Chair of Computational Modeling and Simulation
TUM Deparment of Civil, Geo and Environmental Engineering
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TUM

High-order finite element discretizations of the scalar wave equation

Task

Project Characteristics
Modeling:
Mathematics:
Programming:
Science:

The goal of this software lab topic is to write a simple finite element code for the scalar wave equation in Matlab or Python. The different approaches shall be tested with respect to their convergence and conditioning. To this end, the students should start with a one-dimensional example first and then continue with two-dimensional problems towards the end of the project. Also, different material distributions shall be considered.

- Write an boundary conforming finite element code in 1D
- Implement different approaches with high-order shape functions (e.g. [1], [2], [3])
- Compare the different approaches with respect to convergence, conditioning, etc.
- Extend implementations and comparison to two-dimensional problems

[1] Düster A, Rank E, Szabó B (2018) The p-version of the finite element and finite cell methods, chap. 4. Wiley, New York, pp 1–55
[2] Dimitri Komatitsch, Jeroen Tromp (1999) Introduction to the spectral element method for three-dimensional seismic wave propagation, *Geophysical Journal International*, Volume 139, Issue 3, December 1999, Pages 806–822
[3] Thomas JR Hughes, John A Cottrell, Yuri Bazilevs (2005) Isogeometric analysis: CAD, finite elements, NURBS, exact geometry and mesh refinement, Computer Methods in Applied Mechanics and Engineering, Volume 194, Issues 39–41, Pages 4135-4195