# NASA SBIR 2009 Phase I Solicitation

## O3 Processing and Operations

The Space Operations Mission Directorate (SOMD) is responsible for providing mission critical space exploration services to both NASA customers and to other partners within the U.S. and throughout the world: from flying the Space Shuttle, to assembling the International Space Station; ensuring safe and reliable access to space; maintaining secure and dependable communications between platforms across the solar system; and ensuring the health and safety of our Nation's astronauts. Each of the activities includes both ground-based and in-flight processing and operations tasks. Support for these tasks that ensures they are accomplished efficiently and accurately enables successful missions and healthy crew.

# Subtopics

### 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.

## O3.02 Vehicle Integration and Ground Processing

**Lead Center: KSC**

**Participating Center(s): MSFC, SSC**

This solicitation seeks to create new and innovative technology solutions for assembly, test, integration and processing of the launch vehicle, spacecraft and payloads; end-to-end launch services; and research and development, design, construction and operation of spaceport services. The following areas are of particular interest.

### Propellant Servicing Technologies Enabling Lower Life Cycle Costs

Technologies for advanced cryogenic fluid storage and transfer, servicing of chilled/densified fluids and advances in state-of-the-art ground insulation are needed to reduce launch operation costs by minimizing consumable losses. Solutions in support of helium conservation and recovery; recapture, reduction, and elimination of cryogenic propellants vented to atmosphere (zero boil-off); insulation for improved storage and distribution minimizing thermal losses; fire resistant liquid oxygen pumping systems; and instrumentation advances to enable high efficiency operations. Providing solutions with higher efficiency, lower maintenance and longer life while improving safety and improving liquid quality delivery.

### Corrosion Control

Technologies for the prevention, detection and mitigation of corrosion/erosion in spaceport facilities and ground support equipment including refractory concrete. Solutions for: damage responsive coatings with corrosion inhibitors; poor-performing refractory concrete; protective coatings for non-painted surfaces; and new environmentally friendly protective coating options to replace products lost due to EPA regulation changes. Providing coating/protection solutions that meet current and emerging environmental restrictions and can endure the corrosive and highly acidic launch environment.

### Spaceport Processing Systems Evaluation/Inspection Tools

Technologies in support of defect detection in composite materials; methods for determining structural integrity of bonded assemblies; and non-intrusive inspection of Composite Overwrapped Pressure Vessels (COPV), Orion heat shield and painted surfaces. Solutions for detecting and pinpointing corrosion under painted surfaces; predicting remaining coatings effectiveness/life expectancy; identifying composite defects and evaluating integrity; non-destructive measurement and evaluation of COPV; and damage inspection and acceptance testing of Orion heat shield. Providing solutions that reduce inspection times and provide higher confidence in system reliability and safety concerns and lower life cycle costs.

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.

This subtopic is also a subtopic for the "Low-Cost and Reliable Access to Space (LCRATS)" topic. Â Proposals to this subtopic may gain additional consideration to the extent that they effectively address the LCRATS topic (See topic O5 under the Space Operations Mission Directorate).

**O3.03 Enabling Research for ISS**

**Lead Center: JSC**

**Participating Center(s): GRC, KSC, MSFC**

The focus of this sub-topic is on the development of systems and technologies that provide innovative ways to leverage the existing ISS facilities for new payloads or provide on orbit analysis to enhance capabilities, reduce sample return requirements, or enable sample return for existing payloads.

Current utilization of ISS is limited by upmass, downmass, crew time and by the capabilities of the interfaces and hardware already developed. Innovative ways of interfacing existing hardware such as being able to use the light microscopy module (LMM) in the Fluids Integrated Rack (FIR) as a life science microscope could increase biotechnology research capabilities. Enabling additional cell and molecular biology culture techniques by providing innovative hardware to allow for safe, contained transfer of cells from container to container within the Microgravity Sciences Glove Box (MSG) would permit new types of studies on ISS. On orbit analysis techniques that would reduce or remove the need for downmass (such as a system for gene array tests, or kits for DNA extractions for long term storage) are also examples of hardware possibilities that would extend and enable additional research.

Capabilities that extend the types of studies that can be completed in orbit are not limited to the above examples or to biotechnology disciplines. Innovative methods for further subdividing payloads lockers to enable numerous pico-payloads, or developing an innovative generic control system to interface with existing ISS control systems are a further examples of the type of technology that is requested under this subtopic.

The existing hardware suite and interfaces available on ISS can be found at:

http://www.nasa.gov/mission_pages/station/science/experiments/Discipline.html

Due to the difficulty and complexity of qualifying hardware for human spaceflight, proposals under this subtopic are expected to advance the development to a level demonstrating the technology in the lab or relevant environment under the SBIR program.

Research should be conducted to demonstrate technical feasibility during Phase 1 and show a path toward 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.