عنوان مقاله:

Direct Normal Form Analysis of Oscillators with Different Combinations of Geometric Nonlinear Stiffness Terms

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خلاصه مقاله:

Nonlinear oscillators with geometric stiffness terms can be used to model a range of structural elements such as cables, beams and plates. In particular, single-degree-of-freedom (SDOF) systems are commonly studied in the literature by means of different approximate analytical methods. In this work, an analytical study of nonlinear oscillators with different combinations of geometric polynomial stiffness nonlinearities is presented. To do this, the method of direct normal forms (DNF) is applied symbolically using Maple software. Closed form (approximate) expressions of the corresponding frequency-amplitude relationships (or backbone curves) are obtained for both ε and ε^2 expansions, and a general pattern for ε truncation is presented in the case of odd nonlinear terms. This is extended to a system of two degrees-of-freedom, where linear and nonlinear cubic and quintic coupling terms exist. Considering the non-resonant case, an example is shown to demonstrate how the single mode backbone curves of the two degree-of-freedom system can be computed in an analogous manner to the approach used for the SDOF analysis. Numerical verifications are also presented using COCO numerical continuation toolbox in Matlab for the SDOF examples.

کلمات کلیدی:

Nonlinear, Mechanical Vibrations, Direct Normal Forms, Backbone curves, Symbolic computations

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