Technische Universität Braunschweig

Institut of Structural Analysis
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Master thesis of Mr. Thies Mattes Buschke, B. Sc., Matr.-Nr. 5247765

Investigation of the coupling of physics-informed neural networks and FE methods for the efficient design of structures.

Physics-informed neural networks (PINN) are an alternative approach to solving differential equations. Here, additional information from the underlying physical model is combined with neural networks. Compared to the de-facto standard method for the calculation of structures, the finite element method, this approach possibly offers promising potentials with respect to fast design iterations without repeated, time-consuming grid generation and design cycles.

The following items need to be addressed:

1. Literature review and discussion on numerical simulation of structures with physics-informed neural networks (PINN) and data-driven approaches (DDA).

2. Research, conceptual design and discussion of different possibilities for a PINN-FEM-DDA coupling for the efficient design and testing of structural analyses.

3. Implementation of a PINN for the calculation of an exemplary structure.

4. Investigation and discussion of the results regarding the generalizability of the approach for different boundary conditions.

5. Documentation and discussion of the results.

During the master thesis close contact with the institute has to be kept. The thesis is supervised by Fabian Meister, M. Sc. and Dr.-Ing. Christian Flack, first examiner is Prof. Dr.-Ing. habil. Roland Wüchner and second examiner is apl. Prof. Dr.-Ing. Ursula Kowalsky. The thesis is to be submitted to the examiners as a digital and printed version.

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