ADVANCED METAMATERIAL-INSPIRED STRATEGIES FOR GROUND-BORNE AND SEISMIC VIBRATION MITIGATION

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ABSTRACT

The rapid growth of urbanization and industrialization has escalated issues of ground-borne and seismic vibrations, posing risks to infrastructure stability, equipment integrity, and environmental quality. Conventional solutions, such as passive barriers and active vibration cancellation systems, often demonstrate limited effectiveness, particularly against low-frequency vibrations from sources like railways, heavy machinery, construction, and seismic activity. This Minisymposium will therefore highlight advanced research of elastic and locally resonant metamaterials engineered to control, redirect, and mitigate both natural and anthropogenic vibrations.

Over the past two decades, elastodynamic metamaterials have demonstrated uncommon features, such as negative material properties, band gaps, and tailored wave propagation behaviors, that enable precise control over ground-induced vibrations [1]. These unique characteristics position metamaterials as a promising alternative solution for complex urban and seismic applications. This Minisymposium will delve into the potential applications of metamaterials in addressing diverse challenges in vibration and noise control. Key topics to be explored include:

- **Metamaterials for ground-borne vibration mitigation:** A review of the latest research and development in the design, fabrication, and testing of effective metamaterial-based vibration isolators, metatrenches, and metabarriers [2-4].

- **Seismic metamaterials for structural protection:** An exploration of the application of seismic metamaterials, including phononic and locally resonant metasurfaces, in earthquake engineering to enhance the seismic resilience of critical buildings and vulnerable infrastructures [5-8].

- **Acoustic metamaterials for noise reduction:** The use of acoustic metamaterials to control sound propagation and absorption, with a focus on applications in urban noise reduction and architectural acoustics [9,10].

- **Analytical tools, numerical simulations, and experimental validation:** A presentation of rigorous analytical tools, numerical modeling techniques, and experimental methodologies for characterizing the performance of metamaterial-based solutions [11-15].

- **Real-world applications and case studies:** A discussion of practical applications of metamaterials in various settings, such as urban infrastructure, railways, and industrial facilities [3,16].

This Minisymposium brings together leading experts from academia and industry to foster interdisciplinary collaboration and advance the field of metamaterial-inspired vibration and noise control. The goal is to develop innovative and sustainable solutions to mitigate vibration and noise pollution, improve the quality of life in urban areas, and enhance the resilience of the built environment.

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