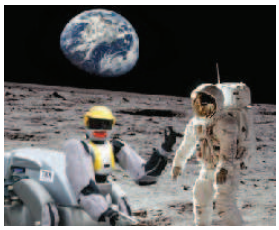
SpacePartner Project Summary Leaflet

Project Background

SpacePartner project is a co-sponsored PhD project of the European Space Agency (ESA) and the Aalto University, Finland. The project was initiated under the ESA Network Partnering Initiative (NPI) program, which target is to enhance space research through spin-ins from advanced non-space projects. In this case, the spin-in is to utilize the existing WorkPartner service robot to develop astronaut-robot cooperative task definition and execution capabilities. The project was active from January 2008 until end of 2011, i.e. four years.

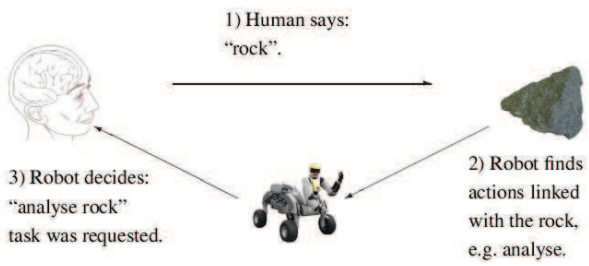


Problem in Task Communication

The problem with current human-robot task communication is that robots cannot understand complex human speech utterances, while humans cannot efficiently use the fixed task request utterances required by robots. Nonetheless, future planetary exploration missions are expected to require astronauts on extra-vehicular activities to communicate task requests to robot assistants with speech- and gesture-type user interfaces that can be easily embedded in their space suits.

Solution from Affordances

The solution proposed in the SpacePartner project is indirect task communication based on the human-like ability to utilise object-action relationships in task communication. Conventional task communication methods, in which all task parameters need to be communicated explicitly, are evaluated against task communication methods where affordances, i.e. action possibilities, are used to complete task communication.



Four User Experiments

Affordances enable humans to request tasks from the robot using only task-related object and action names, because the robot is able to complete the task request using the knowledge of what actions it can perform with certain objects. These formulated so-called affordance-based task communication methods are evaluated by means of four user experiments: two performed with a fully autonomous centauroid robot in a planetary exploration work context and two with a simulated robot in a lander assembly work context.

Results Show Decrease in Workload and Task Communication Times

The user experiments show that affordance-based task communication methods can be used to decrease both the human workload and task communication times in a planetary exploration work context. Furthermore, affordance-based task communication methods are found to be preferred over conventional task communication methods, or to be at least preferred to be used simultaneously with conventional methods.

Conclusions

The affordance-based task communication methods derived can be applied to facilitate any human-robot task communication that includes a priori known or recurring task sequences, although the results were derived in astronaut-robot planetary exploration type of work context.

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