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CONTACT DYNAMICS OF A SPACE ROBOT CAPTURING A SATELLITE BY THE APOGEE KICK MOTOR NOZZLE

Abstract

In this paper, we analyze the capturing phase of an on-orbit docking service comprehending a non-cooperative satellite and a spacecraft-like robot manipulator. Space robotics is a promising approach for on-orbit services (OOS). These missions realize docking, berthing, rescuing and space debris removal, for example. OOS on noncooperative satellites is an open research area that poses several technical challenges. The capture of a nonoperational satellite is an example of an OOS actual challenge. Such a mission comprises in general the following phases: observation and planning, proximity rendezvous, capturing and post-capturing. The capturing phase is critical due to the physical interception. A major step for robotic space servicing is to ensure a safe and reliable docking operation. Improved models for the dynamics of such a problem is a step towards the design of a proper end-effector and a grasp mechanism. In the sense of mechanics, a robot in contact with a surface generates unilateral constraints. These constraints arise contact forces and naturally presents a complementarity behavior with respect to relative kinematics. This means that either relative distance is zero and thus contact forces are not zero or vice-versa. Inspired by ground-based robot manipulators, this paper aims to present the formulation of the contact dynamics between the end-effector of a service satellite and the nozzle of a target satellite.