

Analytical approach to vibro-impact dynamics of two coupled oscillators

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Abstract: Most of approximate analytical methods for nonlinear problems can be used under the restriction of weak nonlinearities. However, recently some approaches to strongly nonlinear systems, including the vibro-impact ones, have been developed for certain types of motion. In what follows, the analytical technique based on a combination of the multiple time scales method and the saw-tooth function is used. A mechanical system composed of two weakly coupled oscillators under harmonic excitation is considered. The primary oscillator is linear, while the other one has a relatively small mass and is subjected to bilateral rigid barriers. The impacts are characterized by the restitution coefficient. Equations of motion for the system are derived and presented in a non-dimensional form. Periodic behaviour of the system with two impacts per cycle near 1:1 resonance is analyzed. The results have a semi-analytical character. Stability of the periodic motions is studied. In the unstable case, occurrence of the strongly modulated response can be observed. The analytical solutions are compared with purely numerical results. The interplay between the model parameters is analyzed. Particularly, the effect of the distance between barriers on dynamics of the system is discussed.

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