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Acoustic waves in granular materials

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The numerous sound propagation mechanisms in granular materials are rather complex and strongly depend on the material micro-scale parameters, such as inter-particle friction or damping. The use of DEM (Discrete Element Simulations) allows to tune these parameters and hence to understand their influence. In both regular (crystal-like) and polydisperse (sand-like) systems of spheres, a small perturbation is created on one side of the simulation box and examined during its propagation and on arrival at the opposite side. Starting from a regular packing, a tiny size variation comparable to the typical contact deformation already changes sound propagation considerably [1]. The transmission spectrum becomes discontinuous, i.e., a lower frequency band is transmitted well, while higher frequencies are not, mainly due to scattering effects. Furthermore, the wave propagation and transmission properties are studied on fully polydisperse, frictional and cohesive packings under increasing load until breakage of the material [2].
[1] O. Mouraille and S. Luding, Sound wave propagation in weakly polydisperse granular materials, Ultrasonics, submitted.
[2] O. Mouraille, O. Herbst and S. Luding, Testing cohesive and frictional granular materials with the discrete element model, in preparation.