Using Machine Learning to Interpret Seismic Data Like a Human

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ABSTRACT

Machine learning approaches to seismic interpretation have been gaining traction over the last few years, yet results which have made it into the literature have not yet exhibited any breakthroughs. One major problem, in our opinion, seems to stem from the focus on wavelet-based methods. Although traces and their phase-rotated imaginary counterparts are the fundamental building blocks of seismic data, they do not directly reflect the geology they record in the subsurface, as they are composed of a potential multitude of constructive and destructive interference patterns which depend not just on the local geology, but are actually a blend of reflection coefficients dependent upon the frequency of the wavelet. Therefore, a seismic record can be reflective of a range of geological possibilities in the subsurface, and any individual wavelet can be interpreted in several different ways. Further, typical autotracking methods attempt to pick acoustic (lithostratigraphic) boundaries instead of chronostratigraphic surfaces. To get away from the adherence to the wavelet itself, we postulated that we could use deep learning to interpret seismic data in a 'fuzzy' way, more akin to the pattern recognition that humans use when applying seismic stratigraphic techniques. To test this idea, we took several 3D datasets and interpreted intervals with differing seismic stratigraphic expressions on three lines per dataset. This comprised the extent of the training data for each dataset. We then used a series of deep learning and statistical algorithms to first teach the machine to interpret, and then to apply this interpretation across each of the 3D datasets. The results are very encouraging and we hope will lead to new tools for machine-augmented workflows.

Dykstra, M., B. Lasscock, B. Hall, and M. Seeber, 2019, Using machine learning to interpret seismic like a human: GeoGulf Transactions, v. 69, p. 491.