



NASA SBIR 2016 Phase I Solicitation

H6.02 Requirements Management for Spacecraft Autonomy and Space Mission Automation

Lead Center: ARC

System and software requirements for autonomy have been difficult to define and test due to uncertainties in the environment in which autonomous systems might be deployed, the flexible yet safe interaction with in-situ humans that is needed, and the adaptability needed from an autonomous system for novel situations. Future human spaceflight missions will place crews and other assets at large distances and light-time delays from Earth that will need to act autonomously from mission control over significant time intervals in both nominal and emergency situations. Space missions have small crew sizes, and many mission concepts involve spacecraft and habitats that are only intermittently crewed, so automation through software will be a major portion of autonomous systems.

Proposals are solicited that provide novel methods and tools specifically targeted to defining and testing requirements for autonomy capabilities, including the definition of interactions and roles with in-situ humans. Proposals should encompass a subset of the following: methods and tools for autonomy requirement definition, refinement, verification of internal consistency, validation, and testing during subsequent development.

Proposals should compare their proposed methods and tools to conventional requirements management, and indicate why their methods and tools will result in requirements for autonomy with less ambiguity, fewer conflicts between different requirements, and more testable requirements - as compared to state of the art requirements methods. Proposals should provide metrics for measuring the quality of autonomy requirements resulting from their methods and tools compared to SOA. For example, in the aircraft industry today over half of system development errors originate during the requirements phase, while over 75% of system development errors are caught very late in development - typically in late phases of testing. This leads to high costs and development schedule overruns due to rework. Proposers should ground their proposed research by demonstrating methods and tools on plausible design reference missions involving autonomy.

Proposals should indicate how their methods and tools will bridge the gap between requirements definition and requirements-based testing, potentially including semi-automatic test generation suitable for the autonomy attributes of flexible response in uncertain environments with uncertain situations.

Proposals can draw upon a wide range of methods, including but not limited to ontology definition, uncertainty quantification, formal approaches to requirements engineering, symbolic methods for test generation from requirements, and techniques for requirements elicitation from stakeholders. Proposals that involve natural language as a medium for autonomy system and software requirements definition should describe how the natural language will be disambiguated in subsequent phases of system development.