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QUIJOTEEXPRESS - A NOVEL PLANNING SYSTEM FOR FUTURE PLANETARY ROVER MISSIONS

Abstract

While space industry is reaching quite a mature point with increasing reusability of existing technologies, robotic missions such as MSL or Exomars might be considered an exception. Previous NASA Mars rovers have demonstrated the great possibilities of these missions, but also that some key technologies are not mature. Our interest focus on one of them, automated planning for planetary rovers.

Communications delay, an undeterministic/dynamic environment, science return or cost efficiency are some of the reasons that claim for more autonomy. The main effort of previous Mars Rover missions have been focused on onboard segment, where at least three systems have been successfully deployed on MER: Autonomous navigation, SPOTTER (dust-devil & cloud detection) and AEGIS (autonomous data collection).

Considering the sophistication of future rover payloads (e.g., Exomars Pasteur & Humboldt) and with the lessons learnt from previous rover missions, an advanced planner/replanner represents one of the main building blocks for enabling technology. This paper discusses an advanced planner: QuijoteExpress an heuristic-driven planner based on a evolution of the ESA APSI framework.

QuijoteExpress allows the definition of complex goals using a planning technique called Hierarchical Task Networks (HTN). Human operators can define in this way a plan in terms of complex goals while the planner is in charge of decomposing them into commands. This technique provides several advantages. First, it represents an improvement on the planner performance, as HTN simplifies the search space. The planner does not need to search anymore how to achieve repetitive tasks. Instead, predefined methods specify the different ways to accomplish complex goals. Second, it also simplifies the modeling which is one of the major problems that engineers need to face to deploy automated tools. Finally, it makes plans easier to understand and validate by humans.

Besides, QuijoteExpress presents other novelties such as parallel planning and management of uncertainty by means of flexible plans.