Nonlinear Dynamic Analysis of Floating ring gas bearing systems

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Abstract

Floating ring gas bearing (FRGB) systems have been extensively used for a variety of mechanical engineering application, and potential for use in high-rotational speed, and high-precision instrumentation. FRGBs provide double gas films of supporting forces to increase the greater rotational stability. However, under certain operating conditions, FRGB systems exhibit non-periodic rotational motion as the result of a nonlinear pressure distribution within the gas film, rotor imbalances, an inappropriate design, and so forth. So, In order to understand and control when the bearing system occurs non-periodic motions and under what kind of operating conditions, the dynamic response of the bearing system will be analyzed using two different methods, namely a successive over relation (SOR) method and a hybrid numerical scheme combining the finite difference method and the differential transformation method. The relative performances of the two methods will be compared and contrasted in terms of the quality of the solutions they provide and their numerical efficiency. The dynamic behavior of the rotor and floating ring centers will be examined under different operating conditions by generating the corresponding Poincaré maps, Lyapunov exponents etc.

Keywords: Floating ring gas bearing, Hybrid method, Lyapunov exponent