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Volumetric lattice Boltzmann simulation for blood flow in aorta arteries DEBANJAN DEEP, HUIDAN (WHITNEY) YU, Mechanical Engineering Department, Indiana University-Purdue University Indianapolis (IUPUI), SHAWN TEAGUE, Department of Radiology and Imaging Sciences, School of Medicine, Indiana University — Complicated moving boundaries pose a major challenge in computational fluid dynamics for complex flows, especially in the biomechanics of both blood flow in the cardiovascular system and air flow in the respiratory system where the compliant nature of the vessels can have significant effects on the flow rate and wall shear stress. We develop a computation approach to treat arbitrarily moving boundaries using a volumetric representation of lattice Boltzmann method, which distributes fluid particles inside lattice cells. A volumetric bounce-back procedure is applied in the streaming step while momentum exchange between the fluid and moving solid boundary are accounted for in the collision sub-step. Additional boundary-induced migration is introduced to conserve fluid mass as the boundary moves across fluid cells. The volumetric LBM (VLBM) is used to simulate blood flow in both normal and dilated aorta arteries. We first compare flow structure and pressure distribution in steady state with results from Navier-Stokes based solver and good agreements are achieved. Then we focus on wall stress within the aorta for different heart pumping condition and present quantitative measurement of wall shear and normal stress.

Huidan (Whitney) Yu
Indiana University-Purdue University Indianapolis (IUPUI)

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