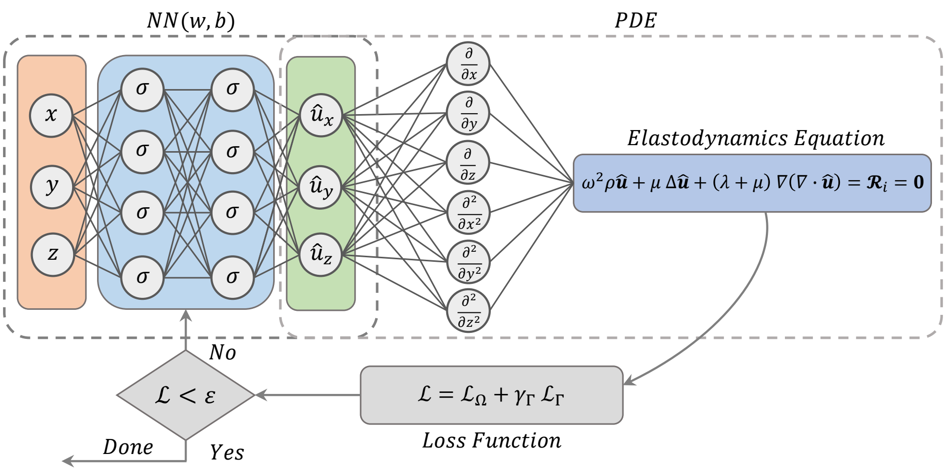
Chair of Vibroacoustics of Vehicles and Machines
School of Engineering and Design
Technical University of Munich

Master's or Semester Thesis

Physics-Informed Machine Learning for the Vibration Analysis of Shell Structures

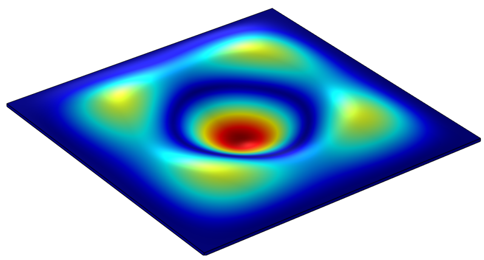
Your Task

Physics-informed neural networks (PINNs) have shown great potential in solving computational physics problems. The main idea of PINNs is to incorporate the residual of a partial differential equation (PDE) and the boundary conditions into the loss function of a neural network. By training the neural network, the loss function is minimized, which means that the PDE residual and the error of the boundary conditions will be minimized as well. This way, the PINN implicitly learns a solution, which satisfies the PDE boundary value problem.
It is your task to apply PINNs for the vibration analysis of shell structures. Shells are used to model the structural dynamics of thin-walled structures, e.g. a vehicle body in white. The vibration of such shell structures can be described by the differential equations of plate theory (e.g. Kirchhoff-Love) and Dirichlet boundary conditions. The PINN prediction of the displacement field is compared to the finite element method (FEM) and analytical reference solutions. Besides the vibration analysis of a single plate, also the coupling between two plates and the implementation in PINNs is investigated. This research project is conducted in close collaboration with the BMW Group.



Your Skills

- Programming skills in Python
- Knowledge in machine learning
- Implementation skills in PyTorch or Tensorflow
- Basic knowledge in numerical methods (e.g. FEM)
- Interest in structural dynamics and vibroacoustics



Application in English or German possible.

Contact

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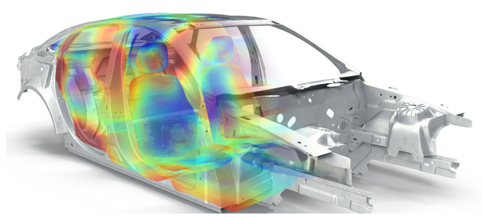

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