ABSTRACT

The main objective of this work is to project a magnetic bearing for reaction wheels with application in satellite attitude control.

Magnetic bearings are alternatives to traditional bearings such as ball or dry lubrication because they work without mechanical contact between the rotor and the stator thereby minimizing friction between both parts. In addition to minimizing friction, the gain in reliability and lifetime of the reaction wheel is considerable as a consequence of the absence of wear.

Because of the consequences of any friction in the relative movement between the inertia (of the reaction wheel) and the satellite ( which is rigidly connected to the satellite body), the bearing becomes a critical component of the reaction wheel. The friction gives rise not only to a greater consumption of electric power, as well as the introduction of a torque dead zone operation, in a reduced lifetime of the reaction wheel due to gradual wear of the bearing.

The proposed bearing has two axial degrees of freedom actively controlled and makes use of magnets for the passive stabilization of other degrees of freedom.

Nonlinear models of magnetic fields and forces acting on the bearing are presented. With these models, an optimization is performed to find the best bearing characteristics. A nonlinear model rotor dynamics is developed and a PID control capable of stabilizing the active degrees of freedom presented.

Keywords: Magnetic Bearing, Reaction Wheel, Multivariable Control, Electromagnetic modeling.