Abstract Submitted
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Multi-Fidelity Uncertainty Propagation for Cardiovascular Modeling[1] CASEY FLEETER, Stanford University, GIANLUCA GERACI, Sandia National Labs, DANIELE SCHIAVAZZI, University of Notre Dame, ANDREW KAHN, UCSD, ALISON MARSDEN, Stanford University — Hemodynamic models are successfully employed in the diagnosis and treatment of cardiovascular disease with increasing frequency. However, their widespread adoption is hindered by our inability to account for uncertainty stemming from multiple sources, including boundary conditions, vessel material properties, and model geometry. In this study, we propose a stochastic framework which leverages three cardiovascular model fidelities: 3D, 1D and 0D models. 3D models are generated from patient-specific medical imaging (CT and MRI) of aortic and coronary anatomies using the SimVascular open-source platform, with fluid structure interaction simulations and Windkessel boundary conditions. 1D models consist of a simplified geometry automatically extracted from the 3D model, while 0D models are obtained from equivalent circuit representations of blood flow in deformable vessels. Multi-level and multi-fidelity estimators from Sandia's open-source DAKOTA toolkit are leveraged to reduce the variance in our estimated output quantities of interest while maintaining a reasonable computational cost. The performance of these estimators in terms of computational cost reductions is investigated for a variety of output quantities of interest, including global and local hemodynamic indicators.

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