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Analysis of Power Quality Based on Machine Learning Methods for Low-Voltage Electrical Distribution Lines

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Abstract: *The main objective of this paper is to propose two innovative monitoring methods for electrical disturbances in low-voltage networks. The two approaches present a focus on the classification of voltage signals in the frequency domain using machine learning techniques. The first technique proposed here uses the Fourier transform (FT) of the voltage waveform and classifies the corresponding complex coefficients through a multilayered neural network with multivalve neurons (MLMVN). In this case, the classifier structure has three layers and a small number of neurons in the hidden layer. This allows complex-valued inputs to be processed without the need for pre-coding, thus reducing computational cost and keeping training time short. The second technique involves these of the short-time Fourier transform (STFT) and a convolution neural network (CNN) with 2Dconvolutions in each layer for feature extraction and dimensionality reduction. The voltage waveform perturbations taken into consideration are: voltage sag, voltage swell, harmonic pollution, voltage notch, and interruption. The comparison between the two proposed techniques is developed in two phases: initially, the simulated data used during the training phase are considered and, subsequently, various experimental measurements are processed, obtained both through an artificial disturbance generator and through a variable load. The two techniques represent an innovative approach to this problem and guarantee excellent classification results.*

Keywords: convolution neural networks; electrical disturbances; short-time Fourier transform; multilayer neural networks with multivalve neurons; power quality.

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