



NASA SBIR 2009 Phase I Solicitation

X13 Space Human Factors and Food Systems

The new Vision for Space Exploration encompasses needs for innovative technologies in the areas of Space Human Factors and Food Systems. Operations in confined, isolated, and foreign environments can lead to impairments of human performance. Research and development activities in the Space Human Factors and Food Systems topic address challenges that are fundamental to design and development of the next generation crewed space vehicles. These challenges include: (1) understanding the requirements for information feedback to the crew and developing technologies to ensure these requirements are met, (2) building tasks and tools that are compatible with humans and that enable human performance consistent with mission success, and (3) providing extended shelf life foods with improved nutritional content, quality and reduced packaging mass. This Topic seeks methods for monitoring, modeling, and predicting human performance in the spaceflight environment. The Space Human Factors and Food Systems is seeking new Space Human Factors Assessment Tools and Advanced Food Technologies that utilize non-foil barriers and allow food processing or preparation in a reduced gravity and pressure environment.

http://humanresearch.jsc.nasa.gov/elements/smo/docs/shfh_evidence_report_summary.pdf

<http://hefd.jsc.nasa.gov/aft.htm>

Subtopics

X13.01 An Automated Tool for Human Factors Evaluations

Lead Center: JSC

Participating Center(s): ARC

This subtopic calls for a Small Business Innovative Research project to develop an automated tool to assist non-human factors engineers to conduct human factors evaluations. Human factors evaluations are essential in gathering human performance data and analyzing the usability of new design concepts. These evaluations are generally carried out by human factors experts due to the level of expertise required. However, in some cases, it would both save time and cost if a tool is available for non-human factors engineers to carry out a standardized evaluation procedure to obtain the needed data and with comparable quality.

The tool therefore shall provide a comprehensive set of measurement methods and guide non-human factors engineer to carry out human factors evaluations. The tool development shall include defining a comprehensive set of commonly used human factors evaluation methods that allow engineers to gather relevant human factors data. Through a user-friendly interface, the tool shall recommend evaluation metrics, provide step-by-step guidance for setting up the evaluation, and summarize/store evaluation data. The ability for the tool provide interfaces for human factors data acquisition systems is highly desirable.

An algorithm for the tool is expected as the deliverable for Phase 1 and a prototype is expected should the project continue on to Phase 2.

X13.02 Situational Awareness for Multi-Agent Operations

Lead Center: JSC

Participating Center(s): ARC

This subtopic calls for a Small Business Innovative Research project to develop a situation awareness and conflict resolution tool for a wide-area multi-agent operation environment with substantial time delays. Humans and robots in future Lunar or Mars surface operations would be operating both on the Lunar (Mars) surface and on Earth remotely to carry out a common task. Consequently, substantial communication delay would make tasks planning and execution difficult. The goal of this SBIR is to develop a tool so multiple agents can work harmoniously regardless of geographical locations.

The tool therefore shall overcome the hurdle of communication delays and (1) enable situation awareness by providing timely information of tasks conducted by other agents, (2) ensure that newly generated procedures mesh well with the originally scheduled activities, (3) allow operators to poll state data from all agents at any moment, and (4) provide recommendations for best task planning and procedures.

An algorithm for the tool is expected as the deliverable for Phase 1 and a prototype is expected should the project continue on to Phase 2.

X13.03 Advanced Food Technologies

Lead Center: JSC

The purpose of the Advanced Food Technology Project is to develop, evaluate and deliver food technologies for human centered spacecraft that will support crews on missions to the Moon, Mars, and beyond. Safe, nutritious, acceptable, and varied shelf-stable foods with a shelf life of 3 - 5 years will be required to support the crew during future exploration missions to the Moon or Mars. Concurrently, the food system must efficiently balance appropriate vehicle resources such as mass, volume, water, air, waste, power, and crew time. One of the objectives during the lunar outpost missions is to test technologies that can be used during the Mars missions.

It will require approximately 10,000 kg of packaged food for a 6-crew, 1000 day mission to Mars. The packaged food will require that the safety, nutrition, and acceptability are maintained at reasonable levels for the entire 5-year shelf life. Therefore, this subtopic request will concentrate on technologies that use a systems approach to provide food in remote locations with limited mass, volume, power, and waste is required.

It has been proposed to use a food system which incorporates processing of raw ingredients into edible ingredients and uses these edible ingredients in recipes in the galley to produce meals. This type of food system will require technologies that will allow these raw ingredients to maintain their functionality and nutrition for 5-years. This food system would also require food processing and food preparation equipment. The equipment should be miniaturized, multipurpose and efficiently use vehicle resources such as mass, volume, water, and power.

There are some unique parameters that need to be considered when developing the technologies. The Moon's gravity is 1/6 of Earth's gravity. In addition, it is being proposed that the habitat will have a reduced atmospheric pressure of 8 psia which is equivalent to a 16,000 foot mountain top. These two factors will affect the heat and mass transfer during food processing and food preparation of the food. In addition, there also will not be any significant refrigerator or freezer available.

The response to this subtopic should include a plan to develop a technology that will enable safe and timely food processing and food preparation in reduced cabin pressure and reduced gravity.

Phase 1 Requirements: Phase 1 should concentrate on the scientific, technical, and commercial merit and feasibility of the proposed innovation resulting in a feasibility report and concept, complete with analyses and top-level drawings.