19th IAA SYMPOSIUM ON BUILDING BLOCKS FOR FUTURE SPACE EXPLORATION AND DEVELOPMENT (D3)
Systems and Infrastructures to Implement Sustainable Space Development and Settlement - Technologies (2B)

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ORCHESTRATING SYMBIOSIS: FOUNDATIONAL TECHNOLOGIES FOR HUMAN AND ROBOTIC SHARED CONTROL

Abstract

N-Dimensional interaction problems (i.e., an arbitrary number of objects interacting in an arbitrary number of ways) are a class of problems for which the generalized solution space is typically computationally intractable in any time frame.

Space automation and robotics present a subset of these problems that exacerbates the situation by requiring near real-time solutions in many instances. The bottom line is that reality is not a convenient problem or solution space.

This paper will layout a tractable framework for architecting systems with a mutable locus of control involving virtual actors, physical actors, and autonoma. This is an effort to foster the development of the foundational technologies that allow for the orchestration of the human-robotic symbiosis required for space development and settlement.

Using real world examples from the development of the ISS robotic systems, NASA sponsored research on the structure and ordering of knowledge, and other application mission requirements the efficacy of the postulated framework will be examined.

This body of work is an opportunity to craft viable technology demonstrations that will establish the basis for a confluence of interest between real mission users and the technology development effort. This can lead to a range of technology development missions on ISS and subsequent Cislunar flight opportunities that can make efficient and effective use of near realtime state models and the enhanced Management Operations Control Applications (MOCA) that can be brought to fruition.

XISP-Inc Interoperable Network Communications Architecture – Application (INCA-A) is a planned guest experimenter on upcoming the NASA Laser Communications Relay Demonstration (LCRD) mission. Planned applications overlays in the INCA-A experiment set to be considered include: (1) Team Alpha CubeSat (ACS) Technology Demonstration System which is an entry in the NASA CubeQuest Challenge Entry Deep Space Lunar Derbies leading to Virtual Operations Center capabilities. (2) Space-to-Space Power Beaming (SSPB) including power and ancillary services beaming abstracted to lunar surface operations seeking to prove out the efficacious use of radiant energy beam components leading to a Cislunar Electrical Utility - Lunar Power Light Company (3) Interoperable Network Communications Architecture (INCA) that incorporates pervasively networked DTN gateway/QoS Routers lading to Space Based Automated Telco Central Office Analogs (5) Advanced Vision and Task Area Recognition (AVaTAR) Framework for supporting a mutable locus of control between teleoperation and autonomy on a shared control basis leading to Dramatic improvements in speed, efficiency, and safety for EVR and combined EVA/EVR tasks.