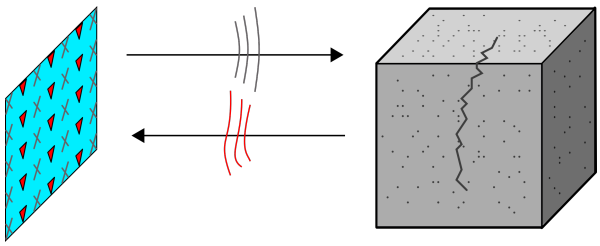
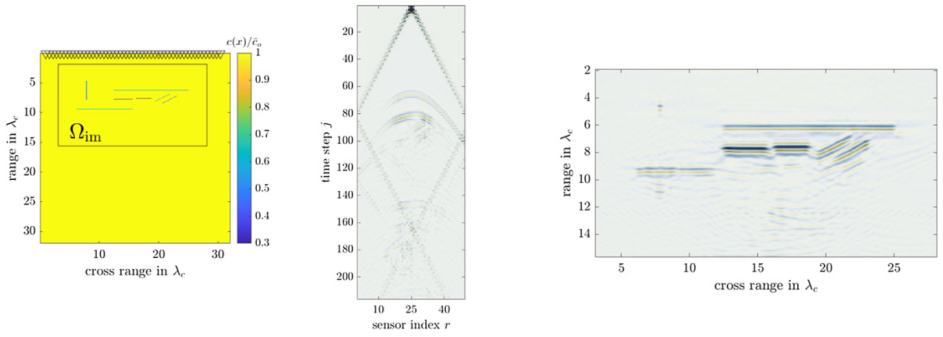
REMOVAL OF IMAGING ARTIFACTS WITH NN

Background Array imaging is at the core of many applications, for instance, medical ultrasound or radar imaging. An array is a collection of sources and receivers that emit probing pulses into an unknown object and measure scattered returns. In imaging, one tries to locate variation of the coefficients of the governing partial differential equation of the probed medium. Below you see an illustration of an example imaging configuration, with an array on the left sending probing pulses into the object on the right.



To be computationally tractable, many imaging methods make crude approximations, such as the single-scattering approximation, which assumes that a wave only scatters once inside the unknown object. This leads to imaging artifacts.

In the image below you see a typical measurement setup with sources and receivers on the surface probing a medium that contains several thin slanted inclusions (leftmost image). In the middle, an example of how the recorded scattering data looks is shown. An imaging algorithm takes this data and tries to reconstruct the medium, leading to an image shown on the right. The reconstruction contains clear artifacts and has trouble reconstructing some of the inclusions. In this project, we try to train a convolutional neural network to remove some of these imaging artifacts. We will try to do this with a recently published imaging algorithm.



Project description The main focus of this project is to investigate the use of neural networks for the postprocessing of results from imaging algorithms.

The goals of the project are

1. Gain a rough understanding of the imaging algorithm we will use[1]
2. Use this imaging algorithm to produce a training set. How we generate this training set is important since we can only reasonably expect the final neural network to perform well on images that are similar to the ones in the training set.
3. Discuss several possible neural network architectures for this problem
4. Implement a convolution neural network and investigate its performance

Suggested programming background: Python and TensorFlow

Supervisor: Jörn Zimmerling, Division of Scientific Computing, Department of Information Technology, jorn.zimmerling@it.uu.se

[1] Liliana Borcea, Josslin Garnier Alexander V. Mamonov, and Jörn Zimmerling, *Reduced order model approach for imaging with waves*, Inverse Problems 38-2, pp 025004 (2021), arxiv:2108.01609