World Academy of Science, Engineering and Technology
International Journal of Transport and Vehicle Engineering
Vol:13, No:09, 2019

1-D Convolutional Neural Network Approach for Wheel Flat Detection for Freight Wagons

Authors : Dachuan Shi, M. Hecht, Y. Ye

Abstract : With the trend of digitalization in railway freight transport, a large number of freight wagons in Germany have been equipped with telematics devices, commonly placed on the wagon body. A telematics device contains a GPS module for tracking and a 3-axis accelerometer for shock detection. Besides these basic functions, it is desired to use the integrated accelerometer for condition monitoring without any additional sensors. Wheel flats as a common type of failure on wheel tread cause large impacts on wagons and infrastructure as well as impulsive noise. A large wheel flat may even cause safety issues such as derailments. In this sense, this paper proposes a machine learning approach for wheel flat detection by using car body accelerations. Due to suspension systems, impulsive signals caused by wheel flats are damped significantly and thus could be buried in signal noise and disturbances. Therefore, it is very challenging to detect wheel flats using car body accelerations. The proposed algorithm considers the envelope spectrum of car body accelerations to eliminate the effect of noise and disturbances. Subsequently, a 1-D convolutional neural network (CNN), which is well known as a deep learning method, is constructed to automatically extract features in the envelope-frequency domain and conduct classification. The constructed CNN is trained and tested on field test data, which are measured on the underframe of a tank wagon with a wheel flat of 20 mm length in the operational condition. The test results demonstrate the good performance of the proposed algorithm for real-time fault detection.

Keywords : fault detection, wheel flat, convolutional neural network, machine learning
Conference Title : ICRCM 2019 : International Conference on Railway Condition Monitoring
Conference Location : Tokyo, Japan
Conference Dates : September 09-10, 2019