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SPACE EXPLORATION SYMPOSIUM (A3)
Moon Exploration – Part 2 (2B)

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ON ADVANCED MOBILITY CONCEPTS FOR INTELLIGENT PLANETARY SURFACE EXPLORATION

Abstract

Surface exploration by wheeled rovers on Earth's Moon (the two Lunokhods) and Mars (Nasa's Sojourner and the two MERs) have been followed since many years already very suc-cessfully, specifically concerning operations over long time. However, despite of this success, the explored surface area was very small, having in mind a total driving distance of about 8 km (Spirit) and 21 km (Opportunity) over 6 years of operation. Moreover, ESA will send its ExoMars rover in 2018 to Mars, and NASA its MSL rover probably this year. However, all these rovers are lacking sufficient on-board intelligence in order to overcome longer dis-tances, driving much faster and deciding autonomously on path planning for the best trajec-tory to follow. In order to increase the scientific output of a rover mission it seems very nec-essary to explore much larger surface areas reliably in much less time. This is the main driver for a robotics institute to combine mechatronics functionalities to develop an intelligent mo-bile wheeled rover with four or six wheels, and having specific kinematics and locomotion suspension depending on the operational terrain of the rover to operate. DLR's Robotics and Mechatronics Center has a long tradition in developing advanced components in the field of light-weight motion actuation, intelligent and soft manipulation and skilled hands and tools, perception and cognition, and in increasing the autonomy of any kind of mechatronic systems. The whole design is supported and is based upon detailed modeling, optimization, and simula-tion tasks. We have developed efficient software tools to simulate the rover driveability per-formance on various terrain characteristics such as soft sandy and hard rocky terrains as well as on inclined planes, where wheel and grouser geometry plays a dominant role. Moreover, rover optimization is performed to support the best engineering intuitions, that will optimize structural and geometric parameters, compare various kinematics suspension concepts, and make use of realistic cost functions like mass and consumed energy minimization, static sta-bility, and more. For self-localization and safe navigation through unknown terrain we make use of fast 3D stereo algorithms that were successfully used e.g. in unmanned air vehicle ap-plications and on terrestrial mobile systems. The advanced rover design approach is applica-ble for lunar as well as Martian surface exploration purposes. A first mobility concept ap-proach for a lunar vehicle will be presented.