The ExoMars Rover

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The search for life and sub-surface sampling represent capabilities not previously flown on other Mars Exploration Missions. NASA's two Mars Exploration Rovers (MER) were devoted to geological investigations. The Mars Science Laboratory (MSL), planned to be launched in 2009, will have the goal to identify habitable environments. ExoMars (2013) will be the first mission, following the Viking (1976) landers, directly addressing the search for signs of life on Mars. ExoMars will combine mobility and access to subsurface locations, where organic molecules may be well-preserved; thus allowing, for the first time, to investigate Mars's third dimension: depth. This alone is a guarantee that ExoMars will break new scientific ground.

The ExoMars Rover is a highly autonomous six-wheeled terrain vehicle weighing approximately 210kg. The Rover is a key element of the ExoMars mission in charge of the surface mobility, subsurface drilling and sample collection. It also hosts the Pasteur payload package, 11 different instruments, and provides associated instrument support functions.

The vehicle will use the sun light to generate the necessary electrical power and by the help of sophisticated batteries and heater units it is designed to survive the dark and very cold Martian nights. Due to the rare Earth communication opportunities, only 1 or 2 short sessions per Martian day, the vehicle will have to be highly autonomous. Scientist on Earth will have to give mobility destination targets using compressed stereo images from mast mounted panoramic and infrared cameras. The Rover must navigate and safely travel approximately 100 m per day. For this purpose it creates digital maps from navigation stereo pair cameras and autonomously finds the adequate trajectory. Special visual aids are used to determine the travelled path and to ensure vehicle safety. The actual locomotion is achieved through six wheels; a wheel pair is suspended on three independently pivoted bogies and each wheel can be independently steered and driven. All six wheels can also be individually pivoted to support the initial deployment after landing, to adjust the Rover height and angle with respect to the local surface and to create a sort of walking ability, particularly useful in soft and non-cohesive soil. Inclinometers and gyroscopes are used in addition to enhance the motion control robustness. Finally sun sensors are used to determine the Rover absolute attitude on the Mars surface and the direction to Earth.

Contact instruments will be deployed by means of a robotic arm at scientifically interesting sites for detailed investigations of local geology and rocks. The acquired scientific data combined with ground penetrating radar data collected during travelling, will allow scientists on-ground to define a suitable drill location. The Rover subsurface sampling device will then autonomously drill to the required depth, maximum 2 m, and collect a small sample. This sample will be delivered to the analytical laboratory in the hart of the vehicle for further analysis. The laboratory hosts five different instruments and several supporting mechanisms. Imaging instruments will initially observe the "as collected" sample. Following the determination of its morphology the sample will them be crushed into a fine powder. By means of a dosing station the powder will then be presented in parallel to other instrument for imaging, excitation and destructive analysis.

The acquired scientific data will be compressed and transmitted back to Earth via non-ESA Mars obiter relay satellites. The transmission between the Rover and the relay orbiter will be in UHF while the transmission from the relay orbiter and ground stations on Earth will be in X-band. The total data volume transmitted per day will be ~120 Mbit. The Rover has also a direct to and from Earth telecommunication capability in X-band. The direct data transmission rate back to Earth is very limited, a few hundred bits per second. However the telecommand receive capability direct from Earth will be operationally useful to update the Rover each local morning with the detailed plan of tasks and action to be carried out during that day.

The presentation will explain the overall objectives and scope of the ExoMars project, present the current programmatic status and go into detail on the Rover design and development.