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MECHANICAL SIMULATION OF CLAMPING CAPTURE SPACECRAFT FOR DUAL-ARM SPACE ROBOT AND PASSIVITY-BASED FORCE/POSITION NEURAL NETWORK H-INFINITY ROBUST CONTROL

Abstract

With the development of space, Space robots becoming more and more widely used. Therefore, the space robot system has been widely concerned by researchers from all over the world. With the increase of satellites in orbits, many satellites become defunct satellites due to fuel, mechanical fault, etc. In order to achieve the maintenance and clearance of the defunct satellites, the space robot's ability to capture the target becomes the key technology. In the space microgravity environment, Dynamic coupling exists between the space robot base and the mechanical arm, In the process of capturing the target, there are also changes and transfer in momentum, angular momentum and energy, which makes the control of space robot is more difficult than the ground robot. For the reason, the impact effect and post-capture passivity-based force/position neural network H-infinity robust control of dual-arm free-floating space robot clamping capture non-cooperative spacecraft are studied. First, the dynamic models of the dual-arm space robot and the target spacecraft before capture are obtained by multi rigid body dynamics method. After that, based on the law of conservation of momentum, the constraints of kinematics and the law of force transfer, the impact effect caused by collision of capture process is analyzed. Finally, the integrated dynamic model of the closed chain composite system is derived. On the basis, a force/position neural network H-infinity robust control scheme based on passivity theory is proposed for post-capture closed chain composite system with consider actuator saturation and external disturbance, which can achieve the coordinated control of the internal force and position of the target spacecraft. The scheme designed a stabilization controller for the nominal model by passivity theory, the radial basis neural network is used to approach the uncertain part of the system, Then, the approximation error of neural network is suppressed by using H-infinity theory, which make the effect of external disturbance on output is minimized. The proposed scheme has good dynamic characteristics and strong robustness. It can effectively resist the interference of strong impact effect caused by capture operation and achieve the stabilization control of composite system. The numerical simulation results verify the effectiveness of the control scheme.