CNN-Based Learning Algorithm Utilizing Smart-Grid for Real-Time Detection of Railway Ballast Integrity Postprint

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Abstract

Railway ballastless track is critical for maintaining track stability and extending service life. However, due to settlement, propagation, and scaling, the effectiveness of ballastless track may be compromised, thereby affecting the safe operation of trains. To address this challenge, this study developed an intelligent detection device "SmartGrid" and proposed a machine learning method based on detection data to monitor the waveform of the device, thereby enabling intelligent ballastless track integrity detection. In machine learning, experimental data were divided into test and validation sets and fed into a CNN algorithm for learning and classification. Data experimental results demonstrate that SmartGrid can fairly accurately distinguish whether track slabs are scaled and can be applied for large-scale detection of track slab integrity in engineering applications.

Full Text

Real-Time Detection of Railroad Ballast Integrity Using SmartGrid and CNN-Based Learning Algorithms

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Abstract

Railroad ballasted track is critical for maintaining track stability and extending service life. However, due to settlement, spreading, and fouling, the effective-

ness of ballasted track can be compromised, thereby affecting the safe operation of trains. To address this challenge, this study developed an intelligent detection device called "SmartGrid" and proposed a machine learning method based on detection data to monitor the device's waveforms, thereby enabling intelligent ballasted track integrity detection. In the machine learning process, experimental data were divided into training and validation sets and fed into a CNN algorithm for learning and classification. Experimental results demonstrate that SmartGrid can accurately distinguish whether ballast is fouled and can be applied to large-scale ballast integrity detection in engineering practice.

Keywords: SmartGrid, railroad ballast, CNN, detection equipment

Note: Figure translations are in progress. See original paper for figures.