X5.02  Human Autonomy Interaction

Autonomous and automated operations will be required for systems fulfilling the Vision for Space Exploration. This subtopic addresses the need for modeling and analysis tools and technologies for design, test, and evaluation of human-autonomy interaction systems. The tools will support analyses of scenarios, tasks, information, and communication. They can validate and build confidence in human-autonomy interfaces and interaction support by identifying and mitigating risks (e.g., workload, situational awareness, and error). The technologies will interoperate with models and tools for design, evaluation, and certification of hardware and software systems, and will support understanding by engineers and planners who are not experts in human-system design or human factors. They will be cost-effective to use and be easily updated and reconfigured to reflect changes in designs and plans.

The human-autonomy modeling and analysis technology will be applied to astronaut crew-autonomy and ground-crew-autonomy interactions in space missions. Autonomous systems can include exploration vehicles and subsystems, science stations, robots, robotic manipulators, rovers, and communications satellites. Autonomous operations can include rendezvous, proximity operations, mating of on-orbit elements, in-space assembly, maintenance, and robotic operations, including inspection, material transport, and sampling. These operations can be nominal, off-nominal, or contingency operations. Autonomy will be essential to ensure safe robot operation in the proximity of critical systems and humans. Autonomous functions can include science traverse and path planning, crew and resource scheduling, procedure execution, and control of subsystems such as power, thermal, propulsion, and communications.

Innovative human-autonomy modeling and analysis technologies are needed to address unique challenges of space missions. These include multi-modal interfaces, asynchronous communication with long delays and long blackouts, unanticipated problems, and rare crew interactions by exception. Human-autonomy interactions can include supervisory control, communication, and coordination in shared planning and operations. They can include interactions to adapt, modify, and maintain systems to respond to emerging requirements and challenges. The interactions can also include dynamic control and adjustment of level of autonomy or supervision, type of coordination, and type of communication.

This subtopic seeks projects that will demonstrate innovative technologies for use by engineering and operations teams for analyzing human-autonomy interactions and risks and for evaluating proposed mitigations of these risks, within the constraints of an affordable and timely mission design and planning process.