NASA SBIR 2012 Phase I Solicitation

H4.02 Space Suit Life Support and Avionics Systems

Lead Center: JSC
Participating Center(s): GRC

Space Suit Life Support Systems

Advanced space suit life support systems are necessary for the successful support of the International Space Station (ISS) and future human space exploration missions for in-space microgravity EVA and planetary surface operations. Exploration missions will require a robust, lightweight, and maintainable Primary Life Support System (PLSS). The PLSS attaches to the space suit pressure garment and provides approximately an 8 hour supply of oxygen for breathing, suit pressurization, ventilation and CO₂ removal, and a thermal control system for crew member metabolic heat rejection. Innovative technologies are needed for high-pressure O₂ delivery, crewmember cooling, heat rejection, and removal of expired CO₂ and water vapor.

Space Suit Avionics Systems

Future generations of advanced space suit avionics will be far superior to those on the current generation of space suits. They will be more capable, configurable, lightweight, and low power with a footprint that will rival current consumer electronic devices, but survive the harsh space environment. They must be self-contained, so that maintenance on the devices can be performed on-orbit or they can be easily swapped for functioning or upgraded devices. Those considered will be radio, displays, and cameras.

Future advanced radios will be configurable and, potentially, software-defined and/or re-configurable to support future communications network-based architectures in addition to the point-to-point communications links that are prevalent today. The next-generation EVA radios will need to support voice, telemetry, and standard/high definition video data flows (up to 20 Mbps) and the radio architecture will need to be lightweight and power efficient while managing data in a seamless and lossless manner between multiple interfaces. Radios should support space-based or terrestrial-based protocols to enable communications between multiple entities across a communications link and have an open and modular architecture.

The current generation of Head-Mounted Displays (HMDs) and Near-to-Eye (NTE) Displays are not viable, since it
is desirable for the display to be decoupled from the user's head for improved safety, comfort, and alignment. The decoupling makes the specifications for the eyebox (tolerance to misalignment before image goes out of focus), field of view (angle of the image created by the optics), and eye relief (working distance from the eye to the last optical element) difficult. Key performance targets include:

- **Graphical Data Presentation**: SXGA @ 40 °FOV (possibly biocular).
- **Decoupled from User's Head - Large Eyebox**: 100 mm x 100mm x 50mm (D).
- **Sunlight Readability**: 500 fL inside visor, 1800 fL outside visor (>10 to 1 contrast).

Display technologies must ensure that suit displays can operate outside the suit environment in thermal, radiation, and vacuum as well as internally without imposing ignition hazards due to 100% oxygen environment.

Cameras will not only provide the crewmember the ability for still and motion image, but also situational awareness, which enhances safety for the crewmember. The cameras should be capable of recording high definition motion and high-resolution imagery with the ability to compress the data for transmission over a variety of RF transmissions and/or IP networks with varying bandwidths. Hemispherical and dynamic cameras are desired. Dynamic cameras can take still images and motion video in variable bandwidths, capture images based on link quality, and change frame rates. Hemispherical cameras record 360 ° video views of a crewmember, distort views through optics and then undistort the views via software on the ground to pan/zoom for total situational awareness. Cameras should be low-power and lightweight with a number of mounting options for optimal placement on the suit.

Technology Readiness Levels (TRL) of 4 to 6 or higher are sought.

Potential NASA Customers include:

- **EVA Project Office**.
- **International Space Station**.
- **Human Exploration Operations Mission Directorate**.
- **Office of Chief Technologist**.