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In Silico Stent-Graft Repair of Patient-Specific Abdominal Aortic Aneurysms

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Endovascular aneurysm repair (EVAR) is a widely used and well established technique to intervene before rupture of abdominal aortic aneurysms (AAA) occurs. However, EVAR can involve some unfavorable complications such as endoleaks or stent-graft (SG) migration. Such complications, resulting from the complex mechanical interaction of vascular tissue, SG and blood flow or incompatibility of SG design and vessel geometry, are difficult to predict. Computational vascular mechanics models can be a predictive tool for the selection, sizing and placement process of SGs depending on the patient-specific vessel geometry and hence reduce the risk of potential complications after EVAR [1].

In this contribution, we present a new in silico EVAR methodology to predict the final state of the deployed SG after intervention and evaluate the mechanical state of vessel and SG, such as contact forces or wall stresses. Four different constituents of the vascular tissue are considered: healthy vessel wall, diseased aneurysmatic wall, intraluminal thrombus and calcifications [2]. We consider mortar based frictional contact [3] between a sophisticated AAA model and a SG composed of a parameterized, product specific graft shell and stent wire frame that can undergo finite deformations. The simulation results of three patient-specific cases are compared to the geometry of the deployed SG taken from postinterventional CT scans and the quality of the predictive capability is quantified.

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