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Data Assimilation and Propagation of Uncertainty in Multiscale Cardiovascular Simulation DANIELE SCHIAVAZZI, ALISON MARSDEN, Stanford University — Cardiovascular modeling is the application of computational tools to predict hemodynamics. State-of-the-art techniques couple a 3D incompressible Navier-Stokes solver with a boundary circulation model and can predict local and peripheral hemodynamics, analyze the post-operative performance of surgical designs and complement clinical data collection minimizing invasive and risky measurement practices. The ability of these tools to make useful predictions is directly related to their accuracy in representing measured physiologies. Tuning of model parameters is therefore a topic of paramount importance and should include clinical data uncertainty, revealing how this uncertainty will affect the predictions. We propose a fully Bayesian, multi-level approach to data assimilation of uncertain clinical data in multiscale circulation models. To reduce the computational cost, we use a stable, condensed approximation of the 3D model build by linear sparse regression of the pressure/flow rate relationship at the outlets. Finally, we consider the problem of non-invasively propagating the uncertainty in model parameters to the resulting hemodynamics and compare Monte Carlo simulation with Stochastic Collocation approaches based on Polynomial or Multi-resolution Chaos expansions.

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