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SPACE EXPLORATION SYMPOSIUM (A3)
Mars Exploration – Part 2 (3B)

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SCIENCE-INFLUENCED GUIDANCE OF MICRO-ROVER SCOUTS USING BAYESIAN NETWORKS

Abstract

The high cost of planetary rover missions limits risk-taking and as a result restricts scientific exploration. This constraint is further compounded by limited autonomy that requires time-consuming intervention of Earth-based operators to ensure safe operation in previously unexplored areas. The result is a frequently idle rover that misses potential scientifically valuable areas due to a lack of a priori knowledge about its current local surroundings. One solution that could address these issues is the inclusion of a micro-rover scout that would accompany the larger primary rover to reduce the burden of risky exploration. The micro-rover should be capable of making preliminary scientific evaluations in the local area as well as producing a traversability map. This information would be relayed back to the primary rover, allowing for concise path-planning in a known map with established areas of scientific interest. This paper explores the combination of vision-based geological information inferred from a Bayesian Network with the guidance system of a micro-rover scout. The scout deduces the likelihood that a feature matches pre-defined descriptions of desirable minerals, assigns each feature a score depending on the goals of the mission, and relays this information back to the primary rover. The primary rover, now equipped with a traversability map and the location of scientific hotspots, plans a path established by balancing energy requirements and scientific potential. A simulated environment was created that quantifies the potential scientific and safety benefits using this system. Further validation was performed using a differential-drive mobile robot equipped with a stereo camera in a laboratory environment.