Constructing Hexahedral Meshes of Abdominal Aortic Aneurysms for Use in Finite Element Modeling

As abdominal aortic aneurysms (AAAs) represent a leading cause of death in the U.S., computational models of AAAs are being developed to better predict location and risk of rupture. Most of these models involve three parts: (1) equations to model blood flow and/or wall stress, (2) reconstruction of vessel geometry from CT or MRI data, and (3) finite element analysis (FEA) to numerically solve the equations. One goal of AAA modeling is to explore the effects of the iliac bifurcation and thrombus on AAA development. In order to obtain the best results from a FEA of an AAA, a high-quality mesh with regular elements should be used. However, because of the geometry of the bifurcation and the need to distinguish between the inner surface of the thrombus and the arterial wall, especially in areas of thinning thrombus, obtaining a quality mesh can be difficult. The goal of this project is to obtain quality finite element meshes of AAAs from CT data, including bifurcation and distinguishing between the inner surface of the thrombus and the arterial wall. To accomplish this, a method developed by Antiga and Steinman (2004) to automatically decompose a bifurcation into three branches and construct a parameterized representation of the surface will be extended in C++. From this parameterized representation, a sweeping algorithm will be used to construct hexahedral meshes of the AAA. These meshes may be used in fluid-solid interaction models in the future, potentially giving more accurate results than fluid or structural models and providing insight into how the iliac bifurcation and thrombus affect AAA formation.

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