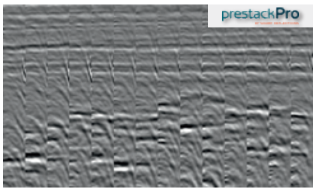
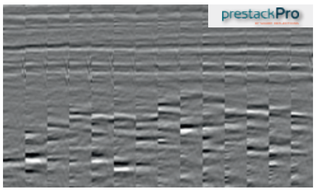
Deep Learning Speeds up Seismic Data Processing





Seismic gathers after prestack depth migration. Curved events (upper image) originate from multiple reflections and are recognized as such by the ML software and eliminated (lower image).

The energy supply of industrialized nations is increasingly based on a mix of different sources. Despite their diversity, they have one important feature in common: the nature of the earth's subsurface. Whether it is locating oil and gas fields, siting offshore wind farms, or identifying areas suitable for geothermal energy: Seismic data sets are measured, processed and interpreted to identify the geology of the subsurface. A research project of the "High Performance Computing" department investigates how Deep Learning methods can support this process.

Deep Learning (DL) has proven its usefulness in many application areas. For seismic data, however, the application is more difficult because the data originates from the unknown and inaccessible subsurface. DL methods that accelerate seismic interpretation are sought; most current methods are too complicated due to many parameters. The working group around Dr. Norman Ettrich has now achieved an important step: They have developed machine learning (ML) methods that do not require parameters. The subjectivity of human data interpretation is also eliminated.

Training through Supervised Learning

The basis is the training of deep neural networks. This is not uncommon, but so far the networks are trained on only part of the data and the learning steps are applied to the entire data set bit by bit. A neural network learns quickly what a cat looks like because it can be trained with photos of cats. This is completely different with seismic data: here there is no clear target image. That is why it trains on synthetic data that reflects the wide variety of real-world data.

"We train exclusively on synthetic data and transfer what we learn to arbitrary field data sets," says project leader Dr. Norman Ettrich. "This is successful because our data modeling excellently reflects the properties and diversity of real measured data. Our methods are used in processing. In simple terms, the input is data with interfering signals, the output is cleaned data. In other words, data without interfering signals, which makes interpretation much easier."

Enormous reduction in computing time

The newly developed methods simplify the seismic work chain. Above all they shorten the required working time by days and even weeks – in each case depending on the amount of data. And this can be huge, because areas of 1000 to 10,000 square kilometers are considered!

The new ML methods were integrated into the ALOMA software, which was also developed in the "High Performance Computing" department. The result is a software package for parallel ML-supported processing of seismic data.

Further information on our website www.itwm.fraunhofer.de/seismic

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