DOWNLOAD PDF ROTOR DYNAMIC PREDICTION IN ENGINEERING

Chapter 1 : Rotordynamics prediction in engineering | Open Library

It has been shown by Thomas () and Alford (), that axial flow turbo-machinery is subject to rotor dynamic destabilizing gas forces produced by the circumferential variation of blade-tip clearance when the rotor is whirling.

C is the symmetric damping matrix G is the skew-symmetric gyroscopic matrix K is the symmetric bearing or seal stiffness matrix N is the gyroscopic matrix of deflection for inclusion of e. The general solution to the above equation involves complex eigenvectors which are spin speed dependent. Engineering specialists in this field rely on the Campbell Diagram to explore these solutions. An interesting feature of the rotordynamic system of equations are the off-diagonal terms of stiffness, damping, and mass. These terms are called cross-coupled stiffness, cross-coupled damping, and cross-coupled mass. When there is a positive cross-coupled stiffness, a deflection will cause a reaction force opposite the direction of deflection to react the load, and also a reaction force in the direction of positive whirl. If this force is large enough compared with the available direct damping and stiffness, the rotor will be unstable. When a rotor is unstable, it will typically require immediate shutdown of the machine to avoid catastrophic failure. The pink and blue curves show the backward whirl BW and forward whirl FW modes, respectively, which diverge as the spin speed increases. This is called a critical speed. Jeffcott rotor[edit] The Jeffcott rotor named after Henry Homan Jeffcott , also known as the de Laval rotor in Europe, is a simplified lumped parameter model used to solve these equations. The Jeffcott rotor is a mathematical idealization that may not reflect actual rotor mechanics. History[edit] The history of rotordynamics is replete with the interplay of theory and practice. Rankine first performed an analysis of a spinning shaft in , but his model was not adequate and he predicted that supercritical speeds could not be attained. In , Dunkerley published an experimental paper describing supercritical speeds. Gustaf de Laval , a Swedish engineer, ran a steam turbine to supercritical speeds in , and Kerr published a paper showing experimental evidence of a second critical speed in Henry Jeffcott was commissioned by the Royal Society of London to resolve the conflict between theory and practice. He published a paper now considered classic in the Philosophical Magazine in in which he confirmed the existence of stable supercritical speeds. Between the work of Jeffcott and the start of World War II there was much work in the area of instabilities and modeling techniques culminating in the work of Nils Otto Myklestad [2] and M. Prohl [3] which led to the transfer matrix method TMM for analyzing rotors. The most prevalent method used today for rotordynamics analysis is the finite element method. Modern computer models have been commented on in a quote attributed to Dara Childs, "the quality of predictions from a computer code has more to do with the soundness of the basic model and the physical insight of the analyst. Superior algorithms or computer codes will not cure bad models or a lack of engineering judgment. Nelson has written extensively on the history of rotordynamics and most of this section is based on his work. Software[edit] There are many software packages that are capable of solving the rotor dynamic system of equations. Rotor dynamic specific codes are more versatile for design purposes. These codes make it easy to add bearing coefficients, side loads, and many other items only a rotordynamicist would need. The non-rotor dynamic specific codes are full featured FEA solvers, and have many years of development in their solving techniques. The non-rotor dynamic specific codes can also be used to calibrate a code designed for rotor dynamics. Dynamics R4 Alfa-Tranzit Co. A powerful, fast and easy to use tool for rotor dynamic modeling and analysis using Excel spreadsheets.

Chapter 2 : Rotordynamics - CRC Press Book

SYNCHRONOUS THERMAL INSTABILITY PREDICTION FOR OVERHUNG ROTORS by R. Gordon Kirk Professor, Mechanical Engineering Department Director, Rotor Dynamics Laboratory.

Chapter 3 : Rotordynamics - Wikipedia

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