Organization

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Lecturer	**Martin Ruess**, Prof. Dr.-Ing. habil.
Reviews	t.b.a. | support in consultation
Workload	180h | project-based
Credits	6 ects
Prerequisite	programming skills, partially FEM
Examination	3 review presentations/defense + documented software
Language	English
Online-Resource	Moodle Kurs-Link

Seminar / review presentations

- to document the progress of the project
- to discuss open problems with peers
- 2-3 reviews during the semester

Grading aspects

- quality of the generated software
- review performance
- final poster presentation / documentation

SoftwareLab
winter term 2022/2023

Topic 1   marching cubes voxelizer for medical imaging data

- Implementation/continuation of a marching cubes algorithm as suitable voxelization method for e.g. medical imaging data
- possible programming language: Java/C++/Matlab
- benchmark testing + MRI-based model voxelization + documentation
- suited as single student project OR maximum two students' project
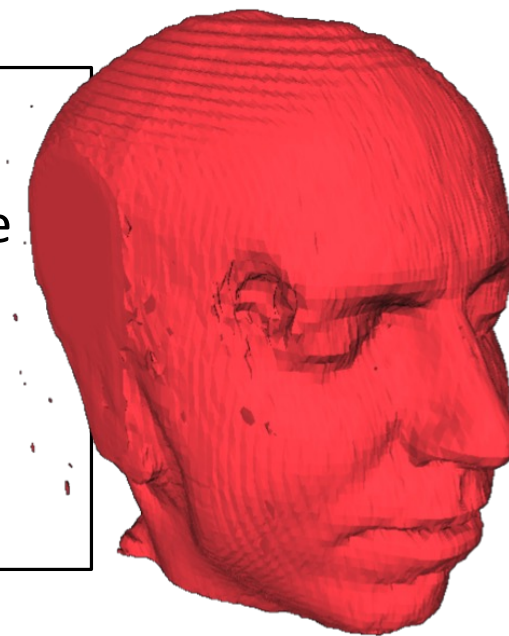
example of a marching cubes generated voxel model on basis of MRI data

source: Wikipedia (https://en.wikipedia.org/wiki/Marching_cubes)

Topic 2   finite cell method for complex geometries

- implementation of the finite cell method (fcm) into an existing Java FEM-framework, code support from a C++ code available
- fcm is a novel fictitious domain method with superior performance properties compared to classical FEM
- project covers cutting-edge research in computational mechanics
- supports strong understanding of the principles of FEM-based methods
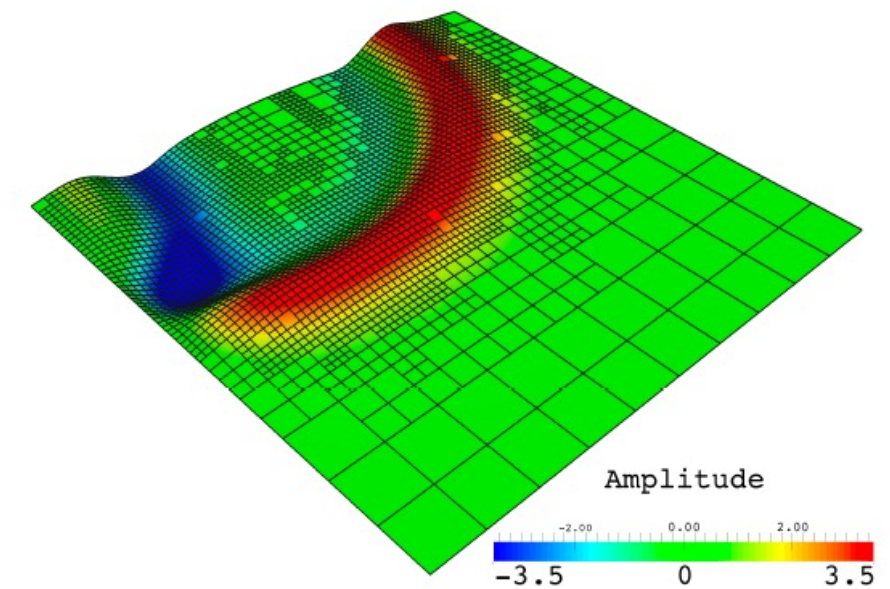

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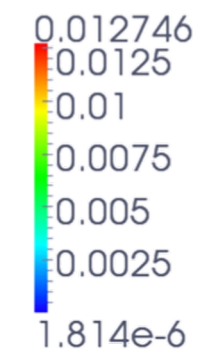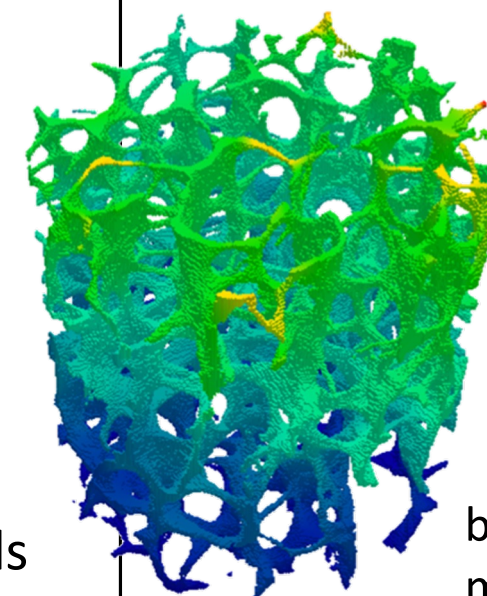
bone micro structure modeled and analyzed by the fcm

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Topic 3   solution of time-dependent problems

- implementation of the initial value problem in FELiNA using a Newmark solver / generalized alpha-method
- possible programming language: Java
- benchmark testing and comparison with results from literature
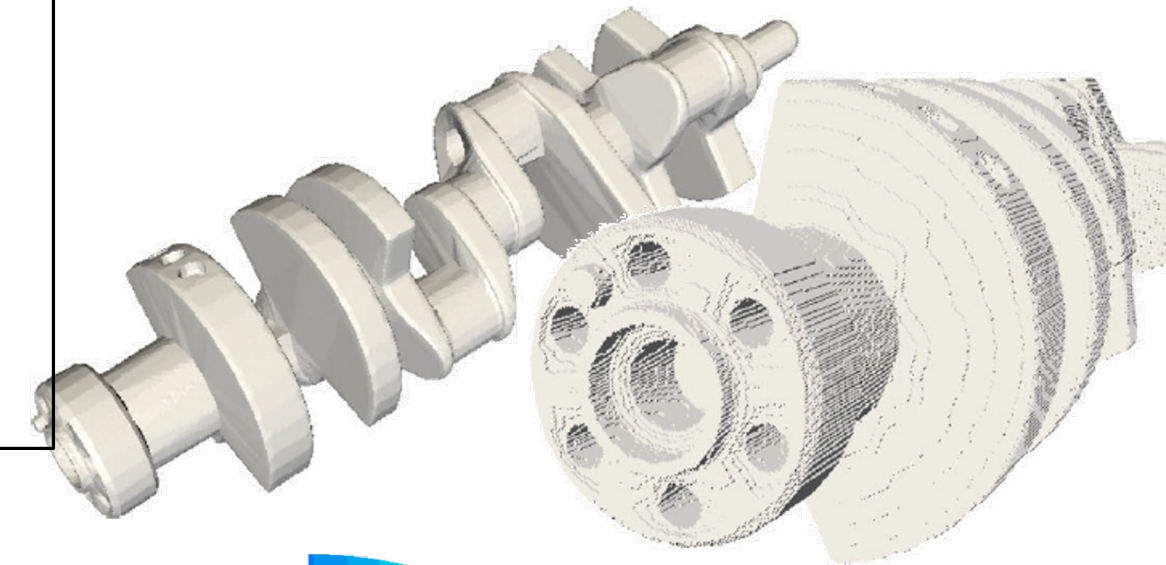- suited as single student project

wave propagation solved with Newmark
source: PhD thesis N. Zander, TUM, 2017

Topic 4

further topics on request

Initial STL-crankshaft model and analysis-suited voxel model with 63mio. voxel

Topic 5   voxel model creator

- Setup of a voxelization modeling pipeline using a voxelizer software tool for closed surface defined volumes
- possible programming language: Java (preferred)/C++/Matlab
- testing + workflow documentation
- suited as single student project

Topic 6   finite element method - benchmark test suite

- implementation several benchmark problems into the Java-FEM Framework FELiNA
- benchmark implementation testing & result documentation
- requires FEM background
- suited as single student project

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(a) von Mises stress

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