# Angle-Dependent Full Waveform Inversion

**Woodon Jeong[1], Constantinos Tsingas[1], and Young Seo Kim[1]**

[1]Saudi Aramco, Dhahran, Saudi Arabia.

## ABSTRACT

Seismic full waveform inversion (FWI) has been an important tool for velocity model building for depth imaging. FWI is an iterative optimization process which minimizes the error between recorded data (field data) and modelled data (synthetic data). For the successful implementation of FWI, several prior conditions are required such as a low frequency component in the observed data, a good initial guess for the velocity model and long offset data. Without these conditions, conventional FWI applications which have highly non-linear solutions can easily converge to local minima. However, the low frequencies and long offsets are not always available. Therefore a good initial velocity model is required for a successful FWI application to field data. In this work, we present angle-dependent full waveform inversion (ADFWI) based on subsurface reflection angle. During reverse time migration, images obtained from large reflection angles are regarded as low frequency artifacts. However, this type of signal reveals long wavelength information of the subsurface model and thus could be useful for FWI. By applying optical flow methodology within FWI, forward (source-side) and backward (receiver-side) propagated wavefields are decomposed into subsurface angle domains. Based on this subsurface reflection angle, a filter or a weighting function is designed and applied to the gradient direction computation during FWI. Using only large reflection angles, a long wavelength gradient direction is estimated which provides an update for the background velocity model. Then, ADFWI can converge on long to short wavelength velocity structures by relaxing the range of the subsurface angles under consideration at each iteration. Consequently, ADFWI can give more accurate and stable results than conventional FWI workflows.