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

Author: Mr. Andrea Pisculli
University of Rome "La Sapienza", Italy, andrea.pisculli@uniroma1.it

Prof. Paolo Gasbarri
Università di Roma "La Sapienza", Italy, paolo.gasbarri@uniroma1.it
Prof. Giovanni B. Palmerini
Sapienza University of Rome, Italy, giovanni.palmerini@uniroma1.it
Dr. Marco Sabatini
Sapienza University of Rome, Italy, marcosabatini@hotmail.it
Dr. Leonard Felicetti
Sapienza University of Rome, Italy, leonard.felicetti@uniroma1.it

DEPLOYMENT ANALYSIS AND CONTROL STRATEGIES OF FLEXIBLE SPACE MANIPULATORS

Abstract

Recent proposals for mission involving the use of space manipulators are presented as a solution for a lot of problems which now affect the procedures and the performance of the space system in orbit. Several rendezvous and docking missions have been performed by the use of robotic manipulators; the same manipulators have been used for handling and assembling of large space modules and to reduce the human extravehicular activities. Other projects are under development in order to make possible the extension of the life of the existing or future platforms by some servicing spacecraft dedicated to repair, refuel and manage in orbit the failures of commercial or scientific satellites. On the other hand, one of the most important problem afflicting the space environment is the growing of the in orbit space debris due to the space activities exploited in the recent years. Launchers' last stages, old space satellites or debris due to the impacts with meteorites or between two satellites are now reducing the useful orbit slots and the mission survivability during the years. The control of such systems is a challenging task, since the equations that govern their motion are highly nonlinear. Different control strategies have been adopted in order to accomplish the mission tasks such as: the use of reaction jets to compensate the robotic arm induced motion of the spacecraft can be adopted. Such approach, though simple and with straightforward implementation has a considerable dis-advantage, since it leads to reduction of the life of a satellite system due to the limited fuel availability on board. Furthermore the impulsive maneuvers given by the jets could excite the manipulator structures, increasing the complexity of the mission guidance and control. For these reasons new kind control strategies have to be investigated: the so-called Reaction-null control strategy could be suitable solution. Indeed, this kind of strategy leads a minimization of the attitude motion of the base platform during the manipulators controlled maneuvers resulting in minimum use of the platform attitude actuators. An investigation of the benefit of this kind of control will presented in this paper compared to the traditional ones, considering the flexibility coupling effect during the maneuvers too. Several optimization algorithms of the joint path planning are developed in order to reduce the control efforts, the time of the maneuver and the entities of the structural excitation for the grasping phase of a no-cooperative object.