IAF MATERIALS AND STRUCTURES SYMPOSIUM (C2)
Interactive Presentations - IAF MATERIALS AND STRUCTURES SYMPOSIUM (IP)

Author: Mr. Luciano Unfried
Aeronautic Institute of Technology (ITA), Brazil, lucianounfried@gmail.com

Prof. Ijar Da Fonseca
ITA-DCTA, Brazil, ijar.fonseca@gmail.com
Mr. Glaydson L. B. Lima
ITA-DCTA, Brazil, mcpglaydson@hotmail.com
Dr. Narumi Seito
ITA-DCTA, Brazil, seito@ita.br

EFFECTS OF THE CENTER OF MASS MOTION ON THE ATTITUDE MOTION OF A MANIPULATOR LIKE-SPACECRAFT IN CLOSE PROXIMITY OF RVD/B OPERATIONS AND THE EXPERIMENTAL VALIDATION OF THE RESULTS

Abstract

This paper presents the mathematical model of a five degree-of-freedom robot manipulator like-spacecraft and the computer simulations of the relative attitude and relative orbital motion in a low Earth orbit. The main goal of this research is the study the effects of the space vehicle center of mass changes on the rotational motion, when the robotic manipulator is in operation. The center of mass moves due to changes in the mass configuration of the robot arm during the robot manipulator orbital operations. In such analysis it is not reasonable to assume the inertia matrix diagonal since the motion of the robot links causes the appearing of products inertia. In the same way it is recommended to consider the non linear equations of motion. Another feature of the work is an active control aiming the suppression of the reaction forces and torque in the manipulator joints, which are related to operation commands sent to the robotic arm. The reaction forces affect the translational and the attitude motion as well. The mathematical model of the dynamics and control is simulated via computer by using the MATLAB® software. In order to validate some of the results, an experiment is conducted at a workbench in the ITA mechatronics' Lab. The experiment consists of two floating wireless platforms (air supported platforms) containing their own air compressed subsystem, microcontrollers, air propulsion actuators for the translational/rotational motion, Wifi, and Kinect V2 sensor for tracking operations in the control loop, and a communication subsystem computer-to-robot and vice versa. The control subsystem includes a human operator who analyzes the video-images received from the Kinect sensor and, on the base of the analysis of the data, commands the robot to continue or stop the operations. The robots operate on a glass table. The experiment uses PID Controller for DC Servo Motor (Current, Speed, Position) and includes an IMU on the air supported platform and the Kalman's filter aiming more accurate attitude estimation.