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High-Resolution Seismic Data Segmentation using Deep Pyramid Scene Parsing Models with Cascade

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ABSTRACT

High resolution subsurface imaging has been identified as one of the six grand challenges for the petroleum industry. Obstacles to solution of this challenge are remote-sensing limitations imposed by the rock physics, instrumentation limits and computations challenges. This paper contributes to the solution of computational challenges by providing application of CascadePSP, a deep learning model, for high resolution seismic-segmentation. Specifically we validate performance of the model on subsurface salt identification.

Proposed approach uses Pyramid Scene Parsing (PSP) networks to extract seismic features from 2D images, irrespective of input-image resolution. It compliments PSP with an implementation of Cascade, that performs multi-level refinement of extracted features and calculates losses using segmentation-labels, that is generated by exploiting ground truth labels. Ground truth label in case of subsurface salt-body segmentation is a 2D image with pixels labelled as salt or sediment. It captures multiple imperfect seismic-segments and refine them to obtain high-resolution segmentation.

For the case of salt-segmentation, the proposed model achieves 92% accuracy, as measured by Intersection-over-union. PSP network is made of a max-pooling layer, followed by convolution layers, upsampling layers and finally a concatenation layer. It extracts seismic features from the input irrespective of their resolution. Further Cascade modules in the proposed method introduces two-step refinement for different seismic segments. It reduces spatial dimensions of extracted seismic features, then recovers them and finally refine them. Specifically for salt-segmentation we used single channel grayscale images with boundaries between different rock types. Though the results in the paper present segmentation of salt-bodies, the presented methodology will generalize to other seismic interpretation methods such as facies classification, fault detection etc.

Novelty of the paper lies in presentation of a unique deep learning model, to produce high-resolution segmentation of seismic images.

Kumar, A. and A. Priyadarshan, 2021, High-resolution seismic data segmentation using deep pyramid scene parsing models with cascade: GeoGulf Transactions, v. 71, p. 437.

NOTES