Analysis of localized excitations of the ‘mass-in-mass’ chain in the state of acoustic vacuum

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Abstract

Of late, formation of localized excitations in highly nonlinear discrete models admitting a state of acoustic vacuum (e.g. granular crystals), has become a subject of intense theoretical and experimental research. Here by the term acoustic vacuum we refer to a special class of the dynamical system which lack the linear components. Therefore, the characteristic frequency as well as the phase speed of any particular wave structure emergent in this special dynamical state is completely tunable with energy. Present study concerns the dynamics of special localized solutions emerging in the locally resonant anharmonic chain subjected to the state of acoustic vacuum. Each outer element of the chain incorporates an additional, purely nonlinear, local mass attachment. Using the homogeneity of the nonlinear lattice under consideration, we use the separation of time and space and analyze the system of nonlinear algebraic equations yielding the standing wave solutions. Analysis of the algebraic system reveals the diverse families of localized solutions such as exact discrete ‘compactons’, site- and bond-centered, bright breathers exhibiting a superexponential decay as well as the dark breathers. In this talk we will present the analytical and numerical studies unveiling the full bifurcation structure of these special localized solutions along with their stability analysis. Results of the analytical approximations are confirmed with the direct numerical simulations of the full model.