SUMMARY

Full waveform inversion (FWI) provides us with the opportunity to utilize the full wavefield to build a high-resolution velocity model with very limited human intervention or bias. For complex salt bodies, it implies high-resolution description of the salt body free of top and bottom of the salt picking and salt body flooding. High velocity contrasts in the Earth (like those given by salt bodies) pose an inherent problem to the Born-approximation based gradients of waveform inversion. These gradients, even if properly preconditioned with the Hessian, are based on small perturbations with small support. Delineating the bottom of the salt is especially challenging in waveform inversion as it relies on the wavefield transmission through the salt. This induces incredibly high nonlinearity of the wavefields with respect to the perturbations in the salt or subsalt regions of the model, which requires very large number of FWI update iterations imposing a top-to-bottom strategy. The cost is exacerbated by the necessity to invert high frequencies (at the large cost of fine sampling) to develop the salt bodies sharp boundaries. Alternatively, salt body flooding within FWI have been utilized over the years to handle salt bodies, however, it requires massive manual intervention including salt body picking. In our lab, we recast the problem from inverting for velocities and impedances to inverting for velocity variations. This allows us to have a better definition of large vertical variations, and as a result, the linearized relation to these changes are better equipped to handle the large contrasts. This is accomplished by utilizing the source-shift wave equation developed by Alkhalifah (2010). We also utilize multi-scattered energy in the inversion, as the majority of the waves penetrating the salt experience multi scattering from the salt edges. The presentation will include an overview of such approaches with numerical examples that demonstrate the effectiveness of the proposed approaches.