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BACKSTEPPING CONTROL OF FREE-FLOATING SPACE ROBOT BASED ON BP NEURAL NETWORK STATE OBSERVER

Abstract

With the deepening of the development of space resources, the cost and risk to complete the task by astronauts are high. Therefore, as a replacement for astronauts, the space robot has become a hot research topic in recent years. Free-floating space robot is a nonlinear, strong coupling and time-varying system and its control technology is rather complex. Considering the uncertainty and disturbance in the system, the global state vector is hard to measure completely . As a result, the controller with high robustness in the field of robot control is particularly important. In this paper, when the model parameter is uncertainty, we put forward a trajectory tracking control method based on Back Propagation neural network state observer of the space robot by using the design of backstepping control . First of all, the design of vehicle location of free-floating space robot is uncontrolled to reduce the consumption of liquid fuel. The carrier needs to maintain a certain attitude angle so as to meet the demand of normal work. Because of that, free-floating space robot system of position-uncontrolled and attitude-controlled, as the research object, is studied. Through theSecond Kind of LagrangeEquations, the dynamic equation of free-floating space robot system is built. By the location and geometry relations of the space robot and the principle of conservation of system momentum, the kinematics and dynamics characteristics of the system are found out.The dynamic equation changes into the form.of state space expression. Then, we design a state observer based on BP neural network, observe the unpredictable state, and make the online approximation of the model . The weights of the adaptive law by neural network have modifications, which improve the precision of the approximation. The approximation model is applied to the design of backstepping control, and the filter is used to solve the calculation inflation problem caused by the virtual control derivation, so its control law is obtained, and the trajectory tracking control of the system is carried out. Then by using Lyapunov Stability Theorem ,the controller ensures that the tracking error is bounded,and the stability and convergence of the system are verified. Finally, through the numerical simulation results, it proves the feasibility and effectiveness of the proposed control scheme.