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HUMAN EXPLORATION OF THE SOLAR SYSTEM SYMPOSIUM (A5)
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A WEARABLE MANIPULATOR FOR SUPPORTING EXTRAVEHICULAR ACTIVITY: GROUND TEST RESULT USING PROTOTYPE MODEL

Abstract

Among astronaut's various works, Extravehicular Activity (EVA) is performed essentially to maintain the International Space Station (ISS), while requiring large risk, time and cost at the same time. In order to solve these problems by assisting astronauts during their EVA, a novel wearable manipulator has been proposed, which is attached either to the space suit or to handrails on the exterior of ISS. The significant feature of the proposed manipulator, unlike conventional astronaut supporting robots which aim to operate independently, is its ability to work dexterously together with astronauts as a highly functional tool, expected to enhance astronaut's ability by behaving as a third arm.

As previous works, first the concept of wearable manipulator was proposed together with its task requirements, functional requirements, and operational scenarios. Then based on those requirement analysis, essential 3 hardware and 2 software components were identified; robotic hand to grasp various objects, robotic arm to perform dexterous manipulation, mounting device to connect mechanically with handrails, human machine interface for the sending commands and receiving telemetry, and control application for processing command and telemetry. Ground prototype models of each component were designed and fabricated for concept verification.

This paper focuses on reporting the results of concept verification tests using ground prototype models. In order to check their functions and specifications, and then to assess feasibility of the concept, following tests were planned. Components and integrated system verification were conducted to confirm whether prototypes fulfill functional and specifications requirements designed for ground use. Each component was verified respectively during either performing standalone or performing as a part of integrated wearable manipulator system. Then working capability was verified whether the expected tasks derived from conceptual study were effective and feasible. Therefore those tasks were modeled and implemented in the system including interaction with human, and they were assessed especially from the perspective whether wearable manipulator actually could assist human effectively or not.

Therefore in this paper, introduction of wearable manipulator and design of the prototype is stated briefly first. Then, details of verification tests are described and their results are reported. Finally based on the results, suggestions for further improvement of the system are stated.