Dual mass lumping in the spectral element method

Bachelor or Master's thesis (Computational Methods in Engineering, Maschinenbau, Mathematik)
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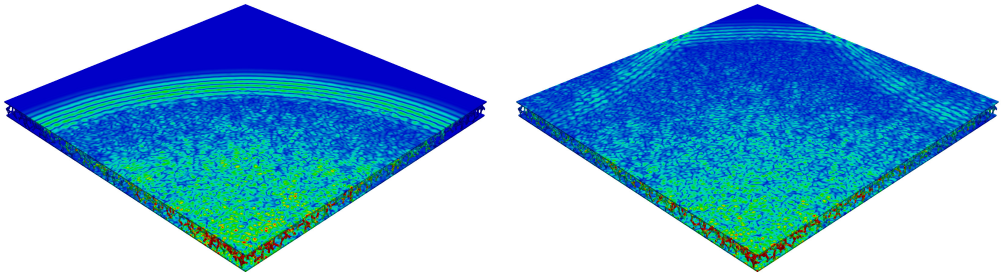
Insitute of Mechanics
Computational Mechanics
Prof. Dr.-Ing. Daniel Juhre
daniel.juhre@ovgu.de

Scope of Work

Explicit time integration approaches play an integral role in high-frequency dynamics for the solution of wave propagation problems or impact events. On key ingredient for explicit dynamics is the availability of a diagonal (or lumped) mass matrix. Therefore, it is of utmost importance to develop methods that can diagonalize the mass matrix for all finite element types. This can be achieved by utilizing a *Petrov-Galerkin* formulation with different test and trial functions. This approach should be implemented and tested in framework of *spectral element method* (SEM). To this end, dual basis functions for Lagrangian interpolation polynomials need to be derived.



The main goal of this thesis is to implement a dual mass lumping approach for the SEM and to study its performance by means of several transient benchmark problems. An area of application is seen in seismic or guided wave propagation problems.

Tasks

- Review of the existing literature on dual basis functions
- Implementation of dual basis and a dual mass lumping scheme for SEM
- Investigations regarding the attainable accuracy
- Computation of benchmark problems

Prerequisites

- Structural dynamics
- Computational mechanics (e.g., Finite Element Method)
- Programming skills (preferably Matlab or Julia)

Supervisor: Dr.-Ing. Sascha Eisenträger G10|R013 sascha.eisentraeger@ovgu.de