Abstract Submitted
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Simulations of cardiovascular blood flow accounting for time dependent deformational forces[1] AMANDA PETERS RANDLES, Harvard University, SIMONE MELCHIONNA, JONAS LATT, SAURO SUCCI, Consiglio Nazionale delle Ricerche, EFTHIMIOS KAXIRAS, Harvard University — Cardiovascular disease is currently the leading cause of death in the United States, and early detection is critical. Despite advances in imaging technology, 50% of these deaths occur suddenly and with no prior symptoms. The development and progression of coronary diseases such as atherosclerosis has been linked to prolonged areas of low endothelial shear stress (ESS); however, there is currently no way to measure ESS in vivo. We will present a patient specific fluid simulation that applies the Lattice Boltzmann equation to model the blood flow in the coronary arteries whose geometries are derived from computed tomography angiography data. Using large-scale supercomputers up to 294,912 processors, we can model a full heartbeat at the resolution of the red blood cells. We are investigating the time dependent deformational forces exerted on the arterial flows from the movement of the heart. The change in arterial curvature that occurs over a heartbeat has been shown to have significant impact on flow velocity and macroscopic quantities like shear stress. We will discuss a method for accounting for these resulting forces by casting them into a kinetic formalism via a Gauss-Hermite projection and their impact on ESS while maintaining the static geomtry obtained from CTA data.

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