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ABSTRACT

Title

Mitigating ground-borne vibration induced by railway traffic using metamaterials

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Abstract

In recent times, railway transportation has received increasing attention, particularly for its ability to operate entirely on electricity sourced from renewable sources. However, the growing demand for railway services has transformed previously acceptable issues into significant challenges, disrupting normal traffic operations. One such issue is ground-borne vibration especially in urban and inter-urban locations. This study explores the efficacy of a novel mitigation technique, termed a "metawedge," in reducing ground-borne vibration at the receiving end. The metawedge consists of a series of periodically arranged barriers that act as resonators. Unlike traditional metamaterials, each resonator within the metawedge possesses slightly different natural frequencies compared to its neighbours. With an appropriate choice of this variation, incoming Rayleigh (surface) waves are converted into body waves, redirecting energy deeper into the ground. Simulation results demonstrate that the metawedge can significantly diminish vibration levels with just a few resonators. Additionally, unlike conventional single trenches, which effectively mitigate vibrations only at specific angles of incoming waves (outside the critical cone), the metawedge remains efficient within this cone. While a theoretical proof-of-concept has been previously presented by the authors, this study makes a step forward by proposing a realizable design. Consequently, this work showcases the potential and feasibility of metamaterials to address present and future challenges in railway transportation.

Preferred Presentation Type

x	Oral		Poster		Only proceedings		No preference

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