Semantic Summarization for Context Aware Manipulation of Data

TRACLabs, Inc.

Technical Abstract

NASA's exploration and scientific missions will produce terabytes of information. As NASA enters a new phase of space exploration, managing large amounts of scientific and operational data will become even more challenging. Robots conducting planetary exploration will produce data for selection and preparation of exploration sites. Robots and space probes will collect scientific data to improve understanding of the solar system. Satellites in low Earth orbit will collect data for monitoring changes in the Earth's atmosphere and surface environment. Key challenges for all these missions are understanding and summarizing what data have been collected and using this knowledge to improve data access. TRACLabs and CMU propose to develop context aware image manipulation software for managing data collected remotely during NASA missions. This software will filter and search large image archives using the temporal and spatial characteristics of images, and the robotic, instrument, and environmental conditions when images were taken. It also will implement techniques for finding which images show a terrain feature specified by the user. In Phase II we will implement this software and evaluate its effectiveness for NASA missions. At the end of Phase II, context aware image manipulation software at TRL 5-6 will be delivered to NASA.

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Information Technologies for Intelligent Planetary Robotics

Multi-Robot Planetary Exploration Architectures

Aurora Flight Sciences Corporation

Technical Abstract

Space policy direction is shifting, particularly with respect to human goals. Given the uncertainty of future missions to the moon, Mars, and other bodies, a tool that allows for informed analysis of the option space is particularly relevant. Aurora Flight Sciences and MIT propose to further develop the Multi-Robot Planetary Exploration Architecture (MRPEA) methodology, a suite of software tools and analysis algorithms developed to provide decision aides to architecture planners of planetary surface exploration missions. MRPEA provides 1. A logical and graphical representation of the system space (e.g. interrelated decision variables with constraints), 2. Structural reasoning for rapid exploration of architectural spaces, 3. Simulation, and 4. Results viewing for a set of feasible architectures. Given the robots available or predicted to be available, the expected duration, and the mission goals, our methodology provides analysis results such as knowledge benefit-vs.-mass Pareto front graphs, to allow the designers to provide the best possible architecture for the planned mission or missions. The MRPEA analysis methodology primarily addresses the planning requirements of planetary surface missions, providing useful analyses of the many elements of the architectural decision space; in addition, the principles and techniques developed to analyze and select multi-robot architectures on planetary surfaces can also be applied to future fractional satellite systems, an area of increasing interest.

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