

Science Crew Operations and Utility Testbed

Frank Delgado, Johnson Space Center

The habitation, development, and exploration of lunar and martian environments will require a human and equipment surface transport vehicle. Although a human surface transport vehicle was designed and used on the Apollo missions, the capabilities required to support the build-up, maintenance, and exploration activities associated with a prolonged stay on the lunar and martian surfaces will require the development of a new vehicle with significantly greater performance capabilities. A multiuse planetary rover will prove very useful when transporting humans and equipment. The equipment transported by the planetary rover can be used by crewmembers to perform short- and long-term scientific endeavors. Riding instead of walking on the planetary rover to get to a remote location of interest will allow crewmembers to conserve important spacewalk suit consumables required to sustain life in the harsh lunar and martian environments, and will allow them to conduct spacewalk activities at a higher performance level for longer periods time.

The Science Crew Operations and Utility Testbed (SCOUT)



Project has led to the development of the mobile platform known as SCOUT I. SCOUT I is being used to develop and test advanced rover technologies and operations concepts that will prove valuable during future planetary rover development activities. The SCOUT project has been a multi-organization effort with participation from experts in automation and robotics, power systems, crew accommodations, avionics, structures, navigation, software systems, communication systems, and operations. SCOUT I has provided engineers and operations personnel with more than two years of hands-on experience in developing and testing subsystem and control software for human transport rovers.

SCOUT I can transport two crewmembers, traverse 10-deg slopes (30-deg Mars equivalent), drive up to six miles per hour, go over one-foot-high rocks, and provide a six-mile drive range. SCOUT I also supports three different drive modes. The first drive mode involves controlling SCOUT I from the onboard open cockpit. The open cockpit is composed of two seats, a control stick, and a display and control system. These three components are ergonomically designed for use by crewmembers wearing a spacewalk suit. The display and control system provides all necessary insight, commanding, and control of SCOUT I. The second drive mode involves controlling SCOUT I from a tele-operation system, which provides operators with all information, command, and control that would be provided to onboard operators. The third drive mode involves controlling SCOUT I using the onboard autonomy system (OAS). The SCOUT I OAS includes an autonomous navigation capability that allows SCOUT I to autonomously drive between waypoints. The OAS is also equipped with a stereo vision system that continually tracks or calculates a relative position for an individual in the vicinity of SCOUT I. This tracking capability has been integrated with the drive

system and is being used to perform human following of an individual in front of SCOUT I.

SCOUT I is currently undergoing hardware and software upgrades that will augment the capabilities currently available. The capability augmentations planned for fiscal year 2005 (FY05) include:

- a spacewalk suit recharge capability that will increase the amount of time suited crewmembers can perform spacewalk activities
- an advanced tele-operation system that will use hybrid synthetic vision and a panoramic video system to significantly enhance a tele-operators situation awareness
- a gesture recognition capability that will allow a crewmember to command the vehicle using arm and body gestures
- a “natural language” speech recognition/synthesis system that will allow operators to command the vehicle using a wide assortment of English words and sentences
- an intelligent vehicle health management system that will manage onboard resources and assure that the vehicle is always in a nominal and safe configuration
- an ultra-wide band system that will be capable of providing very accurate position information for objects near the vehicle
- an obstacle avoidance system that will allow the vehicle to drive around obstacles during autonomous point-to-point navigation
- an illumination system that will be used during suboptimal lighting conditions
- a spacewalk camera system that will provide high-zoom and low-lux capabilities to tele-operators

In FY05, SCOUT I will also be used as a testbed for the Advanced Cockpit Evaluation System (ACES) Project and the Mars Drill Project. The ACES Project will evaluate the use of a “closed” prototype cockpit to monitor and tele-operate SCOUT I. The Mars Drill Project will use SCOUT I to test and evaluate operations concepts related to the integration and testing of a prototype Mars drill.

SCOUT I and all future SCOUT vehicles will be developed using the Agency’s new ideas for intelligent software, operations models, portable power solutions, communication technologies, and in-situ processing. The SCOUT team has developed collaborative partnerships with several NASA centers. The Glenn Research Center, Ames Research Center, Kennedy Space Center, Goddard Space Flight Center and Jet Propulsion Center have all expressed an interest in using SCOUT prototypes for field experiments or as a testbed for integrating and testing their technologies.