MECA Mission Execution Crew Assistant

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Empowering Cognitive Capacities of Human-Machine Exploration Teams

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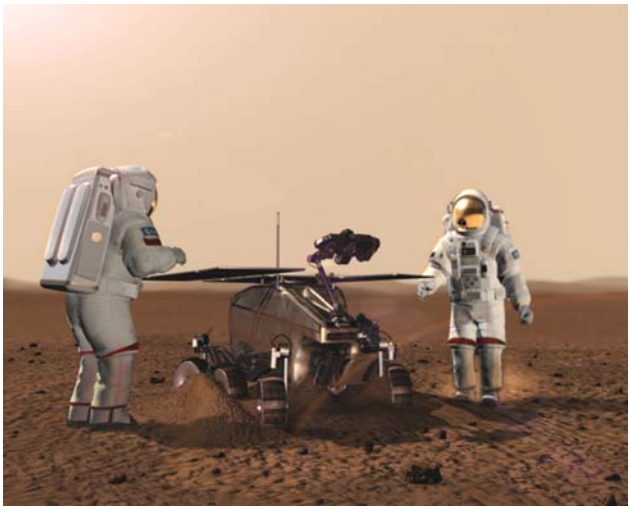

Photo: ESA/Aurora

In the space domain, the plans for manned missions to the Moon and Mars set substantial challenges for developing crew support. For such long-duration missions, there is a need for a Mission Execution Crew Assistant (MECA) that supports (groups of) humans and machines to act in a distributed, autonomous but cooperative way. TNO, S&T, OK-Systems and EADS apply cognitive engineering methods to derive the requirements and to develop a first MECA prototype.

The objective of MECA is to empower the cognitive capacities of human-machine teams during planetary exploration missions in order to cope autonomously with unexpected, complex and potentially hazardous situations.

On the Moon and Mars, machines will include habitats, facilities such as oxygen production plant, exploration vehicles, and autonomous rovers. MECA will provide crew support that acts in a ubiquitous computing environment as "electronic partner", helping the crew to assess the situation, to determine a suitable course of actions to solve a problem, and to safeguard the astronaut from failures. To establish the required optimization of workload, situation awareness, sense making and trust, emerging technologies will be applied. Examples are multi-agent systems, automatic planning and scheduling, and model-based health management.

For the development of MECA, we apply a human-, task- and context-driven design and evaluation approach. According to the vision of the project team, both MECA and the humans will show mutual adaptive behaviour, which effects should be well tested with realistic scenarios. Prototyping, simulation and testing is therefore essential to establish a sound and coherent set of requirements.

TNO science [&] technology EADS SPACE TRANSPORTATION OK-Systems

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In a typical scenario, an in-situ MECA health-management process signals the presence of an imminent equipment failure to an astronaut's "electronic partner". The ePartner, working together with the astronaut, establishes the root of the failure and derives a repair plan that will compensate for the failure. Assuming that this particular repair requires at least two astronauts, the ePartner contacts the crew's captain with an update about the equipment's health status and a request to allocate an additional astronaut having the appropriate skills. It is up to the captain and his or her ePartner to further organize the re-planning and (re-)scheduling of the rest of the crew.

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