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ROZPRAWA DOKTORSKA

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Identyfikacja poruszającego się pojazdu na podstawie sygnałów wibroakustycznych

Identification of a moving vehicle on the basis of vibroacoustic signals

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ABSTRACT

The dissertation presents a novel method for recognizing the type of a moving rail vehicle. The course of research consists of the following stages: registration of vibroacoustic signals, normalization of signals, preliminary statistical analysis, selection of wavelets of WT (Wavelet Transform) analysis, MODWT (Maximal Overlap Discrete Wavelet Transform) analysis, completing the database with information about the relative energy of the signal, compilation of results and determination of features that distinguish rail vehicles in terms of the information capacity of the vibroacoustic signal, final classification of the type of vehicle.

The measurement process consists of recording vibration signals of the rail in three orthogonal axes and synchronous measurement of sound pressure. At the signal processing stage, a preliminary analysis of global statistical measures and wavelet analysis based on MODWT were applied. After selecting the appropriate wavelet and performing MODWT analysis, measures of relative energy of signals were determined by predefined decomposition levels.

The developed method makes it possible to initially identify the type of rail vehicle and determine the characteristic features of the vibroacoustic signal. It can be used to support the identification of vehicles by vibroacoustic methods, as well as for the analysis of various types of vehicles. The current state of research makes it possible to classify into the following groups of rail vehicles: passenger trains (P), freight trains (T), electric multiple units (E) and locomotives/trucks running "solo" (L).

Chapter one of the dissertation presents methods for identifying vehicles in motion, which are further divided into road and rail transportation. It presents existing identification systems based on vibration and noise. Chapter two presents an analysis of the mechanisms by which rail vehicles generate vibroacoustic signals, and the factors affecting the vibration and noise of moving railroad depots are presented. The third chapter introduces the topic of suprastructure in rail transportation. The fourth and fifth chapters are intended to present the positioning of the work's own research, the purpose, thesis, scope, and research hypotheses set. Chapter six describes the research method, its assumptions, and the research plan. The seventh chapter introduces the measurement topic, in which sample results of vibration and sound pressure measurements are presented. Chapter eight is an attempt to analyze the Doppler effect on the measurements carried out. The ninth chapter presents a presentation of the results of the measurements carried out as well as an algorithm for proceeding with the development of the method and its verification. Chapter ten, on the other hand, is a summary of the dissertation.

KEYWORDS: TRANSPORTATION, IDENTIFICATION, VIBROACOUSTICS.