Paper ID: 72027
oral
student

IAF SPACE EXPLORATION SYMPOSIUM (A3)
Interactive Presentations - IAF SPACE EXPLORATION SYMPOSIUM (IPB)

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DEVELOPMENT OF A LOW GRAVITY AIRBEARING SURFACE

Abstract

Airbearing test fixtures have a distinguised history within the space community related to their ability to mimic low friction environments which allow the testing and evaluation of integrated attitude and position control systems. Although these systems are usually implemented with three degrees of freedom, either as a planar surface or a spherical ball/socket arrangement, there have also been hybrid systems which have capability all the way up to full six degree of freedom motion. This paper discusses the development of a novel planar airbearing surface, which has curvature consistent with the attraction of a small gravitational body at its center. An airbearing vehicle on such a surface replicates orbital motion, so can test novel guidance and control schemes for small spacecraft as well as provide a platform for teaching basic orbital dynamics. Design considerations are covered, including tolerances and leveling, as well as surface calibration and polishing. The subsequent design of vehicles designed to ride on this surface is discussed, along their requirements for ride height to deal with surface curvature. System dynamical results are presented, demonstrating orbital trajectories and timelines consistent with the simulated gravitational mass.