Wave propagation in granular materials: Role of cohesive

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ABSTRACT

Due to dissipative particle-particle interactions, continuous energy injection through, e.g., mechanical agitations, is necessary to keep a granular material in a fluid-like state that facilitates processing in different industrial sectors. In vibrofluidized granular materials, understanding how mechanical waves propagate inside is essential for an appropriate prediction of the collective behaviour. For cohesionless dry granular materials, theoretical, numerical and experimental investigations have shown that the mechanical perturbations will evolve into shock waves in which abrupt changes of pressure, temperature and density arise [1-3]. However, much less is known concerning how mechanical perturbations propagate in partially wet granular materials that are often encountered in nature (e.g., soil), industries (e.g., granulation process) and our daily lives (e.g., sand sculptures).

Here, I use molecular dynamics simulations to explore mechanical wave propagation in partially wet granular materials in two dimensions. The cohesive particle-particle interactions are achieved through tuning the velocity dependent coefficient of restitution based on a recently proposed analytical model [4-5]. The evolution process of the shock fronts, the propagation speed for cohesionless and cohesive granular materials will be compared. The influence of capillary, viscous and inertial forces from the wetting liquid will be addressed through tuning the coefficient of restitution. This investigation sheds light on a rational prediction and control of the energy injection in partially wet granular materials.

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