Technical University of Denmark

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Morosi, Stefano; Santos, Ilmar

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ON THE STABILITY ANALYSIS OF FLEXIBLE ROTORS SUPPORTED BY HYBRID AEROSTATIC - GAS JOURNAL BEARINGS

Modern turbo-machinery applications, high speed machine tools, laboratory equipment require nowadays ever-growing rotational speeds and high degree of precision and reliability. Gas journal bearing have been in many extents employed as they meet the demands of performing at high speeds, in clean environment and great efficiency. However, the drawback are inherent poor carrying capacity and dynamic characteristics of passive systems, which often translate to a reduced range of stability. In order to enhance these characteristics, one solution is to combine the hydrodynamic effect with the addition of external pressurization. The present contribution presents a detailed mathematical modeling for hybrid lubrication of a compressible fluid film journal bearing. Piezo-actuated valves are used in order to inject pressurized air into the bearing gap through orifices located on the bearing walls. A modified form of the compressible Reynolds equation for active lubrication is derived. Particular attention is given to the injections terms and a comparison is carried on between fully nonlinear and linearized expressions. By solving this equation, stiffness and damping coefficients can be determined. A multibody dynamics model of a global system comprised of flexible rotor and hybrid journal bearing is built in order to study the lateral dynamics of the system. Different orifices configuration are analyzed; Campbell diagrams and stability maps are presented, showing the main advantages and drawbacks of this special kind of hybrid fluid film bearing.