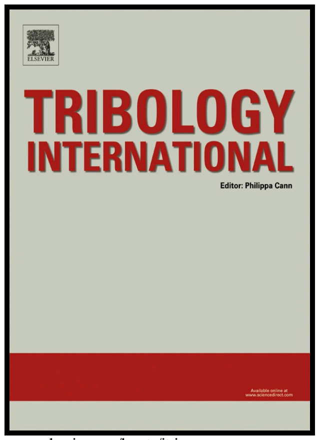

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PII: S0301-679X(17)30135-4
DOI: http://dx.doi.org/10.1016/j.triboint.2017.03.018
Reference: JTRI4646

To appear in: *Tribiology International*

Received date: 31 January 2017
Revised date: 9 March 2017
Accepted date: 13 March 2017

Cite this article as: Abdurrahim Dal and Tuncay Karaçay, Effects of Angula Misalignment on the Performance of Rotor-Bearing Systems Supported b Externally Pressurized Air Bearing, *Tribiology Internationa* http://dx.doi.org/10.1016/j.triboint.2017.03.018

Effects of Angular Misalignment on the Performance of Rotor-Bearing Systems Supported by Externally Pressurized Air Bearing

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Abstract

In this study, the performance of a rotor system supported by externally pressurized air bearing was investigated. Angular misalignment was introduced to the bearing along two perpendicular direction separately, and then both at the same time (combined). The effect of angular misalignment to the pressure distribution in the air bearing was obtained. A clearance function was introduced for misalignment conditions of the bearing, and then the air flow between the rotor and the bearing was modeled using Reynold's equation. Next this flow model was solved using Differential Transform and Finite Difference hybrid numerical solution method to obtain the pressure distribution in the bearing. The effects of the angular misalignment conditions on the load carrying capacity were also analyzed as well.

Keywords: Misalignment, Air bearings, Hybrid numerical solution method

Nomenclature

c	radial clearance
c_d	discharge coefficient
d_o	feeding hole diameter
D	bearing diameter
e	eccentricity
G	center of mass
h, H	air film thickness, $H = h/c$
h_{am}	angular misalignment part of the air film thickness
h_{rm}	rocking motion part of the air film thickness
$I(k)$	convolution of H and H
$J(k)$	convolution of $I(l)$ and H
k, l, m	transform parameters
L	length of the bearing
$\dot{m}$	mass flow rate
M	dimensionless mass flow rate
M, N	number of axial and circumferential grid points
O, O_1, O'	rotor center, bearing and journal center
p_a	atmospheric pressure
p, P	air film pressure, $P = p/P_a$
p_s,P_s	supply pressure, $P_s=p_s/P_a$
P_d	dimensionless downward pressure at feeding holes
R	bearing radius
R_0	Gas constant
T_0	absolute temperature
t	time
U	velocity of the rotor surface
W	load carrying capacity
x, y, z	Cartesian coordinates axes on the rotor
x_1, y_1, z_1	Cartesian coordinates axes on the bearing
σ	squeezing number, $\sigma=(12\mu/Pa)(R/c)^2$
Λ	bearing number, $\Lambda=(6\mu\omega/Pa)(R/c)^2$
μ	dynamic viscosity of air
α	angular misalignment
κ	heat capacity ratio
ε	eccentricity ratio, $\varepsilon=e/c$
θ	dimensionless coordinate axis in circumferential direction, $\theta=x/R$
θ_a	attitude angle