Arterial Element-Based Zero-Stress State Estimation with T-Spline Representation

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ABSTRACT

A method for estimation of element-based ZSS was introduced in [1] and used in coronary arterial dynamics computation with medical-image-based time-dependent anatomical models in [2]. The method has three main component. 1. An iterative method, which starts with a calculated initial guess, is used for computing the ZSS such that when a given pressure load is applied, the image-based target shape is matched. 2. A method for straight-tube segments is used for computing the element-based ZSS so that we match the given diameter and longitudinal stretch in the target configuration and the "opening angle." 3. An element-based mapping between the artery and straight-tube is extracted from the mapping between the artery and straight-tube segments. The version of the method with NURBS wall discretization was introduced in [3]. Here we extend it to T-splines to add to the method more geometric flexibility, such as being able to deal with artery branches, and for that, generalize the straight tube to a torus (Fig. 1). In the test case we present to demonstrate how the method works, we use a patient-specific aorta model (Fig. 2).

Figure 1: Torus model with NURBS representation

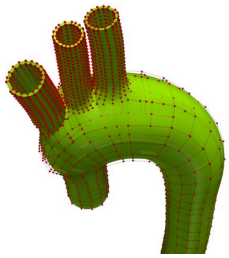

Figure 2: Aorta model with T-spline representation

REFERENCES

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[3] K. Takizawa, T.E. Tezduyar, and T. Sasaki, "Aorta modeling with the element-based zero-stress state and isogeometric discretization", *Computational Mechanics*, **59** (2017) 265–280, doi: 10.1007/s00466-016-1344-5.