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A Study on Analysis of Behavior of Rubbing considering Deflection Angles of a Rotating Body

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Extended Abstract

In designs of rotating machines, it is generally required to make the clearances between a rotor and a stator become narrower, aiming for the leakage reduction of the working fluid or so, in order to accomplish the higher efficiencies and performances of them. However, these designs increase a risk that a rotor and a stator contact each other. As a result, the harmful oscillation that is called rubbing occurs in rotating machines and happens to fractures of equipment and serious accidents. It is important to grasp the characteristics of rubbing from the viewpoint of the remaining life assessment and the anomaly detection of equipment [1][2]. A lot of research intended for rubbing have been conducted until now, but most of them [3] consider only translational motions and ignore rotational motions related to the directions perpendicular to the axial direction of a rotating body. The influences of deflection angles of a rotating body should be considered because translational motions and rotational motions related to the directions perpendicular to the axial direction of it couple.

In this paper, a rotating body generally known as Jeffcott rotor that consists of a rigid disk surrounded by a housing and an elastic shaft simply supported by ideal bearings is introduced as a research object. All components are set as cylindrical shapes. The finite element method [4] is adopted as a modelling method of it. The behavior of a disk's node, that is equivalent to the centroid, is analyzed by considering contact between a disk with deflection angles and a housing. In addition, the contact positions of them are also investigated. The contact judgement between a disk and a housing is conducted by considering the geometrical shapes of them. In this paper, the contact judgement is idealized under the assumption that the deflection angles are sufficiently small. The external force, from a housing to a disk, caused by the contact of them is expressed by using Voigt model. The displacement of a housing that determines elastic force is represented by the disk's maximum penetration amount toward a housing. In addition, the external moment is also acted on a disk from a housing in this paper because the working point of the external force changes along the axial direction of a rotating body over time due to the deflection angles of a disk. By using those ideas, the behavior of the proposed model is analyzed and evaluated by comparing with the conventional model.

Consequently, by considering deflection angles of a disk into the contact judgement, the difference of the analyzed behavior between the proposed model and the conventional model is observed. In addition, the difference of the contact positions between a disk and a housing are also found. Thus, the strict consideration of the contact between them is important. On the other hand, by considering the external moment into influences from a housing to a disk in addition to the external force, few differences of the result are observed.

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