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Audio Frequency Track Circuits Monitoring Based on Wavelet Transform and Artificial Neural Network Classifier

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***Abstract*— The problem of revealing and identifying of signal disturbances in audio frequency track circuits is considered in the article. Track circuits are a key component of automatic train control system and used to detect whether the rail section is free or occupied. Amplitude-modulated signals used in track circuits have low noise immunity, therefore the power wide-band-frequency interference generated by an electrified railway can cause failure operation of track circuits. To ensure the safety of the track circuits, they are subjected to periodic maintenance with registration of the signal current to the computer and measurements of its parameters. The detection of time intervals during which the interference in the track circuits exceeds certain limit values is performed by simple visual analysis of the recorded signal and is time consuming and expensive. In order to automate the revealing and identification of disturbances in audio frequency track circuits with values exceeding the certain level, a new method for processing the of the recorded signal have been proposed. At the first stage of the proposed method, the segments of a signal with interference exceeding a certain permissible level are revealed using the wavelet packet energy Shannon entropy. At the second stage, for the revealed segment with disturbances, a detailed analysis of the signal should be carried out using the digital wavelet packet transform to determine the type and parameters of the disturbances. For automatic identification of the track circuits signal disturbances, an artificial neural network classifier has been used. As a result of investigation the features of the signal disturbances in audio frequency track circuits have been extracted. The processing of the track circuits signals in accordance with the proposed method show high effectiveness in the revealing and identification of the signal disturbances.**

Keywords— track circuits, wavelet transform, wavelet entropy, artificial neural network.

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