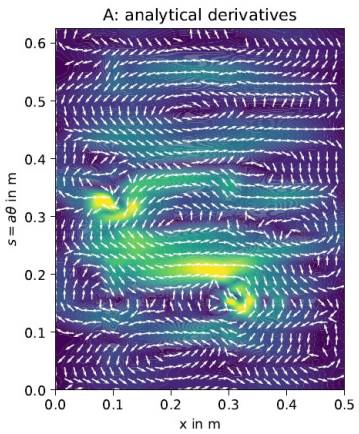
Lehrstuhl für Akustik mobiler Systeme
Fakultät für Maschinenwesen
Technische Universität München

Semesterthesis

Investigation of Shell Formulations for Structural Intensity Analysis of Curved Structures

Topic

Structural intensity describes the power flow per unit area through structures and is calculated from internal forces, moments, and their corresponding velocities. For curved structures, the calculation of these quantities depends on the underlying shell formulation and its kinematic assumptions, particularly regarding rotational degrees of freedom and transverse shear deformation. Different shell theories may therefore lead to differences in the predicted displacement fields, internal forces, and structural intensity fields. This thesis aims to investigate these differences through analytical and numerical implementations of selected shell formulations. Furthermore, the applicability of physics-informed neural networks to structural intensity prediction in curved shells will be investigated, with structural intensity obtained by post-processing the reconstructed smooth displacement field using automatic differentiation.



Tasks

- Review the literature on relevant shell theories, with particular emphasis on their kinematic assumptions, rotational degrees of freedom, and transverse shear deformation
- Implement and validate selected shell formulations using analytical and numerical models
- Develop and verify methods for calculating structural intensity from the selected shell formulations
- Compare the predicted displacement fields, internal stress resultants, and structural intensity field across different shell formulations
- Implement a physics-informed neural network for selected shell formulations and evaluate its accuracy in predicting displacement fields and structural intensity

Requirements

- Basic knowledge of engineering mechanics and shell formulations
- Experience with FEM (COMSOL, Abaqus, ANSYS, etc.)
- Experience with machine learning and PINNs (physics-informed neural networks) is beneficial
- High interest in numerical simulation and analytical models of shell structures

Please submit your transcript of records along with your application.

TUM Contact Person

Technische Universität München
Lehrstuhl für Akustik mobiler Systeme
Uluç Çankayali, M. Sc.
Boltzmannstraße 15, 85748 Garching b. München
Tel. +49 (89) 289-55135
uluc.cankayali@tum.de
https://www.epc.ed.tum.de/vib/mitarbeiterinnen-und-mitarbeiter/uluc-cankayali/