NASA SBIR 2007 Phase I Solicitation

X7.02 Human Systems Interaction

Lead Center: JSC

Participating Center(s): ARC, GRC, GSFC, JPL, KSC, LaRC, MSFC

The objective of this subtopic is to create an effective and efficient operational interface between a human and a robotic system that is supporting the human. This subtopic seeks to develop technology that reduces the risk of Extra-Vehicular Activity (EVA), improves the productivity of Intra-Vehicular Activity (IVA) and facilitates remote operations by both flight crew and ground control. Automation and robotics capabilities include the ability to use robots for site operations, both at an outpost and at remote lunar surface locations. Site operations support focuses on two types of activities: (1) tedious, highly repetitive, long-duration tasks that cannot be performed by EVA crew and (2) rapid response for addressing emergency, time-critical situations. Candidate tasks include: mobile camera platform control, systematic site survey (engineering and/or science), inspection, emergency response, site preparation (clearing, leveling, etc.), and instrument deployment. Proposals are sought which address the following technology needs:

- Telepresence and variable autonomy teleoperation systems that support human and robot teams operating: (1) in a shared space, (2) close but separated, (3) line-of-sight remote, and lunar. Particular interest is given to systems that flexibly support human-robot operations in the presence of time-delays of up to 10 seconds.

- Adaptive user interfaces including perception, speech recognition, context awareness, computational cognitive models, and collaborative 3D graphics, and EVA display devices (i.e., pressure-suit compatible devices and displays). Specific design objectives include enabling more natural interaction with autonomous systems, facilitating situational awareness, increasing overall productivity by reducing the amount of interaction effort the human has with the robot, and flexibly displaying multi-modal and mission-specific data.

- Geospatial tools for situational awareness including content generation tools for geospatial information, particularly for supporting planetary surface missions; software libraries for generating, parsing, and importing heterogeneous mission data (orbital imagery, navigation information, sensor and instrument readings, etc.); and terrain modeling (Digital Elevation Map).

- Vehicle control components and navigation sensors that support on-board driving, teleoperation, and autonomous operations. Control systems should support multiple control modes, include activity monitoring and operator intent prediction, and tolerate up to 10 seconds of time-delay. Navigation sensors that utilize passive computer vision (real-time dense stereo, optical flow, etc.) and/or active illumination (for
recognizing/tracking non-textured objects and operation in permanently shadowed regions) are of particular interest.