Global Stochastic Inversion for Under-Sampled Reservoirs

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Abstract

Geostatistical seismic inversion of under-sampled reservoirs at early exploration stages is still a research challenge, given the lack, or total absence of conditioning data for the inversion. In this study the available information is a 2D seismic line, the final section of interval velocity obtained from seismic processing and seismic horizons resulting from traditional seismic interpretation. No well information is available in the area.

The Global Stochastic Inversion is an iterative geostatistical seismic inversion based in the use of the sequential direct co-simulation as the perturbation method of the model parameter space that follows the sequential procedure of a genetic algorithm optimization to converge the generated models towards an objective function (Soares et al., 2007).

The first step of the proposed methodology consists on the generation of a pseudo-log of acoustic impedance. This was accomplished with the following sequence of steps: i) creating an initial pseudo-log extracting a trace from the interval velocity section and using Gardner's relationship to calculate the density and therefore the acoustic impedance, and ii) generating the final pseudo-log of acoustic impedance, following a model-based inversion optimization, with a low frequency model generated from the initial pseudo-log (i) and taking into consideration the geological interpretation.

In a second stage two approaches were considered to perform the GSI: 1) implementing, in the first iteration, the simulations with local variable mean of an initial low frequency model created by the interpolation of the pseudo-log and taking into consideration the geology of the area, and 2) using a model of geological zones and condition the GSI to the local acoustic impedance distributions taken from the well log. The results show that the proposed approach allow us to explore different scenarios regarding the spatial distribution of acoustic impedances and assessing the corresponding uncertainty of them. Another important issue is about the quality of seismic data: in zones where the quality of the seismic data is doubtful the variability of final acoustic impedance images is high, which mean they are poorly matched at the end of the inversion process. The advantage of this seismic inversion technique is: do not need log data in the area to be inverted and being possible to use logs from other places with a similar geology. This makes this technique suitable for under-sampled reservoirs.