Safe Long-RangeTravelfor Planetary Rovers throughForward Sensing*

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Current rover operations, especially the planning of traverse operations, involve day to day planning and simulation with human involvement to estimate various dangers faced by the rover. Even with good path planning (avoiding hazards such as terrain that is too rough or high to be traversed), conventional operations for autonomous travel leave the risk of the rover becoming stuck in soft soil, as happened to the *MER Spirit rover*. Very cautious slow travel, with frequent human interaction, mitigates such risks but severely limits travel. Such limits on daily traverses are not sufficient for future missions such as a Mars Sample Return mission.

This paper describes an ***operations concept for safe long range traverses*** for planetary rovers. Relying on a light, mobile rover to scout ahead of the primary (mother) rover estimating terrain trafficability, it would allow the primary rover to safely traverse extended distances without waiting for human interpretation and updated maps. The primary rover will move towards a target location, potentially involving traversal over many sols, along the best path planned by Mission Control based on orbiter data. Traversing towards the next waypoint along a planned path, the primary rover would be preceded by the scout rover, allowing the detection of terrain hazards before the primary rover approaches. If any such hazard is found that prevents the traverse to the next waypoint, the traversabilitymap is modified accordingly, and a new path to the target is found.

The proposed architecture for the software system supporting such an operational concept is presented, and subsystems addressing the core aspects of collaborative planning and navigation are described in detail. This includes the following: a mission planner based on ***hierarchical task networks (HTN)*** for joint primary/scoutrover operations, a ***path planner*** capable of taking into account trafficability results, modules for ***mapping and localization*** (odometry based localization as well as localization of the scout rover in images from the primary rover sensors), a ***communication*** subsystem and a framework for **health monitoring and fault detection**.

The software system will be tested using the BRIDGET locomotion testbed from Astrium Ltd as the primary rover and a specially built scout rover from DFKI Robotics Innovation Centeras part of the EU-FP7-SPACE FASTER project.Simulation **results from preliminary tests**are presented, along with a detailed description of the test environment.

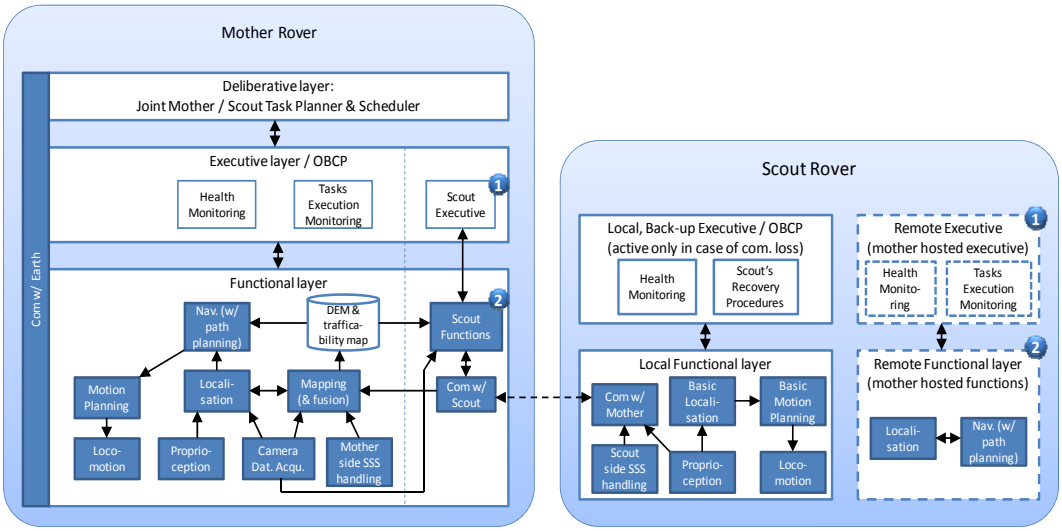

Figure 1: Preliminary System Architecture for the Primary-Scout rover team

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