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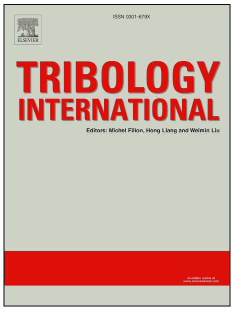


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# Effect of surface roughness on the start-stop behavior of air lubricated thrust micro-bearings

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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 |