Concept Study for the FASTER Micro Scout Rover

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As opposed to the present mars exploration missions future mission concepts ask for a fast and safe traverse through vast and varied expanses of terrain. As seen during the Mars Exploration Rover mission the two rovers *Spirit* and *Opportunity* suffered a lack of detailed soil and terrain information which caused that *Spirit* got permanently stuck in soft soil. The goal of the FASTER (Forward Acquisition of Soil and Terrain for Exploration Rover) EU FP7 project is to improve the mission safety and the effective traverse speed for planetary rover exploration by determining the traversability of the terrain and lowering the risk to enter hazardous areas which might lead to a loss of the rover. In order to achieve this goal, a small scout rover will be used for soil and terrain sensing ahead of the main rover, while both rovers will collaborate autonomously during their mission. In the following the problem of defining a highly mobile, all-terrain micro scout rover that can be used for soil and terrain sensing and collaborate with a primary rover is addressed by means of a concept study.

Alternative concepts for the scout rover mission architecture and system bus design are compared. Since the mission architecture defines the baseline for the scout rover concept evaluation, different operational concepts dealing with the scout rover operational time, energy supply, communication-link architecture and level of autonomy are treated. Following the overall mission concept, different solutions for the subsystems of the scout rover are investigated and evaluated within a trade-off process. A focus is given to locomotion concepts since mobility is one of the key drivers for the scout rover design. Different wheel and steering concepts are investigated providing the scout with high all-terrain mobility in order to traverse unknown and difficult terrain while not creating obstacles for the following primary rover by heavily disturbing the soil.

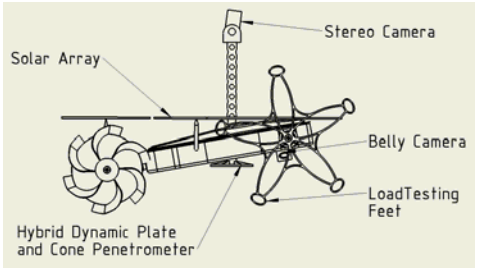

Figure 1 Scout Rover System Concept

Based on the trade-off, a single scout rover is proposed using the primary rover as communication relay and for energy transfer while the scout is not in operation. The level of autonomy is related to three main operational scenarios (normal, scouting and survival operation) while the autonomy level is increasing with each mode. The chosen scout rover concept (cf. Figure 1) is equipped with a stereo camera for navigation and uses solar arrays in combination with a secondary battery for power supply. The estimated dimensions of the scout rover are 400 x 830 x 500 mm (H x L x W) with a mass of 10 to 15 kg. In order to provide high mobility on soft soil as well as on unstructured terrain, a novel locomotion concept is proposed consisting of hybrid legged-wheels in the front and helical rear wheels, allowing a side-to-side steering motion of the tail.

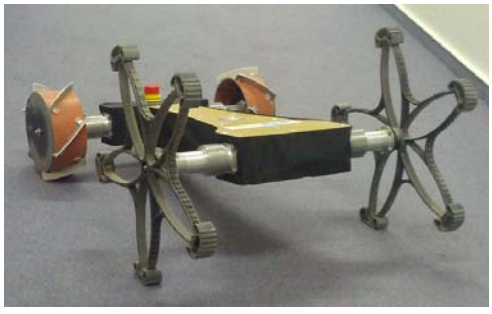

Figure 2 Mobile Test Platform

The chosen concept will be further investigated by means of a terrestrial testbed. First locomotion tests have been realized with a mobile test platform (cf. Figure 2) while further tests will be carried out to compare different locomotion concepts and to analyze their performance. An initial specification for a more detailed terrestrial test platform is derived from the scout rover concept, which will be used for further tests to prove the choice of the concept.

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