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Estimation of dynamic properties for satellite actuator test bed

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Summary

An air-bearing test bed has been developed for ground simulation. It has a table-top configuration capable of floating 250 kg satellite. Estimation of the moment of inertia of test platform has been performed by adapting least square method. A standard mass has been applied on the platform to produce the required torque by gravity. Difficulty in measuring the yaw MOI has been avoided by starting maneuvers on a tilted orientation to improve the condition of the regression matrix. Convergence to the correct inertia and mass imbalance value was improved by stacking the good conditioned data.

Introduction

KAU has developed an air-bearing test bed that is operated by 3 RWA. It will be used to test kinds of device performance on the ground and verify theoretical approach. An air-bearing test bed has a table-top configuration capable of floating 300 kg satellite structure. It provides full freedom of yaw axis while pitch and roll constrained to angles of less than 45 deg as shown in a figure below.

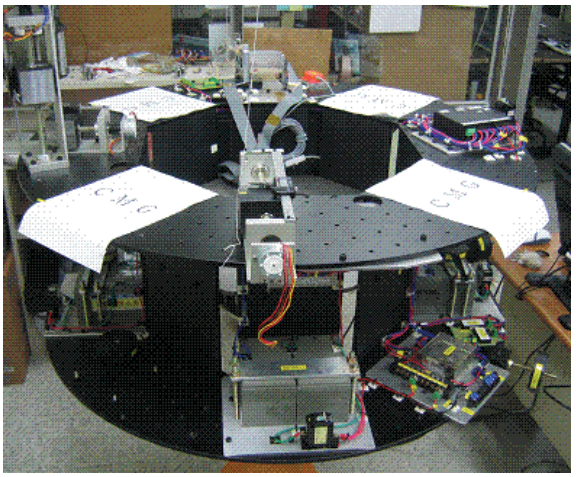

Figure 1: the air-bearing test bed

Identification of Inertia Properties

Information of the moment of inertia of test platform is necessary to apply a control law or a steering law on an actuator. There are usually used two kinds of methods in the estimation of inertia property: external exciting and internal exciting. Assume the torque capability for RWA to be tested has not known, a standard

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mass has been applied on the platform to produce the required torque by gravity. Estimation of MOI has been performed by adapting batch and recursive least square methods. Difficulty in measuring the yaw MOI has been avoided by starting maneuvers on a tilted orientation to improve the condition of the regression matrix. Convergence to the correct inertia and mass imbalance value was improved by stacking the good conditioned data.

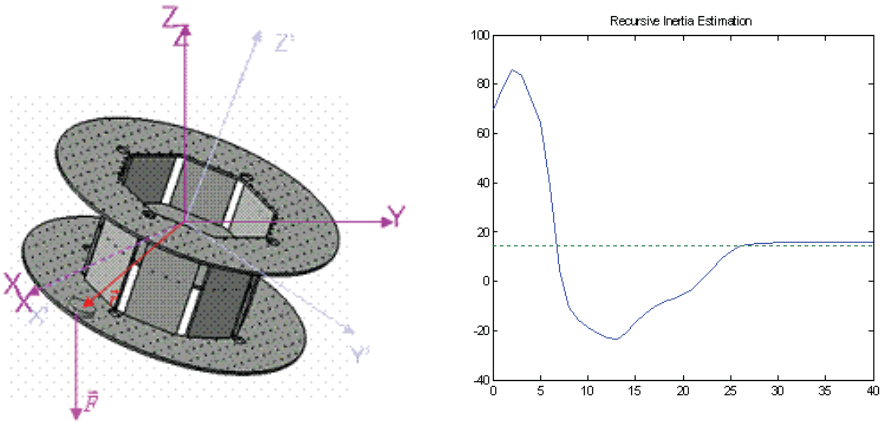

Figure 2: MOI estimation

Conclusions

A standard mass applied to excite the movement of test platform works well as a temporary torque actuator. Starting a maneuver from a tilted orientation provided a yaw torque though short period. Deleting all ill-conditioned data and stacking and post-processing of good-conditioned data covered the shortage of data.