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DISTRIBUTED CONTROL OF FLEXIBLE LOAD TRANSPORTATION BASED ON MULTIPLE ROBOTS

Abstract

The research on unmanned transportation is of great significance for the on-orbit assembly and on-orbit maintenance tasks of large-scale spacecraft. The use of robots for the transportation of goods is of great significance and economic benefits, especially in the face of transportation tasks under some harsh environmental conditions, such as the transportation of goods in space environment. In recent years, the use of robots for load transportation has made some progress. With the large-scale and lightweight of spacecraft, the flexible vibration of load is coupled with the movement of handling robot, which complicates the problem. This paper mainly studies the distributed control of flexible payload transportation by using multiple handling robots. The objective is to control the position and direction of flexible load and robot, and suppress the vibration of flexible load simultaneously. In order to develop a distributed controller, the transportation system is described as a group of transportation robots subjected to the disturbance force and torque from the flexible payload. Aiming at the disharmony of the traditional double-loop control structure, a control framework based on inversion method is proposed, which organically combines the outer loop position control with the inner loop attitude control. Restricted by the environment and the communication radius, it is difficult to ensure that all followers can directly communicate with the leader under actual conditions. To solve this problem, a distributed observer is introduced to estimate the information of the virtual leader. At the same time, based on the deformation analysis, the disturbance acting on the handling robot due to the transverse and torsional deformation of the flexible payload is estimated, the unmodeled disturbance is approximated by neural network, and the weight coefficient of neural network is learned online through adaptive adjustment rate. At the same time, the instruction filter is introduced into the controller to solve the driver saturation problem caused by physical constraints and the attitude restriction problem in the operation process.