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Author: Dr. Haiping Ai
Fuzhou University, China, ahpwuhan@163.com

Prof. Li Chen
Fuzhou University, China, Chnle@fzu.edu.cn
Prof. Xiaoyan Yu
Fuzhou University, China, cool09@163.com

# BUFFER AND COMPLIANT REINFORCEMENT LEARNING CONTROL OF SPACE ROBOT CAPTURE SPACECRAFT WITH COMPLIANT MECHANISM

**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 spacecraft in orbits, many spacecraft become defunct spacecraft due to fuel, mechanical fault, etc. In order to achieve the maintenance and clearance of the defunct spacecraft, the space robot's ability to capture the target becomes the key technology. Considering that when the space robot captures a non-cooperative spacecraft with high speed and rotation characteristics, the joints of the space robot arm will be subjected to a large impact torque. If the impact torque is too large, the joints is likely to be damaged. Aiming at the problem that the joints are easily destroyed by the impact torque during the process of space robot on-orbit capturing non-cooperative spacecraft. For the reason, a compliant mechanism is mounted between the joint motor and space manipulator, its functions are: first, the deformation of internal spring in compliant mechanism can absorb the impact torque of the captured satellite acting on the joint of the space robot; Second, the joint impact torque can be limited to a safe range by reasonably designing the buffer and compliant control scheme. First of all, the dynamic models of the space robot and the target spacecraft before capture are obtained by using the Lagrange approach and Newton-Euler method. After that, based on the law of conservation of momentum, the constraints of kinematics and velocity, the integrated dynamic model of the post-capture hybrid system is derived. Considering the unstable hybrid system, a buffer and compliant reinforcement learning controller is proposed. The critic function is generated by interaction with dynamic environment, which can realize optimal control of the stabilization phase. The numerical simulation shows that the proposed control scheme can not only effectively absorb the impact energy generated by the on-orbit capture, but also timely open and close the joint motor when the impact energy is too large, which can avoid overload and damage of the joint motor.