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3-DOF GAS BEARING SIMULATOR FOR SMALL SATELLITE TESTS WITH AUTOMATED MASS DISPLACEMENT CONTROL TO ELIMINATE DISTURBANCE TORQUES

Abstract

The focus of testing the Attitude Determination and Control System (AOCS) of miniature satellites is set on evaluating the effect of torque exchange devices, as for instance reaction wheels and magnetometers. For simulating a space environment it is therefore one particular task to suspend the satellite freely and frictionless in translational or rotational motion, and allow force-free rotation of a satellite or single components. One appliance that can achieve this even under normal gravitational conditions are gas bearings. However for spherical bearings when the Center of Gravity and Center of Rotation are not equivalent in a system with 3 rotational degrees of freedom, a disturbance torque is induced. Ideally the unit under test of such a three axis air bearing is balanced in such a way that it is indifferent, so that the simulated environment is free of outer forces. A novel method for a gas bearing simulator with three degrees of freedom in rotation without external forces to automatically match the Center of Gravity and Center of Rotation in three dimensions is introduced. A gas bearing simulator is designed to automatically compensate mass displacement using linear actuators for payloads of up to 100 kg. To reach qualification levels the disturbance torque shall be lower than 5e-5 Nm.