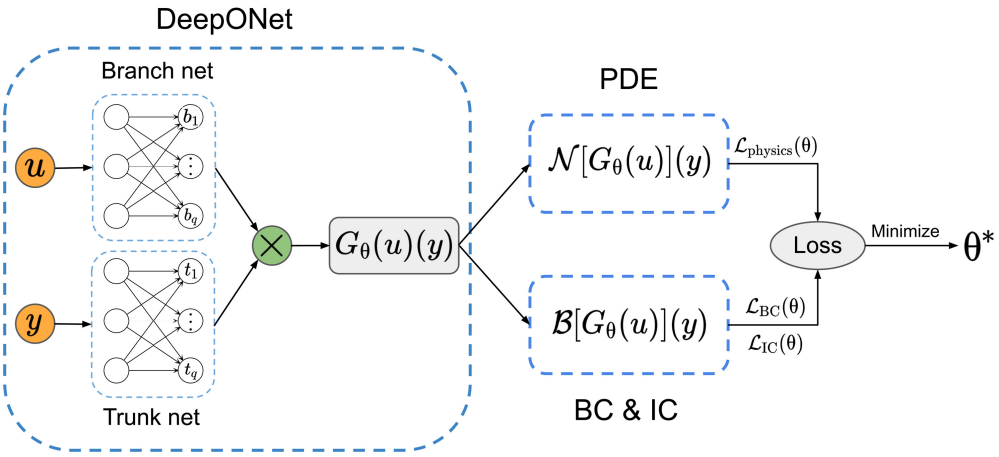
Chair of Vibroacoustics of Vehicles and Machines
School of Engineering and Design
Technical University of Munich

Master's or Semester Thesis

Deep Operator Neural Networks in Acoustics

Your Task

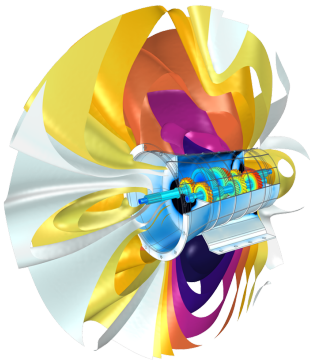
In recent years, deep learning methods have shown great potential for scientific computing. In particular, physics-informed neural networks have been shown to accurately solve partial differential equations (PDEs). However, according to the universal approximation theorem, neural networks in general are only capable of approximating single functions, which would be a single instance of a parameterized PDE problem. In numerical acoustics, one is often interested in an efficient surrogate model for parameterized PDE problems, which allows for e.g. optimization, uncertainty quantification, or the solution of inverse problems. For this purpose, so-called Deep Operator Networks (DeepONets) have recently been introduced, which approximate not only functions, but operators (functions of functions).
Your task is to apply DeepONets as an efficient surrogate model for a given parameterized acoustic problem. Initially, the results are compared to a finite element reference solution. After successful training and validation of the network, the trained DeepONet is then used as a surrogate model to characterize absorption properties of a surface based on existing sound pressure measurements.

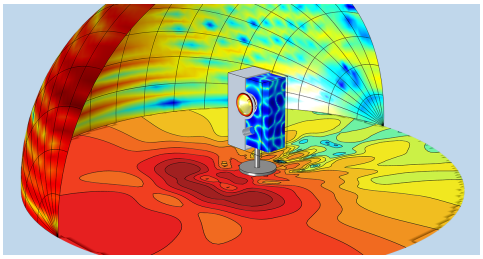


S. Wang: Learning the solution operator of parametric partial differential equations with physics-informed, Science advances (2021)

Your Skills

- Knowledge and in machine learning
- Programming skills in Python
- Neural Network implementation in PyTorch or Tensorflow
- Basic knowledge in numerical methods (e.g. FEM)
- Interest in computational acoustics
- German or English possible





Sources: Comsol Multiphysics

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