



NASA STTR 2011 Phase I Solicitation

T1 Center 2011 Technology Investments

This year's STTR topic hosted by NASA Ames Research Center spans three technology investment areas at the center. These interests include: Synthetic Biology for Space Exploration, Commodity Based Technologies, and Information Technologies for Intelligent Planetary Robotics. Please see the subtopic descriptions for what is sought under each of these solicitations.

Subtopics

T1.01 Synthetic Biology for Space Exploration

Lead Center: ARC

The field of Synthetic Biology is a rapidly growing area of study that encompasses research ranging from the introduction of incremental function or regulation into existing organisms to the creation of fully synthetic living structures and systems. NASA is interested in harnessing this emerging field to create technological advances for multiple mission focus areas. Topics include biological life support for air, water and waste management; local production of fuels, food and plastics; in situ resource utilization (ISRU) technologies such as biomining for metals and biocementation of regolith for building materials/radiation shielding; biomedical applications including in situ therapeutic production and radiation/gravity countermeasures; advanced chemical and life sensing; and fabrication of advanced materials. Overarching research concerns include using synthetic biology techniques for the development of life forms that have been specifically adapted to perform well in extraterrestrial environments, including increased resistance to radiation, desiccation and temperature extremes. Foundational and applied solutions are sought that provide game-changing capabilities that enable cost effective and sustainable spaceflight and habitation.

T1.02 Commodity Based Technologies

Lead Center: ARC

This subtopic seeks out-of-the-box, innovative, broad-based approaches to address space mission requirements.

Desired proposals would enable the commoditization of space mission requirements by utilizing existing commercial technology goods and services to reduce schedule and costs of implementation.

Examples:

Smart-phones today are able to perform many of the basic capabilities of the spacecraft, having a high speed processor with large memory capacity, a set of sensors such as an accelerometer, rate gyroscopes, magnetometer, global positioning system (GPS).

Another example would be using multiple COTS (commercial off the shelf) digital cameras with multiple color filter settings, and then combining the image as a hyper-spectral imager at low cost. Other consumer goods that may have high utility for small spacecraft include but are not limited to:

- PDA-based smart phones.
- High resolution digital cameras.
- Consumer robotics.
- Lego-like assemblies.
- Medical grade surgical adhesives.
- Pressure sensitive paint.
- In-situ bioanalytical diagnostics.
- Mining technologies.
- Biohybrid devices.
- Diagnostics.
- X10-based domonics.

Proposers are asked to build a conceptual system/spacecraft design/operational scenario that details the architecture, components and specifications. Supporting analysis including cost and feasibility should be included. Phase II contract efforts should be used to prototype the system(s) detailed in Phase I.

Proposals should focus on the following areas of research:

- Transformational Small Spacecraft, Subsystems, and Mission Architectures.
- Biological Technologies for Life Beyond Low Earth Orbit.
- GREEN Technologies (Technologies for Sustainability).
- Emerging Aeronautics Systems and Technologies.
- Autonomous Laboratories on Planetary Surfaces.
- Hybrid Systems Modeling and Analysis.
- Advanced Information, Robotics, and Autonomous Systems.

Proposals that focus on the above areas of research, and contribute to the NASA Space Technology Grand Challenges will have higher priority.

Reference Documents:

- Grand Challenges
 - http://www.nasa.gov/pdf/503466main_space_tech_grand_challenges_12_02_10.pdf
- Roadmaps
 - <http://www.nasa.gov/offices/oct/home/roadmaps/index.html>

T1.03 Information Technologies for Intelligent Planetary Robotics

Lead Center: ARC

The objective of this subtopic is to develop information technologies that enable robots to better support planetary exploration. Intelligent robots are already at work in all of NASA's Mission Directorates and will be critical to the success of future exploration missions. The 2010 NASA "Robotics, Tele-Robotics, and Autonomous Systems

Roadmap" (RTA Roadmap) indicates that extensive and pervasive use of intelligent robots can significantly enhance exploration, particularly for surface missions that are progressively longer, more complex, and must operate with fewer ground control resources.

Robots can do a variety of work to increase the productivity of planetary exploration. Robots can perform tasks that are highly-repetitive, long-duration, or tedious. Robots can perform tasks that help prepare for

subsequent human missions. Robots can perform "follow-up" work, completing tasks started by astronauts. Example tasks include: robotic recon (advance scouting), systematic site surveys, documenting sites or samples, and unskilled labor (site clean-up, close-out tasks, etc).

The RTA Roadmap identifies three key areas for improvements in robotics:

- Technology should aim to exceed human performance in sensing, piloting, driving, manipulating, rendezvous and docking.
- Technology should target cooperative and safe human interfaces to form human-robot teams.
- Autonomy should make human crews independent from Earth and robotic missions more capable.

Thus, proposals are sought which address the following topics:

- Advanced user interfaces for remote robotic exploration, which include Web-based collaboration methods, panoramic and time-lapse imagery, support for public outreach/citizen science, social networking and/or visualization of geospatial information. The primary objectives are to enable more efficient interaction with robots, to facilitate situational awareness, and to enable a broad range of users to participate in robotic exploration missions.
- Ground control data systems for robotic exploration. Proposals should focus on software tools for planning variable-duration and adjustable autonomy command sequences; for event summarization and notification; for interactively monitoring/replaying task execution; for managing; and/or for automating ground control functions.
- Mobile robot navigation (localization, hazard avoidance, etc.) for multi-km traverses in unstructured environments. Novel "infrastructure free" techniques that utilize passive computer vision (real-time dense stereo, optical flow, etc.), active illumination (e.g., line striping), repurposed flight vehicle sensors (low light imager, star trackers, etc.), and/or wide-area simultaneous localization and mapping (SLAM) are of particular interest.
- Robot software architecture that radically reduces operator workload for remotely operating planetary rovers. This may include: on-board health management and prognostics, on-board automated data triage (to prioritize information for downlink to ground), and learning algorithms to improve hazard detection and selection of locomotion control modes.

