Wave Dynamics of Impulse Perturbations in 1D Force-Chains

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The problem of pulse transport in 1D force chain with nonlinear interparticle contacts analyzed in details [1-3]. It is shown that altogether with a set quasi-normal modes with power-law decaying amplitudes exist also a resonance solution which displayed in long-wave limit of governing equations [3,4]. This specific solution purposed to be interpreted as a parametric resonance which occur when wave velocity succeed a definitive value. Also, considered class of governed equations are satisfied by autowave solutions. The role of confinement and inhomogeneity (which can be produced by external field, and/or decoration) has been analyzed. We present the obtained results in analytical form which make possible necessary parameterization for practical applications (for instance in the problem of pulse/energy transport in micro-mechanical materials like granular systems).

We conclude that wave dynamics which developed in 1D force chain with inhomogeneities and nonlinear contacts display a multiscale character with transitions between linear (normal-mode) and nonlinear (soliton-like) modes depends on relations between the parameters of confinement, perturbation, nonlinearity, disorder and some others.

1. Nesterenko V. F. Propagation of nonlinear compression pulses in granular media. J. Appl. Mech. Tech. Phys., 1984, 24 (1), pp.733-743.
2. Sen S., Hong J., Bang J., Avalos E. and Doney R. Solitary waves in the granular chain. Physics Reports, 2008, 462 (2), pp.21-66.
3. Gerasymov O. I. Physics of Granular Materials. – Odesa: TES, 2015, 264 p.
4. Gerasymov O. I., Vandewalle N. On the exact solutions of the problem of impulsive propagation in an inhomogeneous granular chain. Dopov. Nac. akad. nauk Ukr., 2012, no. 8, pp. 67-72.