Abstract Submitted
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A Computational Approach to Model Vascular Adaptation During Chronic Hemodialysis: Shape Optimization as a Substitute for Growth Modeling[1] S. M. JAVID MAHMOUDZADEH AKHERAT, MICHAEL BOGHOSIAN, KEVIN CASSEL, Illinois Institute of Technology, MARY HAMMES, University of Chicago — End-stage-renal disease patients depend on successful long-term hemodialysis via vascular access, commonly facilitated via a Brachiocephalic Fistula (BCF). The primary cause of BCF failure is Cephalic Arch Stenosis (CAS). It is believed that low Wall Shear Stress (WSS) regions, which occur because of the high flow rates through the natural bend in the cephalic vein, create hemodynamic circumstances that trigger the onset and development of Intimal Hyperplasia (IH) and subsequent CAS. IH is hypothesized to be a natural effort to reshape the vessel, aiming to bring the WSS values back to a physiologically acceptable range. We seek to explore the correlation between regions of low WSS and subsequent IH and CAS in patient-specific geometries. By utilizing a shape optimization framework, a method is proposed to predict cardiovascular adaptation that could potentially be an alternative to vascular growth and remodeling. Based on an objective functional that seeks to alter the vessel shape in such a way as to readjust the WSS to be within the normal physiological range, CFD and shape optimization are then coupled to investigate whether the optimal shape evolution is correlated with actual patient-specific geometries thereafter.

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Seyed Mohammad Javid Mahmoudzadeh Akherat
Illinois Inst of Tech

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