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FROM ROBOTIC ASTRONAUT ASSISTANT REQUIREMENTS TO DEMONSTRATION: THE CASE OF SPACEPARTNER

Abstract

The astronaut-robot assistants envisioned for future manned missions to the surfaces of Moon and Mars are still in early development phase, meaning that only small number of expected subsystems have been properly developed and evaluated. Especially full demonstrations of astronaut-robot cooperation are still very rare because developing a fully functional and versatile assistant robot is very expensive task that takes numerous man-years to complete.

This paper presents an overview of SpacePartner project in which a existing centaur-type robot was adopted and further developed to serve as an fully autonomous astronaut assistant robot. The project started from the analysis of most typical astronaut-robot cooperation missions in order to identify the respective robotic astronaut assistant capabilities required to implement these missions. This analysis directed the project focus on astronaut-robot task communication development to better support situations where the astronaut and robot are operating face-to-face in same physical workspace.

After presenting the most typical missions and robotic astronaut assistant requirements, findings and proposed task communication approaches from four experiments performed during the project are presented. The core approach in the project is to utilise human-human communication as a model that can be applied also to human-robot communication. Especially the idea of utilising object-action associations in the task communication is examined thoroughly in the presented experiments.

Finally the paper presents in detail a complete cooperation system demonstration experiment performed with the fully autonomous centaur-type robot. The experiment demonstrates the cooperation system's capability to perform useful tasks, such as transferring objects and documenting events, in a planetary analog environment. This final experiment demonstrates that the cooperation system developed in the project contains a complete set of subsystems that is sufficient to implement a usable astronaut assistant robot.