Application of Signal Processing Tools in the Interpretation of Geophysical Seismic Data

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Abstract

Expensive to acquire and almost impossible to re-acquire, seismic reflection and refraction data sets are no doubt the most important assets of any hydrocarbon exploration and prospecting program. During exploration, seismic images of the earth's shallow subsurface are scrutinized by interpreters, whose prerogative is to search for patterns indicating possible hyrdrocarbon reservoirs. One of the most striking features of these seismic signals is their highly non-stationary character, making such interpretations time-sensitive. Raw data sets need to be processed for time and depth corrections, posing some of the most challenging aspects of signal processing techniques, making use of relevant algorithms to eventually help extract the maximum possible information of the subsurface earth from each such data set. However, the tools for information extraction used until recently did not take into account the fundamental non-stationary character of seismic data, and the quality of information extraction suffered as a result. However, at present, high-resolution time-frequency representation technique provides a natural domain for analyzing and processing such non-stationary data. This technique can measure the local changes in frequency and scale content of a signal in the data set. In this paper we present the applications of this advanced signal processing and analysis technique to solve problems related to geophysical seismic data especially applicable to hydrocarbon exploration and prospecting. One of the latest digital signal processing tools is MATLAB (Matrix Laboratory), from MathCAD, which can be used to analyze, interpret, and process seismic data to specialized graphics features required in engineering and scientific practices. With the latest trends in research turning interdisciplinary, MATLAB acts as a perfect example to bridge between the domains of electrical engineering and geosciences.

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