SALT MODEL BUILDING BY SHAPE-BASED PARAMETERIZATION AND GLOBAL FWI

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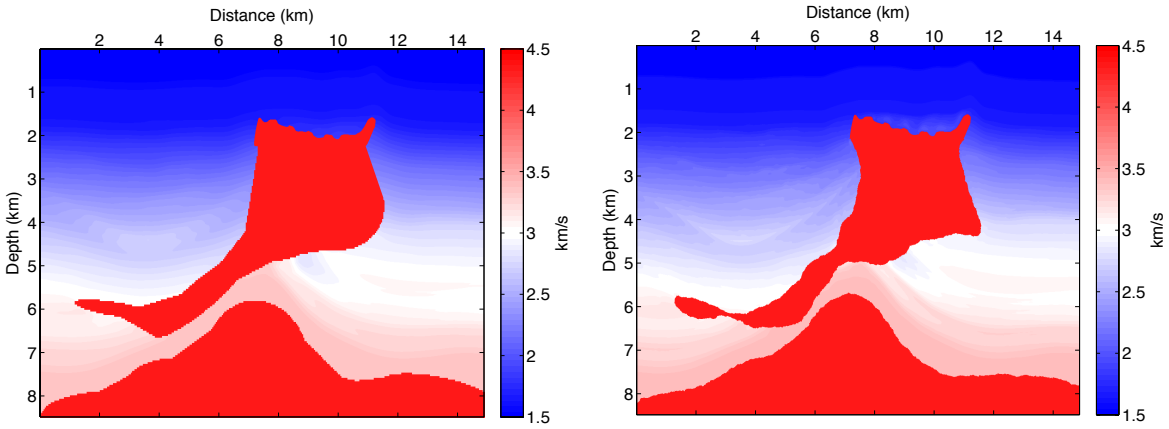
ABSTRACT

Full Waveform Inversion (FWI), as predominantly used in the petroleum industry today, solves a least-squares inversion problem by using a local gradient-based optimization method which estimates an earth model by iteratively updating a starting model. Imaging a salt body using conventional FWI is a very difficult task because of the large velocity contrast and absence of a good starting model. Global optimization methods have not been widely used in problems with a large number of model parameters due to dramatically increased computational cost even though they are not strongly dependent on the starting model. Here we employ a global optimization method for building velocity models with salt bodies using a sparse parameterization. To avoid having a large number of parameters and to impose realistic constraints, we fix the top of salt and describe the rest of the salt body using a set of ellipses while the sediments are parameterized by a set of interfaces and velocities. The positions of the interfaces along with the location, orientation and the eccentricity of the ellipses are the model parameters that we search for using Very Fast Simulated Annealing (VFSA), while fitting the seismic waveform data. This proposed sparse parameterization approach greatly reduces the number of parameters, enabling the VFSA algorithm to converge within a reasonable number of iterations. The VFSA model captures the salt body fairly accurately and is used subsequently in a local FWI with level set decomposition to extract the true salt shape and sediment velocities.



Model after 200 iterations of VFSA. The model resembles the true salt fairly well (left). **The final model (right) after two runs of partitioned FWI using 4Hz and 5Hz central frequencies. The estimated salt is much closer to the true salt, and the background velocity has also been updated in the correct direction.**