Lehrstuhl für Baustatik und Baudynamik | RWTH AACHEN UNIVERSITY

Master Thesis

Local Mesh Refinement Approach Using Graph Neural Networks

Background

The solution accuracy of a Finite Element Analysis (FEA) depends significantly on its mesh quality. Finer meshes provide more accurate results but at the cost of computational effort. To circumvent this problem, local mesh refinement strategies could be applied. However, most of the existing methods are either computationally inefficient or inaccurate.

Aim

In this thesis, based on previous developments of LBB, a machine learning approach, the Graph Neural Networks (GNNs), shall be explored to directly identify the mesh elements, which have to be refined. For this purpose, different network architectures should be implemented and tested. Additionally, a data generation strategy needs to be created, such that the networks are trained on as qualitative data sets as possible.

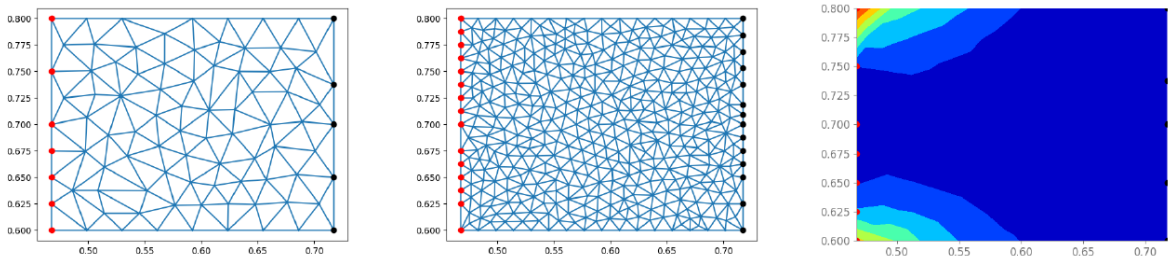

Figure 1: A Low-density mesh (left) and its more accurate high-density version (middle). The error between both solutions shows the importance of the chosen mesh quality (right).

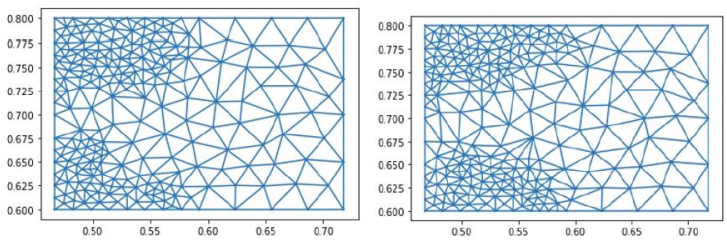

Figure 2: GNN-based refinement (left) and reference mesh (right). Both results match and show the potential of the GNNs.

Prerequisites

The candidate should be familiar with coding in Python. Experience in the field of machine learning can be beneficial.

Language

The thesis can be written in English or German.

Contact

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