Space Laboratory, Space Station and Space Exploration (2)
Space Laboratory, Space Station and Space Exploration (2)

Author: Prof. Yunhe Meng
National University of Defense Technology, China, mengyunhe_nudt@163.com

A COOPERATIVE CONTROL METHOD FOR A DISTRIBUTED SPACE TRANSPORTATION SYSTEM

Abstract

In this paper, a new concept for a distributed space transportation system is proposed and a corresponding decentralized cooperative control scheme is investigated. First, for a leaderless team of homogeneous space robots transporting a large object in orbit, a systematic control architecture that includes information flow is developed. Second, based on relative orbit dynamics, a rendezvous guidance law and a rigid formation control law are designed using a modified linear quadratic regulator method, and the necessary communication topology for the space robot team is discussed. Third, to guarantee the consensus of the motion of the large object with the robot team, both orbital maneuver control and attitude control for the large object are studied. For the former, a method combining feedforward control and feedback control based on the decentralized forces from each robot is developed. For the latter, particular emphasis is placed not on the attitude control law but on the force distribution problem, for which an algorithm exploiting a special property of trigonometric functions is proposed to transfer the necessary attitude control torque to the distributed forces. To support the above control method, an estimation of the motion of the formation center contributed by each robot in a decentralized manner is developed using a Kalman filter, the Trilateration method is used to estimate the position of the object centroid, and the Euler-q method is applied for decentralized attitude demonstrate the above methods. Finally, numerical simulations with measurement noise are presented to demonstrate the above methods.