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A harmonic balance approach for the analysis of flexible rotor bearing systems on non-linear support

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Abstract

The purpose of this article is to describe the theoretical background to the Harmonic Balance approach; adopted and further developed for the analysis of general multi degree of freedom rotor bearing systems with nonlinear supports. System equations of motion are prepared for dynamic systems with any number of degrees of freedom. Nonlinear behaviour can be associated with any number of these freedoms. A computer program which uses the harmonic balance method to solve the system equations of motion is also written. These equations are partitioned into linear and nonlinear parts. The nonlinear sets of equations need to be solved prior to solving the linear sets of equations. Verification of the proposed method of solution is justified through two examples. The frequency response of a well known rotor bearing, the so called Jeffcott rotor, is examined and tested against data reported by some other researchers. Also, the versatility of this method is tested by comparing the harmonic balance approach with the transient solution and some experimental measurements involving the nonlinear squeeze film bearing supports, which have already been reported by this author. It is shown that by utilizing harmonic balance with appropriate condensation, it is possible to considerably reduce the number of simultaneous nonlinear equations inherent to such systems. The stability (linear) of the equilibrium solutions may be conveniently evaluated using the Floquet theory. © Sharif University of Technology, October 2009.

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