IAF SPACE EXPLORATION SYMPOSIUM (A3) Mars Exploration – Science, Instruments and Technologies (3B)

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RESOURCE CONSTRAINED ONBOARD PLANNING FOR MARS ROVERS

Abstract

This paper presents technology for performing autonomous commanding of Mars rovers. Time and resource limitations mean that current Mars rovers cannot hope to achieve every desirable scientific goal. The rover must therefore select and plan for a subset of the possible experiments, maximizing some utility metric. Furthermore, because of limits on critical resources such as time and battery power, rover plans are currently very conservative and based on worst-case estimates of time and resource usage. As to support the robotic mission on Mars, onboard planner is critical for the rover to generate a spacecraft activity plan that produces the highest science return. Typically, daily plans of rovers involve on several scientific goals and limited resources. Our approach is centered on a resource-directed heuristic method to prune irrelevant search space of goals. More specifically, the method dynamically calculates the value of every task goal and achieves the set of goals with the highest value. The key technique we build on is the dynamic cost distribution strategy based on resource availability in a timeline-based search. In addition, we arrange the early detection techniques of goal dependencies into our planning approach. It provides the capability for the planner to avoid the overhead of unnecessary backtracking. We show that this approach is especially effective when resource constraints limit how many of the goals are reachable. Finally, we report on our comprehensive experiments on a Mars rover domain.