LANNM section of IEEE Advancing Technology for Humanity

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have an honor to invite you to a Dinner Talk

Computational Hemodynamics in Patient-specific Aortic Arteries

by Dr. Huidan (Whitney) Yu

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Abstract

Cardiovascular diseases such as heart attack and stroke is the leading cause of death or serious long-term disability with substantial neurologic as well as medical and psychological complications thus results in billions of dollars in the US each year for healthcare, medication, lost productivity, and rehabilitation. Although the major cause of a cardiovascular disease is a blockage in artery, it remains unknown about whether, when, and how a plaque will develop, progress and eventually rupture, leading to a heart attack or stroke. Due to the advances in computer hardware and numerical algorithm, patient-specific computational hemodynamics has emerged as a promising tool to reveal the hemodynamic mechanism of plaque disruption or embolization. However due to its complexity, patient-specific computational hemodynamics heavily relies on the utilization of commercial software packages with inherent limitations in physical modeling and computational performance. We innovatively develop a unified computing platform to simulate patient-specific hemodynamics and flow-vessel interaction using lattice Boltzmann method (LBM), which integrates anatomical-structure extraction from imaging data and numerical simulation in one computation mesh structure, where the LBM solves level set equation for image segmentation and Navier-Stokes equation for fluid dynamics respectively. The patient-specific vessel geometry, volumetric ratio of solid versus fluid, and the orientation of the boundary obtained with high accuracy seamlessly feed to the numerical simulation needs. In order to better treat the complex geometry, we specifically develop volumetric lattice Boltzmann scheme which strictly satisfies mass conservation when boundary moves. Validation study is on hemodynamics and flow-vessel interaction in healthy and diseased aortas. Flow rate and

structure, pressure and vorticity distribution, as well as wall normal and shear stresses, are revealed in both cases. This computation system is suitable to be paralleled on GPU platform aiming to perform real-time simulation and visualization of blood flow in a human body.

Bio sketch of the presenter

Dr. Huidan (Whitney) Yu is currently an Assistant Professor in Mechanical Engineering Department of IUPUI. Prior to this position, she successively completed two PhD programs in Physics at Peking University, China, in 2001 and in Aerospace Engineering at Texas A&M University, USA, in 2004, followed by two postdoctoral research positions at Los Alamos National laboratory and Johns Hopkins University. Dr. Yu's undergraduate major was in Physics, and she had been a faculty member in a university of China for over 10 years, culminating in a promotion to full professor and group leader of General Physics Teaching immediately before she moved into the US in 2000. Dr. Yu's research field is in computational fluid dynamics in general with expertise on kinetic theory based lattice Boltzmann method to model and simulate complex flows involving turbulence. Dr. Yu has extensive research experience in dealing with a variety of fluid and thermal problems applications in energy, biomechanics, atmosphere, etc. She has published more than 50 articles in peer-reviewed journals. Her current research focus is to synergistically combine the novel mesoscale computational paradigm with the emerging Graphic Processing Unit (GPU) technology to develop efficient and unique approaches for computing multi-scale multi-physics flow-structure interaction problems with and without turbulence such as patient-specific hemodynamics with non-Newtonian effects and pulsatility, turbulence control through parity time-reversal symmetry, and bubble dynamics in reactive micro-flow.

When? December 7, 2013, 6:00 (dinner beginning), 6:30 (talk beginning)

Where? In historic Fuller Lodge (pictures) at 2132 Central Av., Los Alamos, Pajarito Room,

(see map at https://maps.google.com/maps?hl=en&tab=wl)

There is no admission fee, but we kindly ask you to register at

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where all necessary information about the meeting is displayed. For registration scroll down to "Click Here to Register" and then click on it and fill out the appropriate form.

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