SIGNAL PROCESSING TECHNIQUES FOR NONLINEARITY IDENTIFICATION OF STRUCTURES USING TRANSIENT RESPONSE

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Abstract

In this work, an alternate method for determining nonlinearity of vibrating structures is investigated. In contrast to previous approaches, transient vibrations have been used in combination with advanced signal processing techniques to determine hardening or softening effects and strength of nonlinearity. In order to demonstrate this method's practicality, an experiment involving a cantilever beam has been subjected to vibratory analysis. Experimental data has first been processed by using either a Butterworth 4^{th} order low pass digital filter or the empirical mode decomposition. A novel signal tracking technique, known as the Harmonics Tracking Method, has been used in conjunction with experimental data for signal analysis. This method was then compared to two other more traditional signal tracking techniques, the Teager-Kaiser algorithm and the Hilbert-Huang transform. Through this analysis it has been determined that a nonlinear softening effect exists within the transient response of the cantilever beam. Additionally, the effect of gravity upon the beam's response has been investigated and shown to have a slight hardening effect. It has also been determined that for transient nonlinear analysis, the Harmonics Tracking Method used in conjunction with the empirical mode decomposition yields the best results.