

## **ELASTOHYDRODYNAMIC CONTACT THEORY IN FOIL GASDYNAMIC BEARING MODEL**

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### **ABSTRACT**

Review of elasto-hydrodynamic contact problem current state is represented. It is shown, that foil gasdynamic bearing characteristics calculation requires elastogasdynamic contact problem, that states a relationship between lubrication parameters and shaft deformations, to be formulated and solved. Considerable nonlinearity of the problem is caused by nonlinearity of expressions, describing gas flow in clearance and nonlinearity of foil elastic deformation contact problem.

Bearing gas lubrication flow calculation is based on solution of two-dimensional nonlinear Reynolds equation for compressible fluid. Reynolds equation solution is carried out by finite elements method with self-correcting algorithm application. Comparison of gas lubrication flow calculation results obtained with Reynolds equation application versus Navier-Stokes equations application via STAR-CD software is carried out for rigid bearing and a good accordance of calculation results with respect to each other is noted.

Clearance dimensions for foil gasdynamic bearing are determined by shaft journal position and foils deformations under the action of gas lubrication pressure or due to contact with the shaft. Depending on foils type, their deformations may be calculated by both numerical finite elements foil bearing models as well as by analytical approximation functions. Finite element foil models are taking contact interaction between each other, with shaft journal and bearing into consideration. Pressure distribution and clearance dimensions are determined iteratively by coupled solution of lubrication flow problem and bearing foils deformation problem.

Gas lubrication flow calculations in clearance between shaft journal and deformed foils are carried out. Rigid bearing characteristics and characteristics of foil gasdynamic bearings with different foil types are calculated depending on shaft journal relative eccentricity value and direction. Comparison of rigid bearing characteristics and foil gasdynamic bearings with different foil types characteristics is performed. Influence of deformations of foils of different types on load carrying capacity and stiffness

characteristics of gasdynamic bearing is investigated. Analytical approximation tolerance evaluation in comparison with contact problem solution is represented.

**Keywords:** gasdynamic bearing, foil bearing, elastohydrodynamic contact problem, self-correcting algorithm, contact problem