Backscattering Spectral Analysis for 1-D Granular Chain.

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ABSTRACT

Wave propagation through discrete and disordered particle systems like Granular Media results in backscattering and multiple scattering, a well known phenomena, observed both experimentally and numerically [1]. Discreteness leads to a cut off in frequency for a travelling pulse and "coda" formation (high frequency oscillations after the main pulse). Multiple scattered waves can have the form of coda during acoustic wave propagation [2]. It was shown in Sen et al. [1] that introduction of mass impurity enhances the backscattering effect.

For studying backscattering, an analytical model with linear contact and static pre-compression has been used. It was shown in Sinkovits et al. [3] that the linear contact model is appropriate for chains with sufficiently high confining force. The individual particle's displacement and velocities are determined through modal analysis. The spectral study shows the Frequency Filtering Effects as well as dispersion [4].

There are two "decoration" types adopted for our granular chain, one is the introduction of mass impurity/impurities and the other is when we vary the magnitude of mass disorder of the chain. The ratio of mass impurity is varied, along with number of mass impurities as well as their location to see the effect of mass disorder on travelling wave and the associated frequency filtering. The backscatter gets enhanced by introduction of mass impurities and increase in mass disorder leads to higher mode wave localisation.

It is observed that the variation of ratio of mass impurities, their number and their location leads to frequency band gaps in the travelling wave as well as the backscattered wave. The spectral analysis of the backscattered wave can also give indirect information about the mass impurities. Further research includes development of transfer function theorem and possible application of our results for detection of buried objects, acoustic filtering and focussing devices.

REFERENCES

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