Suppressing Scattered Energy Effects Using Surface-wave Analysis: An application on Land Seismic Data

Najoud AlOtaibi[1], Dmitry Nikolenko[2]

[1]Saudi Aramco
[2]Schlumberger

Abstract

Sand dunes in land seismic data are a major terrain complexity, the presence of these sand dunes that are parted by flat salts (sabkhas) causes challenges for seismic data acquisition leading to poor data quality. The data quality suffers from both high random noise levels and distorted signal amplitudes. In addition, the complex propagation of seismic waves in sand dunes results in the generation of scattered energy on the near offsets of shot records. This scattered energy is often construed as ground roll energy cone. The conventional attempts to address such high amplitude noise is by using an f-*k* filter which has shown smearing effects on the data, thus compromising the fitness of the data for amplitude versus offset analysis. In this study, we propose to deploy an unconventional method which is the Surface Wave Analysis Modeling and Inversion technique (SWAMI) to suppress the scattered energy. SWAMI utilizes the dispersive properties of the surface waves and the picking of the high energy modes on the dispersion curve. The data has no dominant energy (fundamental mode) due to the near-surface complexity and/or the array forming of 9 geophones per receiver group. Approximately, 80% of the data is dominated by scattered energy with high modes. After analyzing and picking the dispersive velocity of the surface wave using a machine learning picker over the 3D seismic volume in this study, we carry out the noise modelling process and consequently suppress the scattered and aliased energy. By employing SWAMI method, we generate 3 noise models that are one direct ground-roll component with two iterations of scattered energy. These noise models were then adaptively subtracted from the raw data. The results of applying SWAMI showed an effective suppression of both scattered and aliased surface wave energy with superior results compared to that conventional velocity discrimination techniques. This method suppressed noises below 20 Hz, this further was confirmed by running post stack migration before and after SWAMI, and the results revealed that this method suppressed remnant migration swings from the low frequency noise of the ground-roll.