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Design of acoustic transmission along drill strings for logging while drilling data based on adaptive NC-OFDM

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Abstract

This paper represents a new scheme using the drill strings as the medium to deliver logging information via a compressional acoustic wave. Considering the comb-type frequency characteristics of an acoustic channel, non-contiguous orthogonal frequency division multiplexing (NC-OFDM) has been selected as a promising technique for achieving high-rate transmission with high spectral efficiency and immunity to multipath channels. However, the irregular pilot design and high peak-to-average power ratio (PAPR) halted the widespread application of NC-OFDM. To overcome these two disadvantages, we propose an adaptive pilot design scheme in which the dynamic range of available frequency is presimulated and an improved discrete Fourier transformation based least square (PDFT-LS) channel estimation scheme to obtain the channel characteristics and an improved selected mapping (PSLM) scheme with low-complexity to reduce the PAPR of the transmitter are applied. Computer simulation and circuit test results are presented to demonstrate that the data transmission rate can be in excess of 500 bps along a 53.76 m experimental channel under the conditions of the simulated impulse noise and surface noise with a low bit error rate (BER), and the PAPR reduction performance can reach almost the same as that of a

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