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VARIABLE STRUCTURE SLIDING MODE CONTROL BASED ON PASSIVITY THEORY FOR FREE FLOATING SPACE ROBOT

Abstract

With the continuous increase space activities and the constant deepening of space exploration, there are more and more external missions need to do, using space robots instead of astronauts to complete space activities has become a hot topic because of the harsh space environment, so its key technology has attracted the attention of scholars all over the world. In the space weightlessness environment, there is conservation of momentum conservation or conservation of moment of momentum or both conservation of the space robot system, which results in strong coupling between base and mechanical arms, and there are some uncertainties such as joint friction and external disturbance, that makes the control of the space robot far more difficult to control the ground robot. For the uncertain space robot system, a neural network variable structure sliding mode control scheme based on passive theory is proposed. First, combining the relationship of the conservation of momentum and the Lagrange approach, the dynamic equation of free floating space robot system were established. Based on this, the controller is designed by passive theory. The upper bound of uncertain factors was obtained by radial basis function neural network, and then the system uncertainty is compensated by sliding mode variable structure, which can realize accurate tracking of the trajectory. The neural network adaptive rate is estimated by Lyapunov theory, and the stability of the system is proved. The control scheme overcomes traditional sliding mode control and needs to know the limit of known uncertainty boundary and can eliminate chattering. The simulation results prove the controller's efficiency.