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

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MISSION CONCEPTS AND NEW TECHNOLOGIES FOR LUNAR SURFACE EXPLORATION USING THE NANOKHOD MICROROVER

Abstract

Further exploration of the Lunar surface and accessing extreme environments like polar regions, crater slopes, or even lava tubes state one of the most recent international activities and scientific investigations for planetary robotics. Technological advances, limited resources and a high degree of complexity therefore reasons the efforts in the application field of robotic micro systems and advanced mobility concepts in particular. Since 2017, the University of Stuttgart's Institute of Space Systems (IRS) and the company von Hoerner and Sulger GmbH (vH&S) are focussing on a variety of development aspects for a future application of the Nanokhod Microrover for versatile Lunar surface mission scenarios, thus continuing previous development phases of the Nanokhod Microrover within ESA's BepiColombo mission to Mercury (MRP). The initial Nanokhod Rover system had a total mass of around 3,2 kg and a peak power consumption of roughly 6 W. The mission scenario of the Nanokhod Microrover foresees a constant Tether connection towards another surface element in order to use synergies for the payload data exchange and power supply of the rover and with it providing a thermal robustness, despite its minimal volume. The latest development and implementation of a new Tether recoil mechanism increased the possible Tether length to up to 100 m and also allowed significant new operating modes for the rover (vertical deployment, crater and cave descent, etc.). As especially a long-term application of the Nanokhod for a future Lunar mission, and also the access of demanding sites of scientific interest is anticipated, a variety of investigations and subsystem developments have been performed. This paper presents the recent development activities of IRS and vH&S, pointing out technological developments and describing the benefits from connecting space industry, research and educational institutions. The paper shall point out the technological advances for the Nanokhod Microrover System for future Lunar surface exploration, covering a variety of design studies and analyses, such as possible mission scenarios (mission analyses, scientific payload concepts, operational scenarios and utilisation). These have been consolidated with a variety of new analytical assessments (locomotion performance, thermal design, power- and data handling), subsystem developments (e.g. the new Tether recoil mechanism, a new drive unit design, surface element design, hold-down and release mechanisms) as well as the implementation and testing of new technologies (dust mitigation, sensory components implementation and functional testing).