Another constraint of STFT is related to the side-lobe levels of the window in the frequency domain, which leads to a decrease in the measured values of the RMS current of the har-monics and in some cases can even to hide the weak harmonics against the back-ground of strong harmonics. To improve the accuracy of the spectral analysis of the traction current, it is necessary to correctly choose the parameters of the win-dowed FFT.

In the work the correct choosing of the windowed FFT parameters to achieve the necessary time and frequency resolution of the traction current spectral analysis in accordance with the requirements of regulatory documents has been investigated.

Dynamic range of the traction current harmonics for AC TC is 46 dB for fre-quency band 21-29 Hz, 55 dB for frequency bands of TRC-3, and 60 dB for fre-quency bands TRC-4 (for TC 200 A).

The requirement that the duration of the harmonics defined by the standard can-not exceed 0.3 s, together with the restriction on the values of the frequency and time resolutions, should also be taken into account when selecting the window type, especially in the frequency range from 19 Hz to 58 Hz, which contains very closely spaced harmonics, which are specified by the standard.

For the spectral analysis of traction current, four types of windows were select-ed: rectangular, Hann, Hamming and Blackman windows with duration of 0.3 and 1 s. For a sampling frequency of 27500 Hz and a window length of 0.3 s, the fre-quency resolution is 0.27 Hz for a rectangular window, 0.54 Hz for Hann and Hamming windows and 0.81 Hz for Blackman's window, which is consistent with the requirements of the specifications.

The results of spectral analysis of traction current showed that the frequency resolution of harmonics, and accordingly the relative error in determination the frequency and the RMS value of harmonics is lower for high frequencies in spec-trum.

Havryliuk V. I., doct. of phys.-math. sci., professor (DNURT)

WAVELET BASED DETECTION OF SIGNAL DISTURBANCES IN CAB SIGNALLING SYSTEM

The problem considered in the work is concerned to the methods to reveal and identify the signal disturbances occurred in the railway cab signaling system caused by electromagnetic interference from traction current. The continuous automatic locomotive signalling system (ALSN) is a type of cab signalling systems that provides track status information to the train cab and uses the rails as a continuous communication channel between track and train. To ensure the reliability of the transmission of ALSN commands to the train cab, the basic parameters of the coded current are periodically checked for compliance with certain requirements during planned test trips of a specially equipped railway car-laboratory. The ALSN signal is received by the coils of the car-laboratory and recorded by computer. Then an operator visually analyzes the recorded signal to detect problem segments with interference exceeding the limit level what requires a lot of time and does not provide the necessary accuracy.

The purpose of this work is to investigate the effectiveness of the proposed algo-rithm for the automatic revealing and identifying of electromagnetic interference in the ALSN signal, based on discrete wavelet packet transform, wavelet packet ener-gy Shannon entropy and an artificial neural network for EMI classification.

To automate the detection and identification of the ALSN signal disturbances, the following algorithm has been proposed. At the first stage, the wavelet packet energy Shannon entropy is used to reveal problem segments of ALSN signal. At the second stage, a detailed analysis of the ALSN signal using DWPT is performed to determine the type and parameters of interference at the revealed problem seg-ments.

By using three-level DWPT decompositions of ALSN signals the features of main signal disturbances have been extracted. The wrong number of pulses in the ALSN signal is proposed to detect by a relative number of pulses (RNP). Long-term electromagnetic interference with amplitude exceeding the permissible level can be revealed by the relative energy (REN) of the DWPT coefficients in the wavelet decomposition nodes. To detect sharp pulses in the ALSN signal, it is pro-posed to use the kurtosis of the DWPT decompositions coefficients of signal.

To classify the ALSN signal disturbances the three-layer feed-forward artificial neural network with three input nodes, a hidden layer, four output nodes and sig-moid function neurons was used. The overall mean square error of the trained neu-ral network is 0.031043 and the testing and the validation curves have similar characteristics which is an indication of efficient training.

The performed investigations have confirmed the effectiveness of the proposed algorithm of computer processing of ALSN signals for revealing and identifying of the ALSN signal disturbances.

Havryliuk V. I., doct. of phys.-math. sci., professor (DNURT)

FAULT DIAGNOSTICS OF THE NEUTRAL SIGNALLING RELAY ARMATURE

Signalling relays are used for safety critical and safety related applications in railway signalling systems, so they should be properly maintained and periodically tested to ensure their safe and reliable performance. During relay test sets the oper-ating voltage, contact and coil