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Performance of uncertainty quantification methodologies and linear solvers in cardiovascular simulations[1] JONGMIN SEO, Stanford University, DANIELE SCHIAVAZZI, University of Notre Dame, ALISON MARSDEN, Stanford University — Cardiovascular simulations are increasingly used in clinical decision making, surgical planning, and disease diagnostics. Patient-specific modeling and simulation typically proceeds through a pipeline from anatomic model construction using medical image data to blood flow simulation and analysis. To provide confidence intervals on simulation predictions, we use an uncertainty quantification (UQ) framework to analyze the effects of numerous uncertainties that stem from clinical data acquisition, modeling, material properties, and boundary condition selection. However, UQ poses a computational challenge requiring multiple evaluations of the Navier-Stokes equations in complex 3-D models. To achieve efficiency in UQ problems with many function evaluations, we implement and compare a range of iterative linear solver and preconditioning techniques in our flow solver. We then discuss applications to patient-specific cardiovascular simulation and how the problem/boundary condition formulation in the solver affects the selection of the most efficient linear solver. Finally, we discuss performance improvements in the context of uncertainty propagation.

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