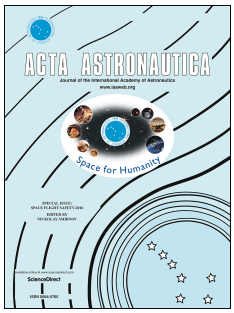
Accepted Manuscript



Determination of disturbances acting on small satellite mock-up on air bearing table

D. Ivanov, M. Koptev, Y. Mashtakov, M. Ovchinnikov, N. Proshunin, S. Tkachev, A. Fedoseev, M. Shachkov

PII: S0094-5765(17)30789-0

DOI: 10.1016/j.actaastro.2017.11.010

Reference: AA 6541

To appear in: *Acta Astronautica*

Received Date: 8 June 2017

Revised Date: 1 October 2017

Accepted Date: 10 November 2017

Please cite this article as: D. Ivanov, M. Koptev, Y. Mashtakov, M. Ovchinnikov, N. Proshunin, S. Tkachev, A. Fedoseev, M. Shachkov, Determination of disturbances acting on small satellite mock-up on air bearing table, *Acta Astronautica* (2017), doi: 10.1016/j.actaastro.2017.11.010.

Determination of Disturbances Acting on Small Satellite Mock-Up on Air Bearing Table

D. Ivanov, M. Koptev, Y. Mashtakov, M. Ovchinnikov,
N. Proshunin, S. Tkachev, A. Fedoseev, M. Shachkov

Keldysh Institute of Applied Mathematics RAS, Miusskaya Sq.4, Moscow, Russian Federation

Corresponding author: Dr. Danil Ivanov, danilivanovs@gmail.com, +7-499-220-79-29, +7-963-729-58-53 (mob.)

In this paper the facility for the simulation of satellite motion based on planar air-bearing deweighting is considered. The air bearing provides almost frictionless horizontal motion of the small satellite mock-ups. Due to the presence of gravitational and air flow disturbances the motion is far from rectilinear and uniform. This paper is devoted to the determination of these disturbances.

Keywords: test-bench; disturbance determination; control algorithm; motion determination

Introduction

Laboratory simulation and verification is a widely-used way to test the accuracy and performance of the control algorithms and the operation of the whole satellite motion control system. The main problem in performing this kind of simulation is to provide the frictionless conditions for the translational and/or rotational motion. This difficulty is usually overcome by using either spherical or planar air bearing [1–5] that creates a thin layer of compressed air between the surfaces. The spherical bearing allows the mock-up to rotate with three degrees of freedom around a fixed point and usually is used to test the attitude control system performance. The second type provides frictionless conditions between two planar plates and the corresponding air bearing design can be realized in two ways: either compressed air gets into the bearing from the tank situated on the mock-up through a pod or the air is distributed through small holes in the surface over which the mock-up moves. This type provides two translational degrees of freedom motion and one rotational degree of freedom.

Both realizations of the planar air bearing have advantages. Further we consider the planar air-bearing deweighting facility with air distribution over its planar work surface. It is called a planar air-bearing table or an air-table for short.

The first approach requires a pod and the air tanks installation in the mock-up. The air pressure should be high enough to provide continuous operation for a long period. Usually the pressure is between 1 [6] and 12 [7] bar (in some solutions the pressure in tanks reaches 300 bar [7]) and the time of experiments is limited.

Since the air layer between the surface and the mock-up is very thin (1-2 mm) the requirements to the smoothness of the table are high. Also, the surface material should not be deformed by temperature variations, gravity and other factors. There