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Comparison of different models for non-invasive FFR estimation[1]

MEHRAN MIRRAMEZANI, SHAWN SHADDEN, UC Berkeley — Coronary artery disease is a leading cause of death worldwide. Fractional flow reserve (FFR), derived from invasively measuring the pressure drop across a stenosis, is considered the gold standard to diagnose disease severity and need for treatment. Non-invasive estimation of FFR has gained recent attention for its potential to reduce patient risk and procedural cost versus invasive FFR measurement. Non-invasive FFR can be obtained by using image-based computational fluid dynamics to simulate blood flow and pressure in a patient-specific coronary model. However, 3D simulations require extensive effort for model construction and numerical computation, which limits their routine use. In this study we compare (ordered by increasing computational cost/complexity): reduced-order algebraic models of pressure drop across a stenosis; 1D, 2D (multiring) and 3D CFD models; as well as 3D FSI for the computation of FFR in idealized and patient-specific stenosis geometries. We demonstrate the ability of an appropriate reduced order algebraic model to closely predict FFR when compared to FFR from a full 3D simulation.

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