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A SPACE MOBILE ROBOT USING TETHERED MOVING METHODS. – STUDY OF TETHER'S LOCATION AND ROBOT'S LOCOMOTION CAPABILITY -

Abstract

Expanding space activities, space robot is required for supporting human space activities. There are many requirements to support astronauts, and especially the space robot is demanded on the mobility which has an adequate speed, movement range and safety. Several tethers and extendable robot arms (ERA) give effective locomotion system to space robot, called "Tether based locomotion". Tether based locomotion is a part of tethered moving methods such as a tethered satellite or cable-driven parallel manipulator. This robot, which is called "Tether based robot", is anchored by several tethers with a hook to the handles of facilities and moves with the collaboration control of the tethers' lengths in the area where is surrounded by tether's corners. The anchored area is variable because ERA can unhook and hook again the tethers to other place. Therefore it has a capacity of the fast acceleration and wide range of movement. In addition, this method supposes to use redundant tethers and it ensures a safety in emergency such as a tether's fracture or electrical outage, because other tethers hold up the robot's posture. Tether based robot will be demonstrated in Astrobot Experiment on JEM, called REXJ project. Three basic functions of tether based robot are verified in REXJ project, "Extending a robot arm with STEM", "Attaching a tether with extendable robot arm", "The robot's locomotion in plane to control the tethers' lengths". To the Next step, the target of research and development of tether based robot is to demonstrate "Spatial locomotion". To design a spatial locomotion robot, the study of tether's location and robot's locomotion capability is required. Especially the location and direction of the tether's corner is a remarkable issue, which is related in the stability of the locomotion. This report aims the general principle of the optimized tethers' location not only for the tethered based robot but also for the other tethered moving objects. Simulation is conducted by simple models which the tether's location and direction is different. Those models are anchored to the wall with the tensioned tethers. The sensitivity that the model can response the arbitrary forces and moments by tethers and the vibration characteristic in static condition is valuated. Then one model is experimented to confirm the result of simulation in gravity. The best model of tether's location in this result will reflect the design of next tethered based robot used in demonstration.