Analysis and control of localized excitations in coupled essentially nonlinear chains

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Abstract

Up to date, resonant energy transport in strongly nonlinear systems remains one of the intensively studied and perhaps mildly explored areas of nonlinear dynamics. A very discussed example of such a system is granular lattice on elastic support. In the present study we consider a system of two nonlinearly coupled, weakly dissipative, highly nonlinear oscillatory chains. In the uncoupled state, each chain supports stationary and moving breather solutions. Using the traditional method of collective coordinates along with the regular multi-scale analysis we devise a reduced order model, which allows one to depict the intrinsic mechanisms governing the inter-chain resonant transfer of breathers. We particularly focus on the analytical description of the three main states: 1) inter-chain wandering of breathers in the non-dissipative case, 2) uni-directional transfer of breathers and 3) permanent breather entrapment on one of the chains. In this study we emphasize the effect of coupling nonlinearity and weak dissipation on the emergence of irreversible transfer of breathers. Results of the analysis are in agreement with the numerical simulations of the original model under consideration.

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