NASA SBIR 2009 Phase I Solicitation

O3.01 Human Interface Systems and Technologies

Lead Center: GRC

Participating Center(s): ARC, GSFC

The focus of this sub topic is on the development of systems and technologies that advance TRL of man/machine interfaces for humans in space environments. Specific areas of interest include, but are not limited to, high fidelity inbound and outbound speech and audio systems along with data entry/data presentation devices, cameras, metabolic monitoring, health monitoring devices, interfaces that support human/robot interaction, high-level communications protocols and/or standardized interfaces for transmitting and receiving data related to human monitoring systems or human interface systems. Technologies and systems should resolve issues that are peculiar to human/machine interaction in the space environments or exploit unique features of the space environment or both. Interest exists for application to micro-gravity space suits, planetary space suits as well as space-based "shirtsleeve environments" such as onboard the ISS, shuttle or other crew modules. The particular focus area of the topic this year is on Advanced Data Entry systems.

Advanced Data Entry

Terrestrial user-interface devices for controlling portable processing equipment such as laptop computers typically rely on keyboard or touchpad input. Such devices are problematic in the space environment since a suited crewmember must interact with the processing equipment while wearing a pressurized glove. Speech recognition technologies have been proposed and investigated to provide a data entry capability for suited crewmembers. However, speech recognition technologies typically incur a high computational loading burden. Alternative methods and technologies for data entry are anticipated to result in significantly lower processing burden and therefore reduced Size Weight and Power (SWaP) and enhanced system reliability. Preference will be given to proposals that indicate the resulting system will have a low computational burden.

Currently, the main purpose of a suit's processing system is for providing life-support data-acquisition, monitoring, telemetry, and crewmember alerts. The traditional approach to interact with the EVA processing system is with suit-mounted toggle switches optimally sized for a gloved hand and located in the suit's chest area. NASA envisions future generations of suits to contain advanced communication, navigation, and information processing capabilities that will require better ways of interacting with the suited crewmember. It is likely that the processing unit(s) will be installed within the suit's backpack-mounted portable life support unit or in close proximity.

Crewmember usability and efficient operation are prime features of the next-generation input device. The device

must operate robustly in the space environment and on the surface of remote planetary bodies. Devices must be tolerant of dust, vacuum, and radiation exposure. During Extra-Vehicular Activity (EVA), a suited crewmember needs to achieve as high a level of mobility as possible, so a suit-mounted computer-input device must not impede the movements of the suited crewmember or unduly burden the suit system with weight, volume, or electrical power constraints.

NASA is seeking systems, subsystems and/or technologies in support of improvements in suit-mounted computer system data entry user-interface devices. Devices or systems should allow the suited crewmember to control a computer processing system and provide text input and/or spatial indication accurately, at high speed, without little or no user fatigue. Possible interactions for data entry include, but are not limited to: inputting direction or positions (for navigation or robotic-aid purposes), inserting notes (e.g., field or experiment notes, images, labeling of images), and selecting/marking items on lists (e.g., zooming, drilling down lists, scrolling through lists, moving items). Concepts may consider that provide solutions installed internally (within the pure-oxygen pressurized envelop of the suit), externally (mounted on the exterior of the suit), or a combination of the two:

Particular interest is in the areas of:

- Human interface devices that support manual control of mechanical devices such as rovers or tools;
- Chording keyboards, suit or glove mounted fabric keyboards or touch-pads;
- Techniques for routing wires or connections between the user interface device and the computer-processing unit;
- Techniques for routing the wires past bearings or avoidance of such.

Other technologies will be considered.

Research should be conducted to demonstrate technical feasibility during Phase 1 and show a path toward a Phase 2 hardware and software demonstration and delivering a demonstration unit or software package for NASA testing at the completion of the Phase 2 contract. Preference will be given to proposals that support in-flight demonstration opportunities on the ISS at the completion of the Phase 2 contract.