

Master thesis

for students of Mechanical Engineering, CES, SiSc, etc.

Model reduction based on isogeometric analysis of cardiovascular drug-eluting stents

Coronary artery stenosis is commonly treated with the use of drug-eluting stents, which release anti-proliferative drugs to prevent restenosis. To accurately model drug release into the bloodstream, it is essential to first model hemodynamics and ensure that both the stent and artery geometries are properly captured with highly accurate meshes. The complexity of stent designs often makes traditional Finite Element Methods (FEM) computationally expensive. To address this, we explored the combination of FEM with an immersed boundary method on a simple test case. For further developments and application to complex stent and artery geometries, we aim to integrate this approach with NURBS.

Your tasks:

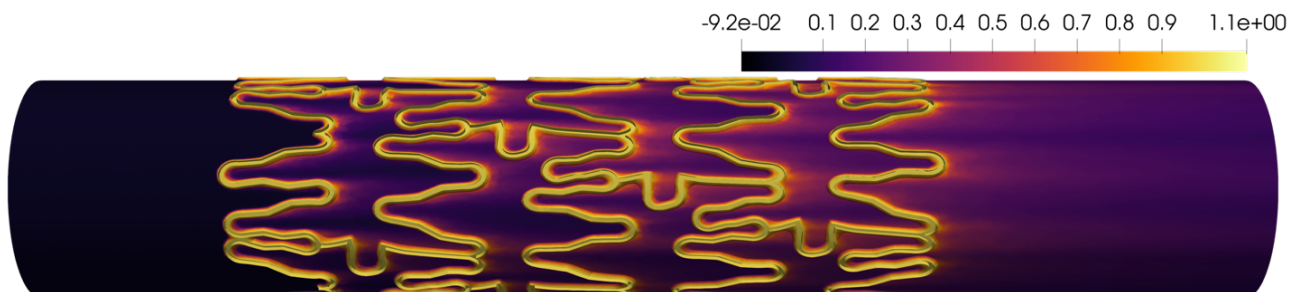
- Implementing an immersed boundary method in an existing model reduction library
- Learning about blood dynamics and drug elution phenomena in a cardiovascular application
- Working with OCT imaging, CAD and geometry formats in biomedical applications

What we offer

You will gain hands-on experience with a model reduction library developed by researchers at Politecnico di Milano (Italy). You will learn advanced mathematical techniques, including immersed boundaries, and how to validate these methods. Additionally, you will learn how to model stented arteries using OCT imaging within the framework of isogeometric analysis (IGA). This work will be conducted in close collaboration with our partners at Politecnico di Milano and the University of the Bundeswehr Munich.

Prerequisites

- Interest in computational modeling of biomedical applications
- Solid background in IGA and advection-diffusion equations
- Programming skills, preferably in Python, Matlab or C++



Drug concentration on artery wall after steady elution from stent.

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