UCI Samueli School of Engineering | Department of Biomedical Engineering

2022-2023 Seminar Series

"Computational Cardiac Fluid Dynamics In Vitro and In Vivo"

Friday, May 19th, 2023
12:00 – 1:00 p.m.

McDonnell Douglas Engineering Auditorium (MDEA)

Boyce Griffith, Ph.D.

University of North Carolina at Chapel Hill

Abstract: Cardiac fluid dynamics fundamentally involves interactions between complex blood flows and the structural deformations of the muscular heart walls and the thin, flexible valve leaflets. This talk will provide an overview of modern numerical methods for treating such fluid-structure interactions and detail some of their applications to cardiac fluid dynamics. I will initially focus on models of an in vitro pulse-duplicator system that is commonly used in the development and regulation of prosthetic heart valves. These models enable detailed comparisons between experimental data and computational model predictions but use highly simplified descriptions of cardiac anatomy and physiology. I will describe experimental and computational investigations on determinants of prosthetic heart valve dynamics using this platform. I will also present recent in vitro models, including a patient-specific model of transcatheter aortic valve replacement and a new comprehensive model of the human heart. This heart model includes fully three-dimensional descriptions of all major cardiac structures along with biomechanics models that are parameterized using experimental tensile test data obtained exclusively from human tissue specimens. Simulation results demonstrate that the model generates physiological stroke volumes, pressure-volume loops, and valvular pressure-flow relationships, thereby illustrating is its potential for predicting cardiac function in both health and disease.

Biography: Boyce Griffith is a Professor of Mathematics at the University of North Carolina at Chapel Hill (UNC-Chapel Hill) with a joint appointment in the Joint Department of Biomedical Engineering at UNC-Chapel Hill and North Carolina State University. Prior to joining the UNC-Chapel Hill faculty in 2014, he was an Assistant Professor of Medicine and Mathematics at New York University (NYU). He received his PhD in Mathematics from NYU's Courant Institute of Mathematical Sciences in 2005. His interests include modeling cardiac mechanics, fluid dynamics, and electrophysiology, with a focus on the fluid dynamics of native and prosthetic heart valves.

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