Accepted Manuscript

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PII: S0301-679X(17)30317-1

DOI: 10.1016/j.triboint.2017.06.029

Reference: JTRI 4789

To appear in: *Tribology International*

Received Date: 23 January 2017

Revised Date: 24 April 2017

Accepted Date: 19 June 2017

Please cite this article as: Adiletta G, An insight into the dynamics of a rigid rotor on two-lobe wave squeeze film damper, *Tribology International* (2017), doi: 10.1016/j.triboint.2017.06.029.

An insight into the dynamics of a rigid rotor on two-lobe wave squeeze film damper

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Abstract

Differently from journal bearings and to author's knowledge, the adoption of lobe geometry in the bearing bore of squeeze film dampers (SFD) has not received any research interest, except for some recent study due to the present author. In this study, a relatively simple system, represented by a rigid, unbalanced rotor on two-lobe SFD, is theoretically investigated by means of numerical continuation. Despite being restricted to periodic solutions, this numerical procedure permits an efficient characterization of the system's bifurcating behaviour, suitably taking into account the shape parameters of the wave profile given to the bore of lobed damper bearing. In particular, the influence of the bearing angular position on the synchronous (1-S) and order-two subharmonic solutions (1/2-S) has been analyzed, assuming the rotor speed as the bifurcation parameter, under different conditions of bearing operation that are expressed by means of the bearing parameter *f*. The results are compared to the corresponding behaviour of the rotor on dampers with circular bearing (CB). The bifurcation structure shows to be rather influenced by both the angular position and *f*. With regard to the 1-S, the two-lobe geometry emphasizes some effects obtained raising *f* in the presence of CB. Some other effects show to be distinctive features of the lobed geometry, like the disappearance of the torus bifurcation and the length modification (as increase or decrease) of the segments representing unstable behaviour. A significant simplification in the bifurcation paths of the 1/2-S, as compared to the CB set-up, is achieved at higher *f* values, especially through suitable angular positions. Contrast with this outcome the relatively involved path-patterns obtained for the sub-harmonic responses at the lowest *f* value. The study represents an insight with respect to the author's previous works on this subject, which were mainly focused on the characterization of the synchronous behaviour.

Keywords: lubrication, squeeze film damper, wave bearings, bifurcation analysis, numerical continuation