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Uncertainty Quantification in Multi-scale Simulations of Coronary Artery Bypass Grafts JUSTIN TRAN, Stanford Univ, DANIELE SCHIAVAZZI, University of Notre Dame, ABHAY RAMACHANDRA, Yale University, ANDREW KAHN, University of California, San Diego, ALISON MARSDEN, Stanford University — Hemodynamic simulations provide non-invasive descriptions of blood flow that are typically not obtainable from standard clinical imaging modalities. However, inputs parameters for such simulations are not known precisely, and uncertainty in the outputs must be quantified for reliable patient-specific predictions. Thus, this study aims to quantify the variability in computed hemodynamic indices hypothesized to correlate with coronary bypass graft failure by including uncertainties due to the model boundary conditions and material model parameters. Uncertainty in the boundary conditions is obtained by sampling parameter sets producing results consistent with uncertain clinical observations, while the effect of spatial variability in the graft material properties is modeled using random field theory. Additionally, stochastic sub-models are constructed to focus the analysis on arterial and venous grafts and to maintain a reasonable computational cost. Finally, heterogeneous inputs (either in the form of samples or with a known distribution) are propagated forward using a generalized multi-resolution stochastic expansion. Results are discussed with references to both hemodynamic indicators and wall mechanics.

Justin Tran
Stanford Univ

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