ETUDE DE LA REACTION D'UN GUIDE DE LIGNE D'ARBRE SOUMIS A UNE SURCHARGE SOUDAINE

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Abstract: During the last decades, technological development has been directed towardsimproving the performance of mechanical systems to preserve the environment, lighten theinstallations and reduce their production costs. The aeronautical field has particularlyexperienced a significant development concerning the air conditioning systems in aircraft.The key component of these systems is the turbomachinery operating in rotation byaerodynamic bearings. Actually, in flight of the aircraft, these bearings may submit to suddenoverloads due to take-off, landing, turbulence or air holes, which can lead to dysfunction ordamage to these systems. The present work concerns the theoretical study of the dynamicbehavior of air foil bearings subjected to sudden external overloads. It is thus a question oftreating the case of an air bearing constituted of a flexible corrugated foils bearing housing(bumps) supporting a rigid rotor. In order to avoid any possible dry contact between the rotorand the housing, due to sudden or severe external excitations, these foils tend to be deformedby widening the reduced air film thickness. As for numerical modeling, starting from thehypothesis of the mechanics of thin viscous films and the mechanics of continuous media, thedynamic behavior of the air is given by the compressible Reynolds equation. The study of thedynamic behavior of air foil bearing is carried out by modeling three different parts: the air,the rotor and the structure. The fluid behavior is expressed by the unsteady Reynoldsequation, the movement of the rotor is obtained by the fundamental law of dynamics and thedeformations of the structure are determined by a simplified mechanical approach. Thetemporal dynamic problem can be solved using the Verlet algorithm which reducescomputational errors. This algorithm obviously includes the nonlinear air-structure interactionby applying finite difference discretization in implicit scheme and Newton Raphson's method.The stability of the rotor without external excitations and the convergence of calculations tovalidate the program, are presented. In theory, different cases of external excitation areintroduced to the algorithm to see their effect on the trajectory and on the temporal behaviorof the rotor. Finally, a parametric study combining the influence of external excitations,operating conditions and stiffness of the flexible structure all on the operation stability anddynamic behavior of air foil bearing is presented.

Keywords : Air foil bearing, elasto-aerodynamic, dynamic behavior, external excitations, compliance, rotor stability