FEATURED SPEAKER

VITALIY RAYZ, PHD

Associate Professor and Associate Head of Academic Programs, Weldon School of Biomedical Engineering; Associate Professor, Mechanical Engineering, Purdue University

Dr. Rayz specializes in image-based flow modeling to advance the diagnostics and treatment of neurovascular disease. He earned his PhD in Mechanical Engineering from the University of California, Berkeley in 2005. Dr. Rayz started his career as a Research Scientist in the Radiology Department at UC San Francisco before accepting a joint faculty position in Neurosurgery at the Medical College of Wisconsin and Engineering at UW – Milwaukee. In 2017, Dr. Rayz joined the Weldon School of Biomedical Engineering at Purdue, with a courtesy appointment in Mechanical Engineering. Dr. Rayz laboratory works on interdisciplinary projects with several medical centers. His research has enjoyed uninterrupted support from the National Institutes of Health for over 15 years. Currently, Dr. Rayz is the lead PI on the multi-institutional project aiming to utilize MRI flow measurements to improve risk stratification of cerebral aneurysms. He has also expanded his research to the analysis of CSF flow and cerebral biomechanics. Dr. Rayz's research has resulted in 48 journal publications as well as presentations at numerous conferences. Additionally, Dr. Rayz serves as the Weldon School Associate Head of Academic Programs and leads the effort on BME curriculum redesign and integration with the BME program in Indianapolis.

SPRING 2024

SEMINAR FOR NEUROTRAUMA AND DISEASES

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PRESENTS

IMAGE-BASED MODELS OF CEREBRAL FLOW DYNAMICS AND BIOMECHANICS

Date: April 3, 2024 **Time:** 4:00 p.m. - 5:00 p.m. EST

Location: DLR 131 **Zoom Link**: http://bit.ly/42hhhJG

Meeting ID: 923 5486 2062 **Passcode:** CPR

ABSTRACT

The flow dynamics of neurofluids – blood and cerebrospinal fluid (CSF) – plays an important role in brain health and function. Abnormal blood flow is a hallmark of cerebrovascular diseases such as intracranial atherosclerotic disease or aneurysms. Impaired CSF flow and transport are implicated in neurodegenerative and neurodevelopmental diseases and disorders. Reliable quantification of relevant flow metrics can provide valuable data for predicting neurovascular or neurodegenerative disease progression or for treatment planning. Computational fluid dynamics (CFD) models are traditionally used to simulate subject-specific flow fields. However, their reliability depends on modeling assumptions and the uncertainty of the geometries and boundary conditions obtained from medical imaging data. Alternatively, flow velocities can be measured in vivo with three-directional phase-contrast MRI velocimetry (4D Flow MRI), but its limited spatiotemporal resolution and measurement noise may affect the accuracy of the resulting flow metrics. In this talk we will discuss the limitations of the current imaging and modeling approaches for subject-specific analysis of cerebral flow dynamics and present a framework for error analysis of 4D flow MRI measurements based on principles of flow physics and medical imaging. We will also consider a 4D flow augmentation approach that utilizes deep learning networks constrained with flow physics equations. Finally, we will discuss quantification of biomechanical stress in brain parenchyma resulting from cardiovascular pulsatility or traumatic brain injury.

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