A Transfer Learning Approach to Rock Property Estimation Workflows

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Abstract

Knowledge of rock properties can help geophysicists better identify hydrocarbons in the subsurface. Rock properties can be measured directly from boreholes in a seismic survey. However, wells are very scarce in a seismic survey due their high cost. Existing machine learning models are used to learn a functional mapping from seismic data to rock properties using well-log data as labels. Once trained, this learned mapping is used to estimate rock properties throughout the survey volume. One challenge that is commonly faced by machine learning-based property estimation approaches in the extremely limited number of labelled training examples in seismic surveys (i.e., well-logs). With only a limited number of wells, machine learning models can easily overfit to the few available wells and fail to generalize beyond the training data. In order to overcome this challenge, we propose a novel transfer learning workflow that is trained on a source dataset that has an abundance of well-logs. Then, the learned knowledge from the source dataset is used to improve the estimation of a target dataset, which has only a limited number of well-logs.Another limitation of the current machine learning algorithms for property estimation is that they are mostly based on 1D trace modeling. This results in vertical discontinuities in the computed property volumes using such a model, since it becomes sensitive to lateral changes in seismic data. In this work, we also propose designing a specialized deep learning architecture based on sequence modeling and convolutional neural networks that is able to take in its field of view the seismic data laterally as well as along depth, which would improve the robustness of our predictions. Preliminary experiments show promising results compared to learning only from the target dataset.