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ASPECTS OF INVERSE PROBLEMS IN MECHANICAL CIRCULATORY DEVICE DESIGN

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Modeling and computational analysis play an increasingly-important role in the design of implantable ventricular assist devices (VAD), other blood-handling devices such as oxygenators and heart valves, as well as surgery planning. Numerical simulation of blood flow and associated physiological phenomena has the potential to give the engineers and clinicians important insights into causes of blood damage and suboptimal performance.

A set of modeling techniques is presented which are based on stabilized space-time finite element formulation of the Navier-Stokes equations [1]. Specific issues affecting shape optimization in this setting, such as reparametrization of complex 3D surfaces using T-splines, as well as sensitivity to constitutive model selection, will be discussed [2].

Of equal importance is the quantification of biocompatibility of the evolving device designs. As an example, hemolysis can be quantified using either device-specific correlations or more fundamental models, taking into account the flow field, exposure time, or even cell membrane properties [3]. Recent developments in this area will be outlined.

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