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THE ROLE OF NATURAL INTERACTION IN ASTRONAUT-ROBOT COOPERATION

Abstract

The next manned missions to the surfaces of Moon and Mars will be longer and more complex than any of the previous human spaceflights. The number of tasks and devices that astronauts need to perform and operate, often without any assistance from the ground control, is expected to increase significantly. One way to cope with this increased complexity is to develop interfaces that can support the human cognitive processes, i.e. develop interfaces that are based on the way people naturally interact and process information.

This paper presents a status report of the SpacePartner project, which objective is to develop methods to enable natural and seamless astronaut-robot interaction. Natural interaction is used here to refer to interaction that is inspired by the human-human interaction. This type of natural human-robot interaction has been frequently visioned in science fiction as the way we humans would communicate with robots in the future. The test platform used in the project is a centaur-type service robot, called WorkPartner, which was initially developed in Aalto University to assist humans with light outdoor tasks.

The first part of the paper reviews the different human-human inspired methods for communicating tasks with robots. Such methods include perspective taking, peer-to-peer dialogue, and establishing of a common ground for the communication. Furthermore, the foreseen advantages of these methods for astronaut and robot cooperation on the surfaces of Moon and Mars are extracted and analysed.

The second part of the paper introduces an approach where object affordances are used to facilitate the communication of tasks to a robot. The idea with object affordances is to mimic the way the human brain is able to automatically associate possible actions with an any given object. This association can be used to provide the astronaut an alternative way to communicate tasks for the robot to execute. This alternate communication method provides both a valuable fall-back option in case the more rigorous attempts to communicate the task fail and a starting point for establishing a common ground for the task communication.

The paper concludes by presenting the preliminary results of the human-robot interaction tests, demonstrating the possible usages of affordance concept. In addition, the plans for a full astronaut-robot planetary exploration cooperation test scenarios, for a representative in-context evaluation of the developed natural human-robot interaction system, will be described and discussed.