NASA SBIR 2011 Phase I Solicitation

X6.01   Spacecraft Autonomy and Space Mission Automation

Lead Center: ARC

Participating Center(s): JPL, JSC

Future human spaceflight missions will place crews at large distances and light-time delays from Earth, requiring novel capabilities for crews and ground to manage spacecraft consumables such as power, water, propellant and life support systems to prevent Loss of Mission (LOM) or Loss of Crew (LOC). This capability is necessary to handle events such as leaks or failures leading to unexpected expenditure of consumables coupled with lack of communications. If crews in the spacecraft must manage, plan and operate much of the mission themselves, NASA must migrate operations functionality from the flight control room to the vehicle for use by the crew. Migrating flight controller tools and procedures to the crew on-board the spacecraft would, even if technically possible, overburden the crew. Enabling these same monitoring, tracking, and management capabilities on-board the spacecraft for a small crew to use will require significant automation and decision support software. Required capabilities to enable future human spaceflight to distant destinations include:

- Enable on-board crew management of vehicle consumables that are currently flight controller responsibilities.

- Increase the onboard capability to detect and respond to unexpected consumables-management related events and faults without dependence on ground.

- Reduce up-front and recurring software costs to produce flight-critical software.

- Provide more efficient and cost effective ground based operations through automation of consumables management processes, and up-front and recurring mission operations software costs.

The same capabilities for enabling human spaceflight missions are directly applicable to efforts to automate the operation of unmanned aircraft flying in the National Airspace (NAS) and robotic planetary explorers.

Mission Operations Automation

Peer-to-peer mission operations planning

Mixed initiative planning systems

Elicitation of mission planning constraints and preferences

Planning system software integration

Space Vehicle Automation

Autonomous rendezvous and docking software

Integrated discrete and continuous control software

Long-duration high-reliability autonomous system

Power aware computing

Robotic Systems Automation

Mutli-agent autonomous systems for mapping

Uncertainty management for mapping system

Uncertainty management for grasping robotic system

Uncertainty management for path planning and traversing

Emphasis of proposed efforts:

- Software proposals only, but emphasize hardware and operating systems the proposed software will run on (e.g., processors, sensors).

- In-space or Terrestrial applications (e.g., UAV mission management) are acceptable.

- Proposals must demonstrate mission operations cost reduction by use of standards, open source software, staff reduction, and/or decrease of software integration costs.

- Proposals must demonstrate autonomy software cost reduction by use of standards, demonstration of capability especially on long-duration missions, system integration, and/or open source software.