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A Multi-Scale Model of the Circulatory System for the Study of Left Ventricular Assist Devices J.R. GOHEAN, R.D. MOSER, Y. BAZILEVS, T.J.R. HUGHES, University of Texas at Austin — A computer model of the cardiovascular system has been developed to study the hemodynamic effects of a non-pulsatile axial flow left ventricular assist device (LVAD). The model is multi-scale and consists of a distributed quasi-one-dimensional arterial tree, based on integrated Navier-Stokes with a pressure/area state equation representing the compliance of the arteries; and lumped parameter models for the systemic return, pulmonary circulation, coronary circulation, and heart. Physiologically consistent aortic pressure and flow histories have been obtained by including a dynamic aortic valve model that allows back-flow by representing leaflet motion. In addition, a three-dimensional finite element model of the aorta with nonlinear elastic arterial walls can be integrated with the quasi-one-dimensional and lumped parameter models, with the lower fidelity models providing boundary conditions for the detailed model. The three dimensional model allows investigation of the detailed flow characteristics induced by the LVAD. The effect of an LVAD and its implant configuration on the hemodynamics of the cardiovascular system and coronary perfusion are studied for various patient conditions and levels of assist.

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