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Towards the problem of the Nesterenko's soliton waves propagation in nonlinear inhomogeneous Hertzian chains

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We consider theoretically the problem of the pulse transmission along 1D vertical chain of hard spheres, which interact with each other by pair-wise nonlinear Hertz law [1-3]. System is subject into gravity and therefore became inhomogeneous [2,3]. We show, that being excited form the boundary (from the top), system is able to exhibit complex multimode dynamics of pulse propagation. After long-wave approximation has been used to study the dynamics of week perturbation, in the lowest approximation, resulted governing equation is satisfy by either singular solutions, or combinations of cylindrical waves [2]. In the higher approximation we obtaine nonlinear equation of motion (generalized in form of Bussinesq equation) which bring us to solution of Nesterenko-type soliton [1] with a negligible differences in the amplitudes, and dispersions.
We conclude that initially weekly nonlinear and inhomogeneous chain, already in the linear approximation, is able to transmit either normal or singular modes, whenever, the accounting, of the nonlinearity leads to familiar Nesterenko-type soliton's [1].
Therefore under the appropriate values of the parameters (nonlinearity, inhomogeneity, signal amplitudes) linearized Hertzian chain support both discontinuous as well as quasinormal mode scenarios of pulse transmission.

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