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Wave propagation in wetted Hertzian granular chains: analysis of a single contact dynamics

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A one-dimensional dry granular medium, a chain of beads which interact via the nonlinear Hertz potential, exhibits strongly nonlinear behaviors. When such an alignment contains some viscous fluid between grains, it exhibits new interesting features. We report some recent experiments, analysis and numerical simulations concerning nonlinear wave propagation in dry and wet chains of spheres. We consider first a monodisperse chain as a reference case. We then analyze how the pulse characteristics are modified in the presence of an interstitial viscous fluid. The fluid not only induces dissipation but also strongly affects the intergrain stiffness: in a wet chain, wave speed is enhanced and characteristic pulse duration is shorter. Our observations are in a satisfactory agreement with ultrasound propagation measurements in 3D wetted granular beds reported in the literature. Recent experiments performed with a single sphere colliding a wall covered by a thin film of fluid allowed us to determine the rheology of the contact dynamics, and confirmed that a complex elastohydrodynamic interaction takes place close to solids contact.