Student Research Assistant Position (SHK)

Implementation of small intestine stretching and elongation simulation in SOFA using the Veronda-Westmann and Neo-Hookean model

Context

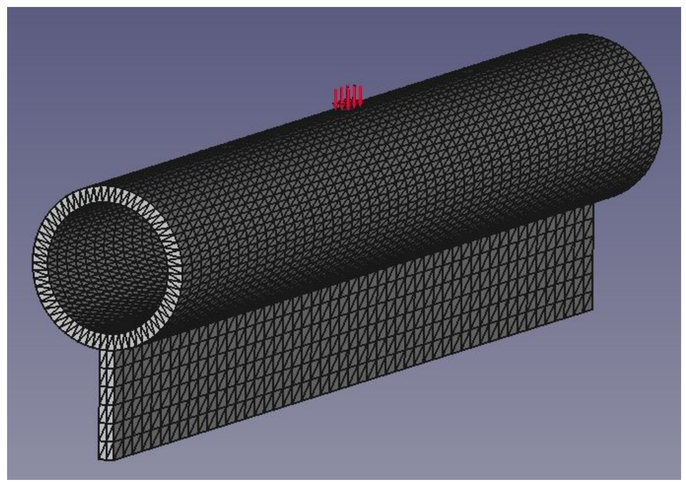
Excess pulling force on the small intestine in surgery could lead to life-threatening bleeding conditions. It is therefore critical that surgeons finely control their movements and the force asserted to the organ by their instruments. In this project, we try to stimulate these movements.

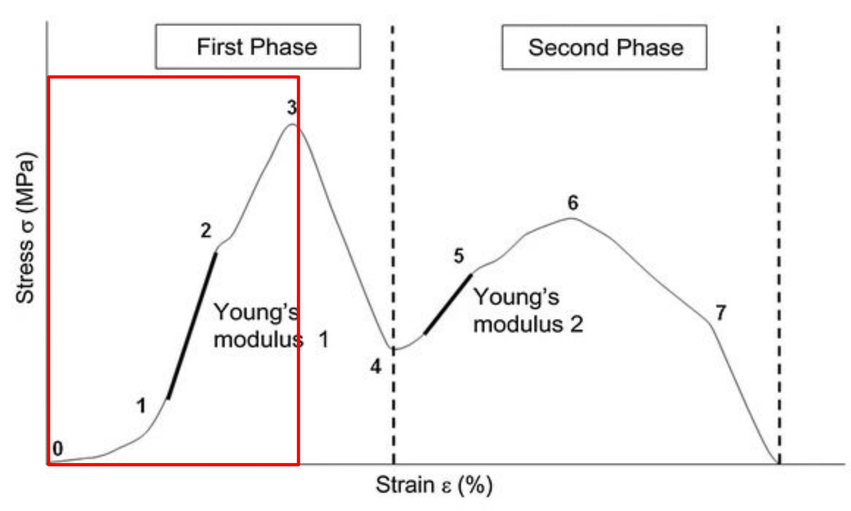
Previous mechanical simulation research on small intestine mechanics has primarily relied on the Neo-Hookean model for finite element analysis (FEA), which may be incorrect. This project aims to explore the impact of using a more complex Veronda-Westermann model for simulating small intestine stretching in SOFA. We will analyze differences in FEA results between the two models. Simulation data will be used to train deep learning models such as 3D ResNet for estimating forces from visual input.

Tasks

- Familiarize with SOFA
- Find out the three mechanical parameters of the Veronda-Westmann model in red box below
- Implement Neo-Hookean and Veronda-Westmann model in SOFA

More information:
https://sofa-framework.github.io/doc/components/solidmechanics/fem/hyperelastic/tetrahedronhyperelasticityfemforcefield/
https://www.sciencedirect.com/science/article/pii/0021929070900552
https://link.springer.com/article/10.1007/s11517-012-0964-y





Requirements

Required technical skills:
- Mastery in Python and C++
- Adaptability using mechanical simulation software (SOFA)
- Understanding of finite element analysis (preferably having some MechEng background)
- Very good literature analysis skills to decipher niche mechanical models
- Familiarity with mechanical parameters, stress-strain curve

Course requirements:
- Must have achieved at least 2.0 in each mandatory mathematics course
- Preferably completed a computer science-related course

Supervision

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