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# MOTION PLANNING STRATEGY OF FREE-FLOATING SPACE ROBOT BASED ON DEEP REINFORCEMENT LEARNING TO CAPTURE NON-COOPERATIVE TARGET

**Abstract**

Recently, the free-floating space robot with uncontrollable base position and posture, which may reduce fuel cost and extend on-orbit life, has attracted more attention. However, the dynamic coupling between the robot arm and the base increase the difficulty of dynamic modeling of free-floating space robots. In addition, the work environment of space robot is complex, and the work objects are generally non-cooperative targets. Under such conditions, the usage of traditional motion planning methods will increase the amount of calculation and reduce the robustness. With the continuous development of machine learning, intelligent algorithms are also widely used in space engineering. Therefore, a new intelligent motion planning method based on deep reinforcement learning is proposed to meet robustness of free-floating space robot operations.

This paper uses deep deterministic policy gradient algorithm (DDPG) to solve the motion planning problem of free-floating space robot in the process of capturing non-cooperative targets. Firstly, the dynamic analysis of the single-arm six-degree-of-freedom free-floating space robot is completed and the virtual simulation environment is established. Secondly, for the capture task of space robots, an interactive solution framework of "agent-controller" is established, and the corresponding neural network is built and connected. At the same time, the state and action of the agent for training are designed, and the reward function is designed according to the capture task requirements of the robotic arm. Finally, using the designed depth deterministic policy gradient algorithm, the free-floating space robot capture task motion planning is trained and analyzed in the established virtual simulation environment to verify the effectiveness of the method.

The simulation results show that space robot after training can obtain correct task decisions according to its state, thereby complete the motion planning of the capture task. Simultaneously, once the training is completed, the strategy output action only needs to calculate forward propagation process of the neural network, which enables motion planning in real-time, indicating that the method has good adaptability and intelligence.