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STUDY OF LIGHT ROBOT ARM FOR SPACE DEBRIS CAPTURE WITH BUFFER FUNCTION

Abstract

Since the number of satellites in Earth orbit is steadily increasing, space debris will eventually pose a serious problem to near-Earth space activities and so effective measures to mitigate it are becoming urgent. The active removal of space debris is effective possible measures. We are studying a micro robotic satellite with a simple light weight robot arm for active space debris removal. The upper stages of H series rocket were selected as target debris objects to remove. It is because many rocket upper stages remain on the low earth orbit, the form and size are alike in general, so H rocket upper stages are removable by the common technique. Capture is an indispensable task for the active removal of large space debris. In general space debris objects do not possess convenient features like target markers — they are non-cooperative targets. In this case, since the conditions are not favourite. Rotational movement remains in the object and dynamic force is produced at the time of capture by robot arm. The active force control of a robot arm is not enough for the buffer of the rapid force. The system which inserts a newly developed flexible mechanism in each joint of a robot arm in series is proposed. This paper first describes the details of a proposed active space debris capture/removal light weight robot arm and its vision system for optical navigation. And this paper presents the results of prototyping of robot arm with new flexible mechanism in each joint and image processing system for tracking target. The test bed containing this prototype of robot arm, the capture part of a target structue, the image-processing system to tracking, and a lighting simulator was built. Finally, we introduce control technologies for robot arm to capture a large space debris object. Experiment results using this testbed and control methods are also discussed.