Adapting and Tuning Edge Detection Seismic Attribute Calculations Based on Post-Stack Seismic Characteristics

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Abstract

Post-stack seismic data is highly varying in nature. Its characteristics of amplitude, frequency and phase change substantially throughout the seismic signal. Traditionally, when calculating seismic attributes, a set of parameters are selected and the computation is run on the entire cube. This has often proven to be difficult in obtaining reasonable results throughout the cube due to challenges such as signal attenuation. The major drawbacks of having a static operator size is the fact that one is either overestimating or underestimating the calculation radius of the seismic attribute leading in either losing information or adding geological noise to the results (Aqrawi and Barka, 2013). This is mainly due to the operator size being too small or too big for the current calculation. In this study, we look at the modified 3D Sobel filter (Aqrawi and Boe, 2011) for edge detection on post-stack seismic. By modifying these calculations to take into account frequency, attenuation, seismic texture and dip, we are able to calculate an adapting operator size that changes with the computation to gain an optimal calculation. As such, per computation we first find the optimal operator before proceeding to compute the same Sobel calculations as done previously. To validate this work, we have focused on two data sets from the North Sea; One, in the Norwegian North Sea, and the other in offshore Netherlands. Both data sets have challenging structural components and exhibit a varying seismic signal. The validation is performed as a comparison study between the traditional approach and our adaptive version of the edge detection attribute. Our results show an improvement in the reduction of noise, an enhancement in the continuity of the fault/edge features, and ultimately a better understanding of the structural components in the data sets. In conclusion, this method is a new way of approaching seismic attribute calculation as a whole and can be applied to various calculations. It is unique and novel in that it adapts and tunes its calculations to the seismic signal. And our results show improvements and detection of details not seen before, with a substantial reduction in geological noise.