Chair of Computational Modeling and Simulation
TUM School of Engineering and Design
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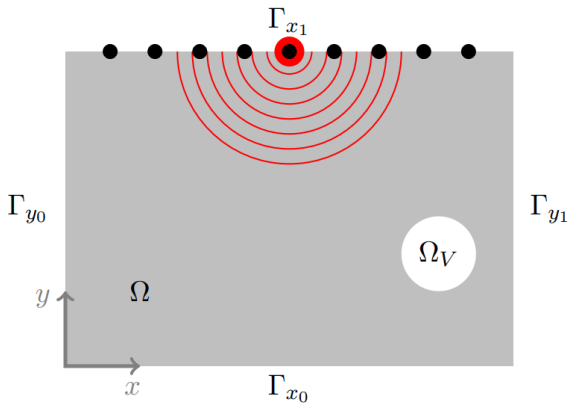
Modeling:
Mathematics:
Programming:
Science:

Software Lab:

Gradient-Free Optimization for Full Waveform Inversion

Description

The aim of full waveform inversion [1] is to non-destructively estimate the material distribution in a specimen. Defects, such as voids, can be detected using a fixed number of sources emitting a signal and sensors recording the image of the signal, as illustrated in the figure below [2]. The signals can be simulated with the wave equation for which a simple finite difference code will be provided. The task of identifying defects can be posed as an optimization problem, i.e. find the material distribution, that minimizes the difference between the sensor measurements and the simulation based on the current material distribution. Conventionally, the optimization is performed with a gradient-based algorithms using gradients obtained by the adjoint method. Gradient-free optimization algorithms make it possible to avoid the complex identification of the gradients and are therefore to be investigated in this project.



Task

Apply gradient-free optimization algorithms to the problem of full waveform inversion

- Perform a literature review to identify potential gradient-free optimization algorithms
- Implement and incorporate the identified optimization algorithm within a full waveform inversion implementation
- Compare the results obtained by the different algorithms and identify the advantages and disadvantages of each algorithm in the context of full waveform inversion

Supervisors

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References

[1] Immersed boundary parametrizations for full waveform inversion, Bürchner, T., Kopp, P., Kollmannsberger, S., Rank, E. (2022)

[2] On the Use of Neural Networks for Full Waveform Inversion, Herrmann, L., Bürchner, T., Dietrich, F., Kollmannsberger, S. (2023)