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Résumé

Angular Contact Ball Bearings are widely used in aerospace industry because of their ability to work at high-speed and to support important loads. Depending on operating conditions, kinematic and dynamic behaviours are complex and bearing design optimisation is essential. That is why this study aims at continuing Leblanc and Nelias' quasi-static model with balls and rings. Difficulty of this model lies in the fact that up to four ball-race contact points are considered. As well, all balls degrees of freedom are calculated without making any kinematic assumption. Then, one of the purpose of this thesis is to improve computation of friction forces, EHD lubrication and kinematics at each point of contact ellipse. The model is also harmonized in order to get a single system of equations that better deals with numerical discontinuities due to contact changes. Solutions are proposed to extend operating conditions at lower speeds and higher radial loads or misalignments.

Besides, aeronautical industry is currently developing ball bearings with cages made of lighter but softer materials. Such bearings experience cage deformation and stress concentration due to ball-to-pocket impacts. These are produced during acceleration and deceleration phases or during cruise when operating with combined thrust and radial load. That is why this study aims, in a second time, at adding cage into the quasi-static model. Ball-to-pocket and cage-race interactions are considered as well as global and local cage elasticity in three dimensions. Finally, the whole system is transposed in dynamics in order to be solved over time and to consider acceleration components.

For various operating conditions, ball kinematics, ball-race interactions, cage center motion, cage local and global deformations are analysed. Model validation is done by comparison with existing models or with experimental results found in literature.