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Optimization of a BT-Shunt Geometry for the Norwood Operation MAHDI ESMAILY MOGHADAM, Mechanical and Aerospace Engineering, UCSD, JEFFREY FEINSTEIN, Bioengineering Department, Stanford, IRENE VIGNON-CLEMENTEL, INRIA, Paris, FRANCESCO MIGLIAVACCA, Bioengineering Department, Politecnico di Milano, ALISON MARSDEN, Mechanical and Aerospace Engineering Department, UCSD — In this study, we present initial results of BT-shunt shape- parameterization and optimization using an automated approach that links optimization to a 3-D custom finite element flow solver. Shape optimization is performed using an efficient derivative-free optimization method called the surrogate management framework (SMF). Two objective functions are developed and tested: first to minimize energy-dissipation, and second to combine oxygen delivery and energy dissipation. Preliminary results suggest that a smooth bifurcation at the BA end with a shunt perpendicular to the PA is the best geometry to minimize energy dissipation, and that the inclusion of an oxygen delivery term in the objective function improved the ratio of systemic to pulmonary blood flow. To better account for global changes in the heart and circulatory system due to changes in shunt geometry, we have implemented a multiscale modeling approach that couples a 0-D lumped parameter network to the 3D flow solver. Initial results of this coupling using idealized geometries demonstrate its stability. Application to the BT shunt problem and design implications will be discussed.

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