Abstract

With the constant aim of reducing the turbofan consumption, aircraft manufacturers try to reach higher efficiency by increasing the compressor-turbine speed. In order to limit the fan speed, a planetary gearbox is introduced between the fan and the compressor. Because of their good oil-off performance, roller bearings are often preferred over hydrodynamic bearings for aircraft applications. However, in the case of planetary gearboxes, the roller bearings are submitted to severe centrifugal forces which cause significant power losses and premature cage fatigue that may lead to overall bearing failure.

The present work consists in the development of a numerical model for the understanding of the dynamic behaviour of a cylindrical roller bearing working in a centrifugal field. Multi-body dynamics is used, coupled with semi-analytical contact models accounting for the different lubrication regimes encountered in the bearing. In addition, a finite element model is developed to account for the outer ring flexibility that may affect the bearing dynamics.

Results are presented for a typical planetary gearbox application in terms of force, speed and power losses. Severe roller/cage impacts are observed and the mechanisms that cause the high power losses and the cage fatigue are explained. The influence of the main model hypothesis is presented. Finally, a study of the influence of the different parameters on the force amplitude and the bearing loaded zone shape and position is performed.