The StentValid Collection and Validation of a Multiscale Model of In-Stent Restenosis

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1. Abstract

In recent years, multitudes of different computational models have emerged in biomedicine. However, not many of them have been approved by regulators and adopted in the medical practice so far. One of the biggest challenges on the way to approval is performing a sufficient validation of the model, and also gathering enough data suitable for the validation study [1].

One important area of modelling is modelling of the cardiovascular system, such as models of atherosclerosis, stent implantation for its treatment, and the organism's response to the stenting procedure.

Here we present StentValid: a large collection of angiograms of stented human coronary arteries with clinical outcomes and a subset with invasive imaging. The purpose of this collection is to provide sufficient data for models dealing with vascular growth and remodelling.

We also present a multiscale model of neointima growth and in-stent restenosis in coronary arteries (ISR3D). This model, an extension of an earlier model for porcine arteries [2], includes a mechanobiological model of arterial wall, which is fully coupled to a lattice Boltzmann model of flow, which is used to provide the wall shear stress (WSS) value (Fig. 1). WSS, together with other values such as mechanical strain from stent deployment and endothelium coverage, is used to predict the extent of cell growth and lumen reduction.

We discuss how the StentValid collection will be used to validate the ISR3D model, and also, we present preliminary validation results in 3D-reconstructed porcine stented coronary arteries.

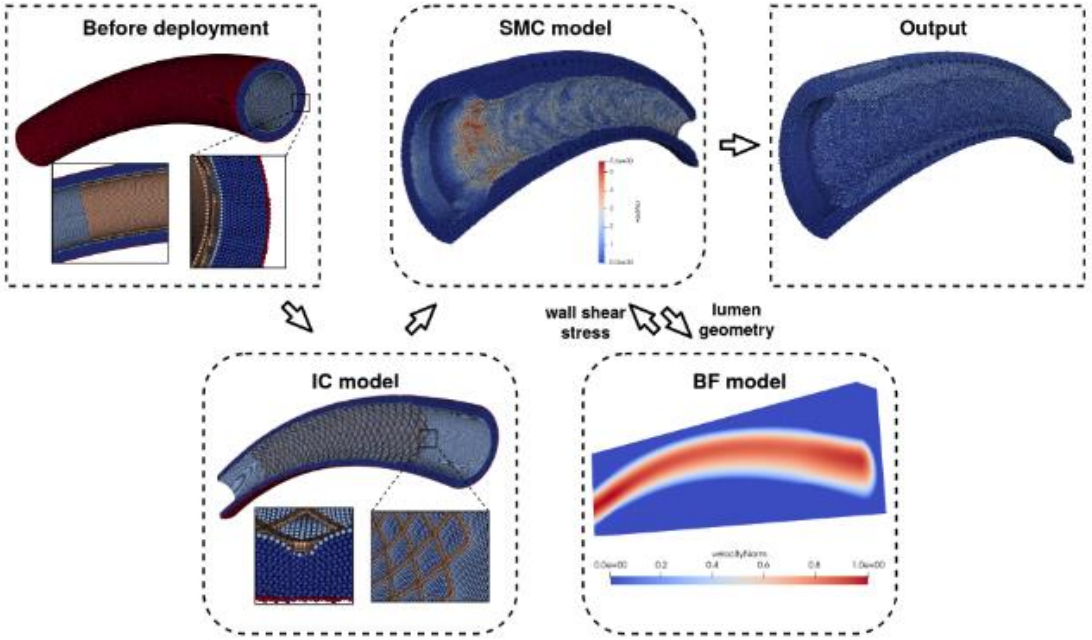

Figure 1 *Schematic representation of communications in the ISR3D multiscale model. SMC – smooth muscle cells; IC – initial condition; BF – Blood flow.*

2. Funding

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3. References

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