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REINFORCEMENT LEARNING ATTITUDE CONTROLLER DESIGN BASED ON PID CONTROL FOR VARIABLE CONFIGURATION

Abstract

Telecommunication spacecraft is an important part in the international space field, and it's a trend that telecommunication spacecraft will be equipped with large-scale expandable antennas in the future. For the spacecraft with an antenna of dozens or hundreds meters diameter, the variable structure of the spacecraft in the process of antenna deployment will bring big challenges to both the dynamic modeling and controller design. The traditional PID controller can hardly reach the attitude control requirement of this kind of spacecraft. To solve the dynamic modeling problem,the rigid-flexible coupling dynamical model is derived from the hybrid coordinating method and Lagrange equation, and the parameters during the structural variation are approximated by the typical status parameters. To reach the requirement of attitude control in the process of antenna deployment, this paper combines deep reinforcement learning method with the traditional PID control method. According to Actor-Critic principle, DDPG(Deep Deterministic Policy Gradient) reinforcement learning control method is designed. Two actor-networks and two value-networks are designed respectively to gain the parameters of PID controller, thus to improve the control effect. Compared with the traditional PID controller, the PID controller combined with DDPG method has smaller overshoots, faster convergence speed, and higher control precision, which is verified by simulation.