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A Multi-fidelity Ensemble Kalman Method for Inverse Problems in Cardiovascular Flows HAN GAO, JIAN-XUN WANG, University of Notre Dame — In cardiovascular modeling, parameters associated with boundary conditions and mechanical properties are often unknown or uncertain, which can be calibrated using indirect and/or sparse clinical measurements based on data assimilation (DA) techniques. The ensemble Kalman filter (EnKF), as a derivative-free DA approach, has started to gain popularity for solving inverse problems in physiological modeling. However, the computational cost of the EnKF could be considerably high due to a large ensemble of costly forward simulations, in particular when the iterative Kalman updates are needed for nonlinear inversion (i.e., iterative ensemble Kalman method). In this work, we propose an efficient multi-fidelity ensemble Kalman inversion approach, where both the low- and high-fidelity forward models are utilized to accelerate the statistical convergence. Moreover, to improve the identifiability of the parameters to be inferred, additional physical/physiological constraints will be imposed by re-weighting the ensemble members in a Bayesian manner. Numerical examples of vascular flows in patient-specific geometries are presented to demonstrate the effectiveness and merit of the proposed framework.

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