# Master Project proposal

## Project Details

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| Title | **Seismic Data Interpolation with Deep Learning** |
| Institution / Company | **Aramco Europe, Delft Research Center** |
| Location | **Delft, the Netherlands** |
| Local Supervisors in Company | **Paul Zwartjes** |
| Miscellaneous | **This is a paid internship** |

Seismic data interpolation is a long standing challenge in the field of seismic data processing. Interpolation corrects for problems during acquisition (dead channels, deviations from orthogonal geometries), but also preconditions data for algorithms that require sampling at a denser grid. Various algorithms currently exist but they can be slow or cumbersome to parameterize and check for accuracy.

Roughly speaking, there are three classes of pre-stack trace interpolation methods: wave-equation based, prediction-error filter based (both requiring regular sampling) and Fourier/Radon transform based (for regular/irregular sampling). Recently, several attempts have been made to perform seismic data interpolation with deep learning frameworks such as convolutional neural networks and generative adversarial networks. These deep learning methods can be considered as a hybrid form of the data-adaptive transform and prediction filter approaches, without making any assumptions about the linearity of events or specific time/frequency transforms (Oliveira et al. 2018).

We want to explore these new methods and the ultimate goal is to develop a Deep Learning based method for interpolating noisy land seismic data that can compete with industry standard methods. In this project we will first focus on data reconstruction using decimated stacked seismic data. The approach will be via supervised learning, the network architecture needs to be chosen based on a literature review. The training data consists of fully sampled and decimated open-source seismic volumes, such as in the figure below. Once a successful algorithm has been developed we can move into the realm of pre-stack seismic data interpolation, using synthetic or real seismic data as training data.

## Work Environment

You will be working in our research team in Delft, where have several ongoing projects on seismic data processing and deep learning. Our office in Delft performs research in various signal processing method to improve seismic data processing workflows. We recently have started using techniques from Artificual Intelligence. Whereas in other fields many advanced tools have been developed, AI in seismic processing is only just getting started.

The team consists of a 11 researchers with varying university background and nationalities and is one of several worldwide that develops seismic data processing software for Aramco.   Our office is located in

the Delftech Park at Delft University and under normal (non-Covid19) circumstances the work is office based, but working from Amsterdam partially is possible. This is a paid internship.

## Expectations

Autonomous, self-motivating and taking initiative. Good knowledge of Python is required. Knowledge and skill in machine vision will be helpful given the nature of the project.

## Supplementary Documents

Kaur, H. , Pham, N., Fomel, S.,Seismic data interpolation using CycleGAN, SEG 2019
https://doi.org/10.1190/segam2019-3207424.1
Sen, S., Kainkaryam. S., Ong, C., Sharma, A. Interpolation of regularly sampled prestack seismic data with self-supervised learning., SEG 2019
Oliveira, D.A., R.S. Ferreira, R. Silva and E.V. Brazil, Interpolating seismic data with conditional generative adversarial networks, IEEE Geoscience and Remote Sensing Letters, 2018
Wang, B., Zhang, N., Lu, W., Intelligent shot gather reconstruction using residual networks, SEG 2018
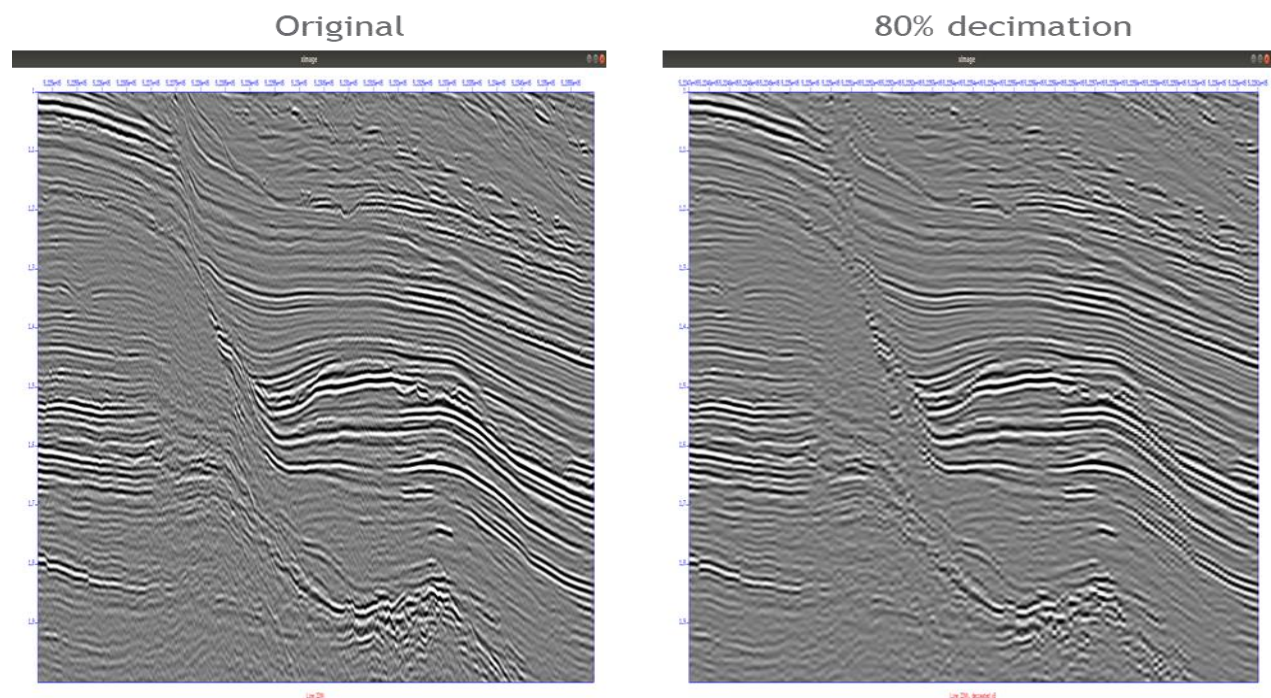
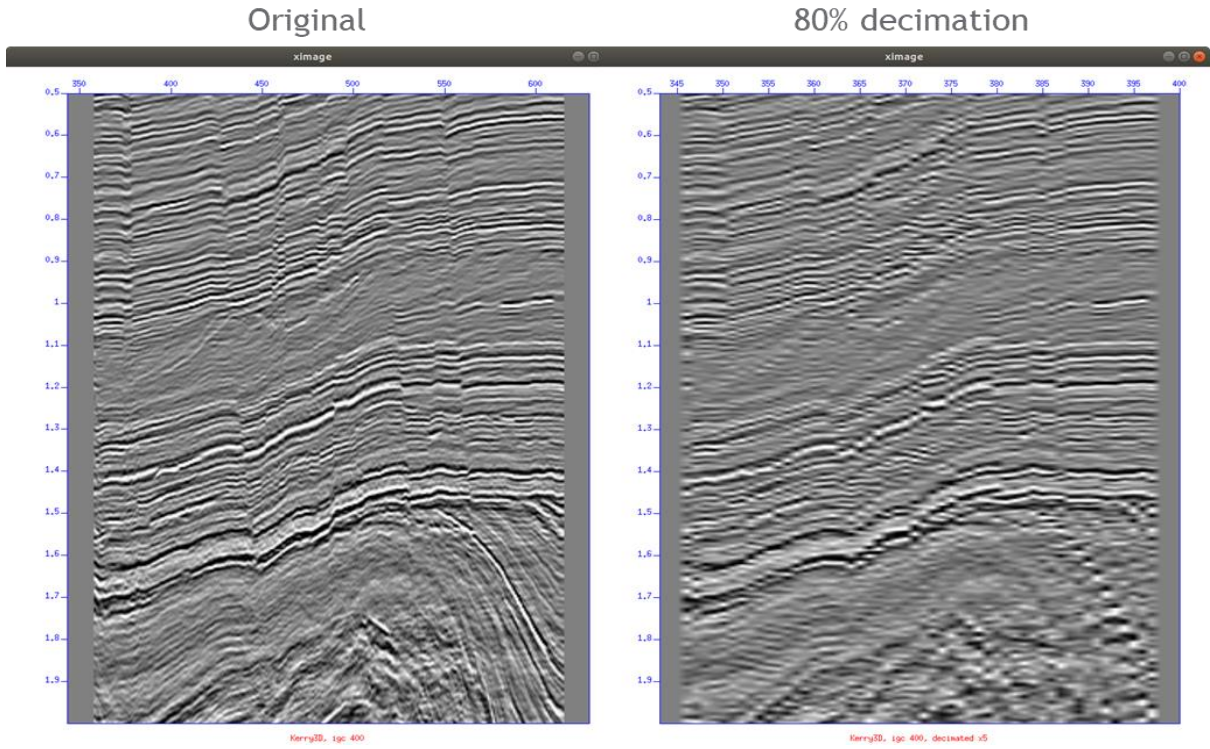**Figure 1: Original and decimated stack (factor 5 decimation)**

Original                                    80% decimation



**Figure 2 Another example of a      ` decimated stack**