X8.02 Intelligent Modular Systems

This subtopic will involve development and demonstration of a range of technologies for reconfigurable, intelligent, modular space subsystems, systems, and systems of systems. Technologies should focus on establishing the validity of new approaches to Earth-Moon human and robotic operations, with a view toward longer-term applications for the inner Solar System (e.g., Mars) exploration missions. Many of these future missions, systems, and capabilities imply the need for the development of large and complex systems and infrastructures in space. But, the size-constraints, mass-capability, and cost of launching large monolithic payloads into space limit the development and realization of these capabilities. If a different design approach using intelligent modular systems rather than monolithic payloads is used, these large space systems become more tractable. Also, intelligent modular systems include low system impact of a single launch vehicle loss, since modular systems are launched on multiple vehicles at multiple times. Replacement of modules over the system lifetime is, in many cases, a more reasonable approach to maintaining a system; and, graceful degradation of the system capability can be more readily managed with modular units. Hardware costs of multiple identical units can be reduced through economies of scale, and modular approaches can accommodate cost-phased programs that develop and fly a “pilot” system, which can initially prove a capability, and then be added to later as demand for capability increases. Technologies of interest include:

Modular Structures (MSFC)

Structural technologies of interest include inflatable, erectable, deployable, or easily connected modules to create large space structures. Assembly technology of interest may include approaches for integrating deployable modular units with larger structures such as habitation modules or propellant tanks, and approaches for assembly of erectable modules that form backbones or support trusses. Attachment technologies such as autonomous rendezvous and docking, innovative connectors and joining, bonding techniques, and module positioning and alignment systems are also of interest.

Adaptable and Reconfigurable Modular Systems (GSFC)

Integrated, reconfigurable modular systems incorporating multiple elements such as solar collection arrays, radiators, power, data, utility lines, science instruments, plug and play avionics, and integrated inspection and verification techniques are solicited, including modular structures using embedded sensors and actuators.
Human-Robotic Modular Systems (JSC)

Multi-functional robotic hardware and software systems are of interest to aide in surface and in-space operations. Robotic surface operations including exploration, assembly, fabrication, construction and transportation operations are of interest as well as similar systems for in-space operations. In addition, techniques are solicited for effective, efficient, and intuitive operation and control of robotic hardware through design and development of advanced human-computer interfaces.