Universität Stuttgart

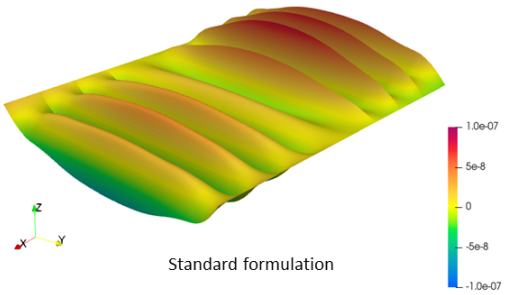
Baustatik und Baudynamik

Master Thesis

Comparison of the Mixed-Displacement method with alternative unlocking schemes

The Finite Element Method (FEM) is popular for solving partial differential equations relating to problems in structural mechanics. However, the locking phenomenon hinders the approximation quality when choosing a relatively coarse mesh. For these formulations, the origin of locking is not in the method of discretization but in the underlying differential equations being solved. With this motivation, a set of intrinsically locking-free formulations was developed that show locking-free characteristics irrespective of the discretization scheme.

In this thesis, the Mixed-Displacement (MD) method ought to be investigated in the institute's finite element code *Ikarus*. Several benchmark problems have to be assessed to study shear locking characteristics in 2D solid elements and plate elements. The results of the MD method ought to be compared with existing unlocking schemes like the Enhanced Assumed Strain (EAS), the Assumed Natural Strain (ANS), and the Discrete Strain Gap Method (DSG), as per their applicability. Lastly, a systematic comparative investigation of the quality of the results is required.



The specific tasks are

- Familiarization with *Ikarus*, the MD method, and other unlocking schemes
- Implementation of the ANS method for plate elements
- Implementation of the MD method for 2D solid elements
- Comparative investigation of different unlocking schemes using different benchmark problems for 2D solid elements and plate elements (for arbitrary meshes).
- Summary and evaluation of the results

Recommended fields of interest

FEM, element technologies, locking, C++.

Literature

Bieber, S., Oesterle, B., Ramm, E., Bischoff, M., 2018. "A variational method to avoid locking - independent of the discretization scheme". Int J Numer Methods Eng 114, 801–827.
Müller, A., Vinod Kumar Mitruka, T. K. M., 2023. "Ikarus v0.3",DaRUS, V1.