design an algorithm that is agnostic to the geometry or the initial and boundary conditions. Furthermore, I will discuss the recent developments in the study of complex biological systems at both micro- and macroscopic scales and present our modeling strategies to address thrombus formation in aortic dissections — a life-threatening event that is initiated by the damage in arterial wall propagating within the media layer and connecting with the true lumen to form a so-called false lumen within the aortic wall — by using in-vivo and in-vitro data collected for murine dissections. I will present a data-driven multiscale framework to elucidate hemodynamic and biochemical conditions under which a thrombus forms.