Master's thesis proposal

Study on the Influence of Soft Tissue Material Models & Parameters in Implantable Medical Device Simulations

Contact person: Bence Rochlitz, Mario Herzog:

rochlitz@virtonomy.io, herzog@virtonomy.io

Project Abstract

This thesis aims to explore the influence of material models and parameters in implantable medical device simulations. It includes building a simulation model using smoothed particle hydrodynamics (SPH) simulation and performing a sensitivity study.

Background and Motivation

Virtonomy GmbH is developing the first web platform for conducting fully data-driven clinical trials of medical devices with the use of virtual patients. Our system is based on clinical scans (CT, MRI), pathology data, and data about medical devices. Medical device simulation is one of the key features of our offering.

Figure 1: Virtonomy's web platform

Our choice of SPH enables interactive simulations for medical device developers and clinicians in our web-platform. This thesis focuses on a use case of an implantable medical device.

Figure 2: Use case, simulation of Total Artificial Heart implantation (Pieper, et al. 2019)

Student's Tasks Description

- Material model research of human soft tissues and identifying material parameter ranges from literature
- Research on state-of-the-art simulation models for a specific use case
- Building a simulation model in Javascript/C++ using an SPH simulation framework and the anatomical and device models provided by Virtonomy
- Sensitivity analysis of material models and parameters in the simulation model

By the end of the project, the student shall have the following outcomes: a simulation model of a specific implantable medical device and sensitivity analysis results.

The student will learn the core concept of the SPH simulation method and how to apply it to a real-life problem. Virtonomy provides supervision with industrial simulation and software development experience.

Technical Prerequisites

Knowledge of basic material models and simulation project background. Feel comfortable to learn a new concept and work on a new framework.

Why you should choose us

- Opportunity to work in a vibrant environment with many other start-ups (Werk1) or from home (home office is 100% allowed)
- Participation in the exciting development and growth of a start-up
- Contributing to an exciting real-life medical data solution with a huge impact: your simulation model will be available for medical device developers and will help them streamline development, and reduce risk in animal/human trials
- The opportunity to introduce the simulation model in user validation calls