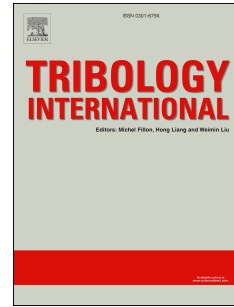


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Effect of surface roughness on the start-stop behavior of air lubricated thrust micro-bearings

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Abstract

The start-stop behavior of air lubricated thrust micro-bearings was investigated. The dynamic air bearing force was calculated considering the air rarefaction effect. The asperity contact force between the rotor face and air bearing surface was calculated. The axial motion of the micro-bearing during the start-stop process was determined. The effects of surface roughness and angular acceleration were discussed. The results showed that an increase in the standard deviation of the asperity height generated an increase in the air film thickness and a decrease in the air bearing force, leading to an increase in both the asperity contact force and the contact time during the start-stop process.

Keywords: Air bearing, start-stop process, surface roughness, asperity contact

Nomenclature

a, b	coefficients in Eq. (1b) and (1c)
A	nominal contact area
d	standard separation of the two surfaces
D	inverse Knudsen number
D_{sum}	surface density of the asperity
E^*	equivalent elasticity modulus
h_g	groove depth
h	air film thickness
h_0	minimum air film thickness
H	normalized air film thickness, $= h/h_0$
k	subscripts for defining time steps
m	mass of the rotor
N_j	shape function, $j = 1, 2, 3$
N_g	groove number
p	air bearing pressure
p_a	ambient pressure
P	normalized air bearing pressure, $= p/p_a$
P_0	interpolated pressure over each element domain
r_{in}, r_{out}	inner and outer radius, respectively
r_c	middle radius
r_g	spiral radius of air bearing surface
R_p	radius of the asperities
t	time

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