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ORCHESTRATING SYMBIOSIS: EVOLVING A FRAMEWORK FOR SHARED CONTROL FOR MISSION OPERATIONS CONTROL APPLICATIONS

Abstract

The postulated tractable framework for shared human, robotic, and autonoma control for Mission Operations Control Applications (MOCA) articulated in (Barnhard, IAC 2021) has been applied and extended. We codify the first-order implementation of a near-real-time state model and the state transition logic for one or more MOCA.

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 effort can support a range of technology development missions as the International Space Station (ISS) evolves and subsequent Cislunar flight opportunities emerge to efficiently and effectively use near real-time state models and the enhanced MOCA.

This effort fosters the development of the foundational technologies that orchestrate the human-robotic symbiosis required for space development and settlement.

The postulated framework is applied using real-world lessons learned from the development and operation of the ISS robotic systems, NASA-sponsored research on the structure and ordering of knowledge, and other application mission requirements. This work is integral to the XISP-Inc Interoperable Network Communications Architecture – Application (INCA-A) is a planned guest experimenter on the upcoming NASA Laser Communications Relay Demonstration (LCRD) mission.

Planned applications overlays in the INCA-A experiment set include: • DOGE-1 Lunar Rideshare mission supporting Distributed Ledger Technology Imaging and Viable Autonomous Space Tracking (VAST), • Team Alpha CubeSat (ACS) Technology Demonstration System, an entry in the NASA CubeQuest Challenge Entry Deep Space Derby leading to virtual operations center capabilities, • Remote Power Services (RPS), including space solar power and ancillary services beaming abstracted to lunar surface operations seeking to prove out the productive use of radiant energy beam components leading to a Cislunar Electrical Utility - Lunar Power & Light Company, • Interoperable Network Communications Architecture (INCA) that incorporates pervasively networked Delay and Disturbance Tolerant Networking (DTN) gateway/Quality of Service (QoS) driven routers leading to Space-Based Automated Telco Central Office Analogues, and • 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 Extra-Vehicular Robotics (EVR) and combined Extra-Vehicular Activity (EVA)/EVR tasks.