Git Project: Image Analysis and FEM

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0.1 Introduction

Simple finite elements in Python (SfePy) uses finite element methods to solve coupled partial differential equation (PDE) in systems up to three dimensions. SfePy is a powerful software that allows complex physical problems to be coded quickly and easily. It has been used successfully in a variety of disciplines, ranging from biomechanical modelling [1] to the computational analysis of acoustic transmission coefficients [2].

In this report, the input file to the SfePy software is a microstructural image which must first be 'cleaned' through segmentation, mesh generation and noise reduction. It can then be imported into the software as a mesh file, where boundary and initial conditions are applied. Fields are then created which can be used to define variables which may be 'unknown field', 'test field' or 'parameter field' [3] and the material properties are defined.

0.2 Aims and Objectives

0.3 Image Analysis

A key requirement for this project is to build a python script which will allow PNG images to be converted to data, which can then be manipulated and processed with python packages such as Sci-Kit Image (skimage) [**?**]. Several microstructure images have been used in this project, from a variety of sources including previous research data, scientific literature and the provided database, all with full and sufficient permissions. Images were then pre-processed accordingly through various techniques such as segmentation, removal of noise and measurement, before being imported into FE simulations to be used to create a mesh.

0.4 Finite Element Modelling

Test!

0.5 Results

Test!

Bibliography

[1] Robert Cimrman and Eduard Rohan. Two-scale modeling of tissue perfusion problem using homogenization of dual porous media. *International Journal for Multiscale Computational Engineering - INT J MULTISCALE COMPUT ENG*, 8:81–102, 01 2010.

[2] E. Rohan and V. Lukeš. Homogenization of the acoustic transmission through a perforated layer. *Journal of Computational and Applied Mathematics*, 234(6):1876 – 1885, 2010. Eighth International Conference on Mathematical and Numerical Aspects of Waves (Waves 2007).

[3] Robert Cimrman, Vladimír Lukeš, and Eduard Rohan. Multiscale finite element calculations in python using sfepy. *Advances in Computational Mathematics*, 45(4):1897–1921, 2019.