

CONTROL OF IMPACT PHENOMENA OF A RUBBING ROTOR

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ABSTRACT

The control of impact phenomena of rotating machinery is of practical interest for the prevention of structural damage, since there is the possibility of serious failures if the impact forces are not taken under control. The aim of this paper is the minimization of the contact forces of a rubbing elastic rotor with the help of an active auxiliary bearing, which is attached to the foundation through two unidirectional electromagnetic actuators. The feedback control is focused on the reduction of the impact effects when the first contact occurs. After this a regulation of the force should guarantee a permanent contact. A switching condition in the design of the control will achieve a smooth transition from free rotor motion to the state of full annular rub. The feasibility of the control strategy will be demonstrated by numerical simulations. Two different contact approaches for impact between a flexible rotor and an active auxiliary bearing are used to design the control system. The first approach uses a rigid body model with unilateral constraints. In this case the contact is formulated by a complementary rule, known as the Signorini condition that can only calculate the normal and tangential impulses, but it is not possible to identify the contact force explicitly. The second approach applies the nonlinear Hertz model, which provides a continuous formulation of the impact problem, so there is the determination of the contact forces and duration of the impact. In both cases the tangential forces obey Coulomb's frictional law. The main emphasis will be laid on the first method, because this approach fits into a real-time control. Experiments to prove the designed control system are already in progress.

Keywords: rotor active auxiliary bearing, rotor-to-stator rubs, reduction of contact forces, real-time control system, contact models, Hertz model