



NASA SBIR 2016 Phase I Solicitation

Z5 Robotics and Autonomous Systems

One of NASA's strategic goals is to extend and sustain human activities across the solar system. With time delays and potentially sparse communications back to earth, astronauts will face the daunting task of operating and maintaining numerous systems that might unexpectedly break or may even be required to perform life-saving surgery without support from the earth based operators. The augmented reality (AR) technology holds the promise to reduce crew reliance of ground and paper procedure support in a deep-space human spaceflight missions.

NASA invests in the development of autonomous systems, advanced avionics, augmented reality and robotics technology capabilities for the purpose of enabling complex missions and technology demonstrations supporting the Science, Technology Mission Directorate (STMD). The software, avionics, and robotics elements requested within this topic are critical to enhancing human spaceflight system functionality. These elements increase autonomy and system reliability; reduce system vulnerability to extreme radiation and thermal environments; and support human exploration missions with robotic assistants, precursors and caretaker robots. As key and enabling technology areas, autonomous systems, avionics, augmented reality and robotics are applicable to broad areas of technology use, including heavy lift launch vehicle technologies, robotic precursor platforms, utilization of the International Space Station, and spacecraft technology demonstrations performed to enable complex or long duration space missions. All of these flight applications will require unique advances in autonomy, software, augmented reality, robotic technologies and avionics. The exploration of space requires the best of the nation's technical community to provide the technologies, engineering, and systems to enable human exploration beyond LEO, to visit Asteroids and the Moon, and to extend our reach to Mars.

Subtopics

Z5.01 Augmented Reality

Lead Center: JSC

Participating Center(s): JPL, KSC

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Within the ISS Program, maintenance requires well trained crew members and is labor intensive, expensive and inefficient. NASA use paper and electronic procedures to direct crew through complex maintenance procedures for all on-board systems. Developing and executing procedures are still time consuming and tedious tasks, and substantial training is needed to understand the technical details for troubleshooting defective components, and the

performance of critical maintenance and repairs. Augmented Reality based systems could significantly support future human exploration missions by providing the type of guidance normally associated with an expert human trainer. The capabilities of envisioned future AR based system will augment the abilities of the crew while being simple and highly intuitive to use.

On board maintenance is one of the potential areas in which Augmented Reality can be a game changing technology. Other areas such as physical and mental health support for long duration mission isolation from family and friends, mission planning, mission data visualization, are also to be considered in the context of this topic.

The objective of this subtopic is to develop and mature AR technology (system/ software) and to impact all aspect of mission operations including planning, execution, training and crew health countermeasures, in order to enable human exploration beyond LEO.

Proposal are sought to address the following Technology Areas:

- TA-4 TABS 4.4 Human Systems Interface: augmenting the natural environment with precise visual cues as well as with audible and tactile alerts to fully engage and guide the human operator through lengthy and complex spaceflight procedures.
- TA-4 TABS 4.5 Autonomy: using AR technology to enable crew autonomous operation and reduce dependency for ground support.
- TA-6 TABS 6.3 Human Health and Performance: using AR technology to enhance situational awareness and to reduce cognitive overload while performing complex task.
- TA-7 TABS 7.5 Mission Operations & Safety: using AR technology to reduce human error, improve operational efficiency and mission timeline while reducing prior training requirements.

For all above technologies, research should be conducted to demonstrate technical feasibility during Phase I and show a path toward Phase II system/software demonstration and delivering a demonstration system/software package for NASA testing.