DATA PRE-PROCESSING EFFECT ON CLASSIFICATION ACCURACY OF CONVOLUTIONAL NEURAL NETWORKS FOR TRAIN TYPE IDENTIFICATION

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Increased dynamic forces in railway switches and crossings (S&C) due to interruption of the rail geometry are responsible for the frequent formation of defects, and identification of train type is a crucial step in the development of condition monitoring system for S&C. Accelerometer data collected by in-situ measurements near the common crossing from two locations in the Czech Republic were used for training and validation of machine learning models. Several architectures of convolutional neural networks (CNN), successfully applied in the previous research for electrical grid analysis, were evaluated in this paper for the problem of locomotive type identification with regards to the number of parameters and the size of the available dataset, which was limited in this case. Therefore, time-series pre-processing techniques aiming to improve classification accuracy by removing noise were incorporated, including Butterworth low-pass and high-pass filters as well as Wavelet threshold filter. Results for raw and filtered data are presented as mean confusion matrices to evaluate the statistical significance of the adopted methods. Due to the limited amount of available data, more complex models with a larger number of layers and trainable parameters exhibited similar accuracy as simpler models. In this case, pre-processing techniques did not improve the performance of the CNNs as high-quality data were already used. However, signal filtering and denoising may be necessary step for future application of developed system in combination with data from inexpensive sensors. Different time-series classification approaches that include end-to-end learning, pre-processing and feature selection are discussed. This paper contributes to the understanding of train type identification problem in railway S&C as well as defines requirements for a minimal amount of data and evaluates pre-processing techniques with regards to the intended in-situ application.