Abstract

Autoencoders for Seismic Model Upscaling and Facies Identification

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The research presented here focuses on the use of autoencoders for geological facies identification from inverted seismic models as well as the use of multiple autoencoders for resolution upscaling of both seismic models and facies maps. In the first section I focus on generative neural networks in the form of variational autoencoders to improve the resolution of inverted seismic models. In the second section I focus on the utilization of autoencoders to identify spatially small geologic features.

In section one I focus on the processing and inversion of seismic data from the 3D Penobscot field to produce models for P – Impedance. The dataset is inverted twice, first using a deterministic method, and secondly using a stochastic method. The stochastically derived models contain higher frequency content than the deterministic models and are used as the target for the task of resolution enhancement. A variational autoencoder is given the two model types and tasked with learning the correlation between the lower frequency deterministic models and the higher frequency stochastic model so that a deterministic model can be fed into the network after training and produce a higher frequency counterpart.

In section two I characterize a seismic volume from the Marco Polo Formation and classify five distinct facies, a shale member, an oil sand member, a gas sand member, and discrete brine sand members corresponding to the sand units. The brine sand members are created through fluid substitution and then have their probabilistic properties derived through a rock physics template. Bayesian classification is used to create an initial facies map which is then used to train an autoencoder to create a binary probabilistic facies map from P-Impedance and Vp/Vs models. The network was created specifically to predict spatially small geologic units and can accurately predict the locations of learned units when provided down sampled seismic models, though the probabilities suffer as a result of the down sampling.

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