Rotation Effect Minimization On Drill Bit Sound Signal

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Abstract

To predict lithology in real time and optimize drilling operations, a system consisting of hardware and software was developed to record and process the drill bit sound. Two field trials have been conducted with this system. Data from both trials indicate that the drill bit rotation can significantly affect the drill bit sound and undermine the potential of deriving lithological information. Herein, we propose the spectral mean normalization method to minimize these effects.

The proposed method consists of four steps in total. Firstly, the entire records are divided into small depth sections using rotation rate log. Each of these depth sections is associated with a nearly constant rotation rate. Secondly, a reference spectral mean curve is calculated in the frequency domain. Thirdly, a proportional spectral mean curve for each depth’s record is derived from the reference spectral mean curve using the rotation rate data. Lastly, the drill bit sound is normalized with the scaled spectral mean curve to result in a drill bit sound record with a minimal drill bit rotation effect.

A field trial drill bit sound data is tested to evaluate the performance of the proposed method and an apparent power attribute is used for the testing. The apparent power here refers to a power calculation within the given frequency range. Before using the normalization method, the calculated apparent power values between sections of nearly zero rotation rate and rotation sections of a rotation rate that is consistently higher than zero usually have large ‘step gap’, which affects the further interpretation of the results. After using the proposed method, the calculated apparent power values from these two sets of sections appear aligned, which make the further interpretation easier and indicate that the proposed method have effectively minimized the rotation effects from the drill bit sound signal.

The proposed method can help to successfully minimize the rotation effects from the drill bit sound signals, which is critical to derive robust lithological information in real time. Such information can be provided to optimize drilling operations for all the drilled geologic layers at relatively low cost.