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Robots come to aid of human exploration

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(SPACE.com) -- Computer software developed in California's Silicon Valley, as well as autonomous robotic assistants, may prove indispensable to future astronauts charged with the monumental job of exploring an entire planet.

Two researchers test computerized systems in the Utah desert for a future lunar or Mars mission.

Embedded in a backpack-mounted laptop, smart software responds to voice commands, links astronauts to mission control and their planet-side habitat. It even communicates with robotic assistants that might be roving nearby.

The complete system -- autonomous rover included -- has already passed an initial shakedown test and is headed out to the Utah desert for another run under research conditions.

"What you're seeing is a fresh look at the whole science of data gathering," said Richard Alena, a computer engineer on the project at NASA's Ames Research Center in Moffett Field, California. "Basically, we're ensuring that we're ready for Utah."

The Utah desert is just a proving ground for intelligent software, called 'mobile agents,' which researchers hope will find a role in future human missions to the moon and Mars.

"We think that it's as critical and obvious as the idea of having wireless computing in the field," said Bill Clancey, principal investigator of the mobile agent project and chief scientist of human-centered computing at Ames. Clancey is also a senior research scientist at the Institute for Human and Machine Cognition at the University of West Florida in Pensacola.

Agents on other worlds

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The goal of the mobile agent software is to blend extravehicular research conducted by human astronauts with data management abilities of computers.

The first role of an astronaut's personal mobile agent is to reduce the amount of time astronauts use to relay information back to Earth about things such as the condition of space suits or computer readouts. Using the agents to control a robot assistant, a landing party could identify interesting locations from the comfort of a habitat module and proceed directly into scientific investigation.

"People's time is very important on the surface and you don't want to waste it doing reconnaissance," Alena said. "You want astronauts to do targeted surveys, to follow the water and maybe even signs of life."

Automating exploration

A mobile agent's second role is more interactive, dating back to days of the Apollo program when humans on the moon constantly reported back to a capsule communicator on Earth that directed their activities.

"We went back to Apollo [moon walks], where [ground control] was providing blow-by-blow advice to astronauts who would narrate all of their activities," Clancey said. "The point is, when you're on Mars you can't be having this conversation with folks back in Houston because of the time delay."

The robotic agents, Clancey said, are a way to automate this command role on other planets. During Mars walk, for example, the course would be determined by a mobile agent guiding astronauts during the excursion.

Should humans get sidetracked or encounter an emergency, an agent could alert other astronauts, as well as the rest of the Mars-bound crew. The agent could also transmit a messages for mission control on Earth.

"I do want a system that's much more sophisticated," Clancey said, adding that mobile agents need to be able to prioritize extra-vehicular tasks.

Terrestrial tryouts

During the shakedown test, two mock-astronauts used mobile agents to monitor their progress and report to a simulated Mars habitat module. The 'astronauts' also relied on the software to control their robot assistant, telling it when to take a picture and stamping data with time and location markers.

A researcher tests software on a backpack-mounted laptop computer at NASA's Ames Research Center in California.

To ensure it worked smoothly, Ames researchers had to facilitate realistic speech between humans and computers, create a wireless network and automate scientific organization of data collected in the field.

"The trick is to make all of those elements work together," Alena said, adding that the test was the first use of a completely autonomous rover that followed its human companions like a loyal mechanical assistant. "And it was a milestone that we've reached…I think the system is maturing nicely."

Like most new systems, there were some minor glitches. At one point during the shakedown, some data did not make it from the mobile agent to the proper database due to a connection problem with Ames' software.

"Because of the nature of a test, you're doing everything for the first time," Clancey said, adding that finding those problems was the whole point of a shakedown test.

"And you realize that there is always something nobody's ever thought of."

Clancey is confident that with the next Utah field test under their belts, he and his team could have a fully functional mobile agent system in about a year. There would still be the task of deciding on a final computer platform, as well as meeting space-hardening requirements, before mobile agents would see their first spaceflight, he added.

Meanwhile, Alena hopes to expand the current system to include other robotic niches, such as a robot flyer for low-altitude reconnaissance or astrobiology applications.

"The current approach is to use the moon as a testbed, particularly for new modes of human-robotic systems," he said. "That's going to be a big difference from the Apollo age."
