

# Utilizing Seismic Attributes for Machine Assisted Fault Detection and Extraction

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## Abstract

Seismic attributes and machine-assisted workflows enable geoscientists to identify and delineate structural and stratigraphic elements from 3D seismic in an efficient manner. Although there is a comprehensive list of available volume-based seismic attributes, the challenge is to select the appropriate ones that produce the desired results for interpretation purposes. Furthermore, seismic data is often masked by noise, which makes it difficult to extract useful structural and stratigraphic information. This paper discusses seismic data conditioning and seismic attributes analysis using machine-assisted model training and fault prediction techniques. The study was applied to Poseidon 3D data to pick faults that originated from consecutive extensional and inversion tectonic events. Post-stack seismic data conditioning remains a key challenge for geophysicists to preserve the seismic signal related to the subsurface whilst removing noise. Initially, noise cancellation is applied to remove coherent and random noise (from acquisition footprints and serrations along reflectors respectively) while preserving subtle details. A noise cancellation cube is used as input to generate fault likelihood, dip and azimuth volumes using Dave Hale's Fault Likelihood method that enables automated extraction of faults. The extracted faults are modified in a representative cropped 3D cube to generate labelled data as transfer learning to update the foundation Convolutional Neural Network (CNN) model that was initially trained on synthetic data. The new trained model is used to predict faults from the whole seismic cube and results are compared with the fault likelihood and foundation trained models. Seismic data conditioning can result in noise suppression and enhanced reflector continuity at depth. The transfer learning approach used to update the foundation model increased the accuracy of fault extraction when compared to the original foundation model and fault likelihood results. Major faults are accurately picked by the transfer learning model and are well connected vertically and spatially. Further model refinement is achieved by adding minor fault interpretation on a few representative lines to improve the minor fault accuracy in future runs. The applied approach significantly improves fault detection and extraction accuracy and reduces the overall time cycle of interpretation. It enables effective extraction of fault discontinuities from seismic data, which would otherwise be challenging to interpret using conventional techniques.