ASTRODYNAMICS SYMPOSIUM (C1)
Attitude Dynamics (1) (1)

Author: Dr. Dongming Ge
China Academy of Space Technology (CAST), China, gedm1982@gmail.com

Dr. Yuanjie Zou
China Academy of Space Technology (CAST), China, zyuanjie@yahoo.com.cn

HYBRID POSITION/FORCE CONTROL OF LARGE SPACE MANIPULATORS

Abstract

Space manipulators play critical roles in the space projects, such as capturing and transferring of cabins, transferring and installing of instruments, and assisting astronauts for operation. In advanced robotic applications, not only the precise positioning control is required, but also the contact force exerted by the manipulator with the environment must be controlled carefully. Simultaneous force and position control of constrained robot systems has been an active research area. Due to the complexity of the kinematic and dynamic equations, absence of the inverse kinematic equation, and the presence of kinematic redundancy, it's difficult to satisfy the control objectives by traditional control schemes.

In this paper, simultaneous position/force control problem of redundant space manipulators is studied when the manipulator is in contact with the environment and a two-loop control method combining Cartesian space and joint space is presented. Compared with the vibration problem in the transition between free motion and constrained motion as well as the complexity problem of algorithms associated with the traditional control method based on the whole model, the hybrid positon/force control problem is decomposed into the motion plan problem in Cartesian space and the motion control problem in joint space. The position/force motion plan from Cartesian space to joint space and dynamics control in joint space are combined as an inter-outer loop control system. As a result, the position control of the end-effecter in free space and contact force control in environment constrained space are realized simultaneously. The simulation results of a 7-dof redundant manipulators demonstrate that the presented method is simple, effective and realizable for engineering.