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Effect of Disorder on Bulk Sound Wave Speed : A Multiscale Spectral Analysis.

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Abstract

Disorder in the form of size (polydispersity) and mass of discrete elements/particles in a disordered media (a granular matter like soil) have numerous effects on it's sound propagation characteristics [1,2]. The influence of disorder on the sound wave speed and it's frequency filtering characteristics is the subject of investigation. The study will assist in understanding the connection between particle-scale dynamics and system-scale behavior of wave propagation which can be further used for modeling during non-destructive testing, seismic exploration of buried objects (oil, mineral, etc.) or to study the internal structure of the Earth. Studying the wave propagation characteristics through Discrete Element Models with varying polydispersity and mass of discrete elements in real-time, frequency space as well as through dispersion curves (ω (frequency) v/s k (wavenumber)) can shed light on this aspect by providing better microscopic understanding. To isolate the P-wave from shear and rotational modes, a one-dimensional system of elements/particles is used to study the effect of mass disorder on bulk sound wave speed through ensemble averaging of signals. Increasing polydispersity/disorder decreases the sound wave speed because of decrease in the number of contacts between particles [2] but, in contrast, increasing mass disorder increases the sound wave speed (in 1 D chains). Thus we conclude that a competition exists between these two kinds of disorder for their influence on the bulk sound wave speed.

References

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