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IMPEDANCE CONTROL FOR ON-ORBIT INSERTION AND EXTRACTION OF SPACE ROBOT BASED ON VARIABLE STRUCTURE WITH FUZZY NEURAL NETWORK

Abstract

In this paper, the impedance control of the on-orbit insertion and extraction of a space robot with external disturbances and modeling uncertainties based on variable structure with fuzzy neural network is studied. Firstly, by using the Lagrange method and the dynamic relationship in the base body coordinate system, the dynamic equation and the Jacobian relationship of motion of the on-orbit insertion and extraction of the space robot are derived. Then, according to the dynamic relationship between the output force of the end of the space robot and the environment and the impedance control principle, a second-order linear impedance model is established. For the deterministic part of the above dynamic equation, a nominal PD controller is designed for general feedback control; For its uncertain part, a variable structure controller is designed for precise compensation. As a kind of precision operation, the on-orbit insertion and extraction hole operation of space robot requires higher control accuracy. In order to achieve its high-quality control requirements, a fuzzy neural network control is considered to eliminate chattering caused by variable structure controller. In the fuzzy controller, the sliding surface is used as the input, the compensation weight is used as the output and the fuzzy membership function is obtained by neural network fitting. The scheme avoids the use of differential signals of sliding mode surface and reduces the calculation amount. The simulation results show that under the influence of external disturbances and uncertainties, the space robot can not only successfully complete the on-orbit insertion and extraction operation, but also effectively suppress the buffeting.