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ON-ORBIT EXPERIMENTAL RESULTS OF THE REX-J EXTENDABLE ROBOTIC MANIPULATOR

Abstract

This paper describes the on-orbit experimental results of the extendable robotic manipulator which is being demonstrated in the ongoing REX-J mission (REX-J: Robot Experiment on JEM/ISS). The mission objective is to demonstrate essential technologies, mainly a unique method of tether-based locomotion and an extendable robotic arm, for developing the astronaut support robots. The robot system was launched by H-II Transfer Vehicle (HTV-3) from Tanegashima space centre to the Japanese Experimental Module's Exposed Facility of the International Space Station (JEM-EF of ISS) on 21 July, 2012. The space robot has been operated remotely from Tsukuba space centre since 20 August, 2012. The functional checkouts of the robot system were successfully completed by the end of the month. After the successful checkouts, on-orbit experiments have started to be conducted.

The robot system has an extendable manipulator which consists of an extendable arm, a 2 DoFs wrist and a gripper-typed hand. This arm has extendable/ retractable function whose mechanism is based on Storable Tubular Extendable Member (STEM) and the extendable boom is made of CFRP. The length of the arm can be controlled from 0mm to 1300mm by the 0.2mm (300mm to 1600mm including the chassis). The hand is designed to grasp EVA tools such as hook and handrail with two fingers closed after approaching them by controlling the arm length and the wrist attitude. In the experiments, the manipulator has been extended and retracted repeatedly within a range of 600mm, and the total motion length is over 4240mm as at 21 February. This extendable function enabled the robot to achieve the several tasks such as grasping a hook and attaching the hook to a separate handrail in the REX-J mission up to now. On the other hand, it is becoming clear that there are several differences of the extendable manipulator between the on-orbit experimental results and the ground tests results such as power consumption in the motion.

At the conference, we will show the experimental results of the extendable robotic manipulator under the microgravity and thermal vacuum environment. In particular, we will focus on the differences of the performance between the on-orbit environment and the ground tests environment, and the reason why it happens. And also, we will present the remaining issues to be tackled for realizing a robotic manipulator which can support and substitute astronauts in the future.