DEVELOPMENT AND TESTING OF A COMBINED SMALL ROVER/SUBSURFACE SAMPLER FOR USE ON THE SURFACE OF MARS

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In the framework of the ESA's technology programme, efforts have been under way to prepare future small mobile vehicles to be used on planetary landing missions. One of these is the MIDD activity (Mobile Instrument Deployment Device) which aims at producing mechanical components and system concepts for such vehicles. MIDD has been focusing on wheeled locomotion and, accordingly, the development of wheels suitable for providing the specified tractive performance on planetary surface soils is one of the key areas of current work. The present paper first presents the vehicle overall concept which is based on previous mechanical component development work for small wheeled devices performed since 1995, and which serves to demonstrate the scientific potential of a 4 kg-class system for supporting surface and subsurface science on a planetary landing mission. As payload elements, two spectrometers for mineralogical and elemental studies on surface materials - including rocks - have been foreseen, as well as an acoustic subsurface sounder, a close-up imager and a self-penetrating "Mole" for subsurface measurements and sampling. In addition, a dust removal device was accommodated for preparing rock surfaces for measurements. The mass of the payload, excluding their electronics, amounts to 1.5 kg. The vehicle chassis was sized by taking into account planetary surface rock distributions with ground clearance as well as mean straight path constraints, while restricting the number of wheels to four for reasons of simplicity and mass. The two front wheels are mounted on folding levers which allow to contact the soil with the cab and to place the spectrometers and the close-up imager against their targets. All wheels and the two folding levers are individually driven by brushless DC motors located inside a thermal enclosure in the vehicle cab. For the power supply and communications, a tether link to the lander is used, allowing a maximum range of some 20 m. As to the tether type, a flexible circuit was chosen which allows efficient packaging of the tether on board the vehicle. The drive mechanisms have been previously developed already and were successfully subjected to environmental testing (low temperature), including tests of the involved dynamic dust seals in a simulated haze of airborne dust particles as occurring on Mars. Results of components tests under simulated environmental conditions, as well as results of locomotion tests with a vehicle Breadboard Model are presented.