

MOBILE AGENTS INTEGRATE ASTRONAUTS, ROVER, AND MISSION SUPPORT IN DESERT-RATS MISSION SIMULATION

**William J. Clancey¹, Maarten Sierhuis², John Dowding², Dan Berrios²,
Mike Scott², Ron van Hoof², Frank Delgado³, Susan Torney³, and Joe
Kosmo³**

NASA's Desert Research and Technology Studies (D-RATS) project conducted a series of integrated field operations near Meteor Crater, AZ, September 5-14, 2006, involving a mission support center in Houston and test subjects conducting simulated extravehicular activity (EVA) tasks while wearing pressurized space suits and using a prototype rover vehicle. The tests demonstrated the first end-to-end systems integration between mission support and people and robotic systems at a remote site. Mission support was provided by JSC's Exploration Planning and Operations Center (ExPOC) facility of the Mission Operations Directorate. Crew systems included two advanced mobility demonstrator space suit assemblies, computer backpacks (CAI Packs), and JSC's Science, Crew, and Operations Utility Testbed (SCOUT) prototype un-pressurized rover vehicle.

D-RATS 2006 demonstrated how agent-based systems integration allows rapid prototyping of complex systems for field testing in mission simulations. Hardware and software systems were integrated using Mobile Agents software running on five interacting laptop computers: at ExPOC, in the two CAI Packs, the HabCom (in trailer simulating a surface habitat), and onboard SCOUT rover vehicle. Integration with SCOUT enabled autonomous drives, control of multiple cameras, programmed control of the Planetary Exploration Geophone System (PEGS) hardware, and access to telemetry (e.g., GPS, communications quality, weather data). For efficiency and safety, the crew used new voice commands that inform others that automated movement is about to occur (e.g., "Scout, prepare to move to X"). Combining following with targeted autonomous drives, SCOUT accompanied, moved ahead, carried, and followed the two astronauts in various combinations. A heads-up display in the pressurized suits showed possible voice commands and verified speech interpretation.

ExPOC commanded SCOUT to move and take pictures, received alerts, and observed the status of the EVA on Microsoft's Terraserver aerial photographs dynamically annotated showing movements of SCOUT, crew, and where photographs, samples, and voice notes were taken. Thus besides direct controls, using Mobile Agents SCOUT could be controlled remotely, by voice command, or through an autonomous program.

¹ NASA/Ames Research Center, Intelligent Systems Division, MS 269-3, Moffett Field, CA 94035; Also Florida Institute for Human and Machine Cognition, Pensacola; William.J.Clancey@nasa.gov.

² NASA/Ames Research Center (Sierhuis: RIACS; Dowding and Berrios: UC Santa Cruz; Scott and van Hoof: QSS)

³ NASA/Johnson Space Center