

Delineating Structural Geological Features in Poststack Seismic Data by Using an Unsupervised Learning Algorithm

Ahmed Adnan Aqrawi¹, Abdul-Razzaq Adnan Aqrawi²

¹Schlumberger

²Carnain

Abstract

There have been some considerable advancements made in the machine learning (ML) and artificial intelligence (AI) fields of study in recent years. Within the energy sector, specifically when looking at structural geological modelling and seismic interpretation, deep learning algorithms, also known as supervised learning algorithms, have dominated the research and commercial space.

There are three main forms of AI/ML, identified as supervised learning, reinforced learning, and unsupervised learning. Supervised learning is defined as an ML approach that is reliant on labeled training data, used to map examples of expected inputs and desired outputs. This makes it sensitive to the training data and requires minimal uncertainties. Reinforced learning is defined as an ML approach that is concerned with decisions that agents make and is assessed by a reward system to determine the intelligence of the decision. This differs from other forms of ML because it does not need training data and the crux of its success depends on how the rewards system is implemented. Unsupervised learning is defined as an ML approach that learns patterns and performs analysis based on predefined information. The algorithm relies on data that are predetermined, performs an analysis based on that, followed by implementing the best possible output match based on the predetermined data.

Our approach uses unsupervised learning. We base our predefined data on published methodologies that determined what the best practices are for any given situation that is encountered when analyzing post-stack seismic for structural geological features and interpretation. This results in adaptive operator sizes that adapt to the nature of seismic based on multiple factors, such as attenuation, frequency, noise, and amplitude content, to name a few. Furthermore, the filter selection is also automated based on a multitude of parameters, selecting the best match for each scenario, on a voxel by voxel as well as a regional basis. The results have shown to be very promising, rivaling those of supervised learning algorithms and, occasionally, generating more detailed and accurate results.