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Environmental vibration characterization and spectral analysis of ground motion sources at the SHINE facility

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The Shanghai High Repetition Rate XFEL and Extreme Light Facility (SHINE), spanning 3.1 kilometers in length, faces unique environmental vibration challenges due to its proximity to multiple urban vibration sources. SHINE's operational environment is characterized by adjacent rivers, metro lines, and elevated roadways that collectively generate elevated ground vibration levels. This study systematically investigates the civil engineering vibration sources affecting SHINE through comprehensive measurements of environmental excitations, including river boats, metro operations, heavy-duty truck movement, and HVAC systems within the experimental hall. Our analysis reveals distinct spectral characteristics in the vibrations induced by HVAC systems and maritime traffic, exhibiting prominent frequency-specific signatures. In contrast, ground vibrations from heavy trucks and metro operations demonstrate broadband excitation patterns, significantly impacting a wider frequency range from 10 Hz to 100 Hz. The quantified vibration spectra provide critical input for developing targeted vibration mitigation strategies essential for maintaining the facility's operational stability and precision.

Footnotes

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