Chair of Computational Modeling and Simulation
TUM Department of Civil, Geo and Environmental Engineering
Technical University of Munich

Modeling:
Mathematics:
Programming:
Science:

Software Lab:

Automated Mechanical Analysis of the Human Spine

Description

With growing elderly population vertebral compression fractures are an increasing clinical problem. Mechanical analysis of vertebrae based on CT-scan data[1] has the potential to provide a better understanding of this frequent injury and can enhance patient-specific treatment of spine injuries. The spine is a complex system consisting of multiple vertebrae stacked on top of each other connected by intervertebral disks. The goal of this project is to build a simulation workflow, which incorporates loadings and constraints from a Multi-Body Simulation, as well as automated segmentation and load surface extraction into a biomechanical FE model.

Task

Main goal of the project is to establish a simulation workflow that allows to perform clinical studies. The workflow combines an automated segmentation of CT-scans and construction of load surfaces with our in-house simulation tool Adhoc++ to perform clinical studies based on MBS generated loads.

- Literature
- Analyse existing data and get familiar with the required tools (python scripts for segmentation and endplate generation, loads from MBS)
- Introduction to Adhoc++ (in-house FE tool at the chair based on C++)
- Transformation of MBS loads as boundary conditions for the FE model
- Combine single tools into an automated simulation workflow
- Perform studies based on clinical CT-scans of human spines

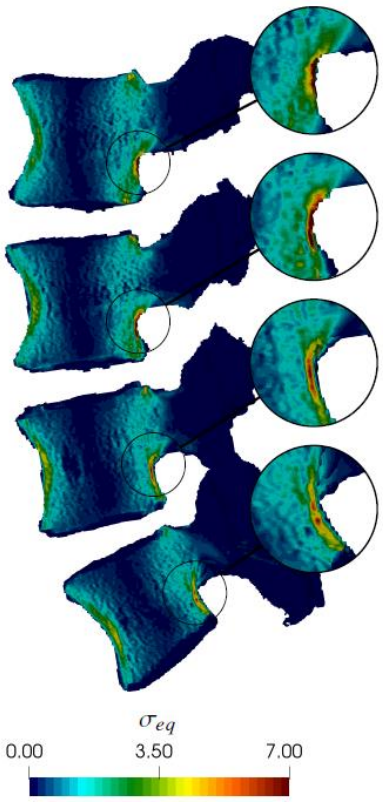

Figure 1: Von Mises stresses in L2-L5 vertebrae. [2]

Supervisor

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References

[1] Elhaddad, Mohamed, et al. "Multi-level hp-finite cell method for embedded interface problems with application in bio-mechanics." INT J NUMER METH BIO 34.4 (2018): e2951.
[2] Oztoprak, O. (2020). Enforcement of Boundary Conditions in FCM with Applications to Biomechanics. Technische Universität München. https://publications.cms.bgu.tum.de/theses/2020_oztoprak_masters_thesis.pdf.