Paper ID: 27249
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MATERIALS AND STRUCTURES SYMPOSIUM (C2)
Space Structures II - Development and Verification (Deployable and Dimensionally Stable Structures) (2)

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THE IMPACT OF THE NON-INERTIAL BASE MOTION IN THE OPERATIONS OF ROBOTIC MANIPULATORS IN ORBIT

Abstract

The robotic manipulators operation in orbit differs from those on ground. On ground the robotic manipulator base or platform is inertial in the sense that it does not move nor is disturbed by the motion of the robotic manipulator arms. In space the environment is characterized by microgravity and because of this the robotic manipulator base is not inertial. It moves and is disturbed by any motion of the robotic arm when performing operations of moving space components or astronauts from one place to other. This fact is associated with the Newton Law of Action and Reaction. The knowledge of the non-inertial base motion effects on the robotic manipulators operations is very important for the success of grasping objects in space, for berthing operations and manipulation of any device by using robotic manipulators. In particular the impact of non-inertial base will play a very important role for space tugs. This type of space vehicle shall be used in a near future to grasp, recover and repair on orbit spacecraft and to grasp objects such as debris. This article presents the mathematical model for a non-inertial robotic manipulator and analyzes the impact of the non-inertial base motion in the robotic arm operation performance. The equations of motion describe the translational and rotational motions. The translational motion describes the non inertial platform motion in response to the robotic arm displacements. The rotational motion describes the attitude motion. The dynamics and control laws are validated through a lab experiment with a robotic arm that operates on an air cushion to reduce the friction effect allowing the analyses of the platform reaction in response to the robot arm commanded actions. The robotic manipulator is commanded through a wireless system by using WIFI.