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Author: Mr. Lennart Fox
NEUROSPACE GmbH, Germany, lennart@neuro-space.de

Mr. Maximilian von Unwerth
NEUROSPACE GmbH, Germany, maximilian@neuro-space.de
Dr. Aditya Thakur
Technische Universität Braunschweig, Germany, aditya.thakur@tu-braunschweig.de
Mr. Karsten Pfeiffer
NEUROSPACE GmbH, Germany, karsten@neuro-space.de
Mr. Simon Stapperfend
TU Berlin, Germany, s.stapperfend@tu-berlin.de
Mr. Nash Benton
University of Toledo, United States, Nash.benton@rockets.utoledo.edu
Ms. Irene Selvanathan
NEUROSPACE GmbH, Germany, irene@neuro-space.de
Prof. Enrico Stoll
TU Berlin, Germany, e.stoll@tu-berlin.de

EXPANDING THE CAPABILITIES OF LUNAR COLLABORATIVE ROVERS WITH A COMPACT ROBOTIC ARM

Abstract

As humanity returns to the Moon and establishes a sustained presence there, the development of advanced robotics has moved into focus for researchers, industrial companies and space agencies alike. Among the pioneers of lunar robotics is the NewSpace company NEUROSPACE GmbH. The Berlin-based start-up is developing a highly versatile robotics ecosystem called HiveR. A core component of HiveR is a collaborative rover platform that is based on the CubeSat form-factor. Collaborative rovers are essential for conducting complex scientific investigations of a research site since they increase the efficiency of gathering data. By working together, a robotic swarm can cover more ground, providing a more extensive picture of the lunar surface environment than would be possible with individual rovers working in isolation. The addition of a robotic arm to such a collaborative rover enables it to interact with the environment, perform maintenance tasks, and deploy other scientific instruments with greater accuracy and dexterity than would be possible with a fixed-mounted tool. Therefore, NEUROSPACE GmbH has developed a compact robotic arm with four degrees of freedom that retracts and stores into a volume of $10\,\mathrm{cm} \times 10\,\mathrm{cm} \times 10\,\mathrm{cm}$. This paper presents the requirements, design, and testing of such robotic arm intended for use on the Moon as part of a rover in the HiveR ecosystem. The lunar environment with its reduced gravity, extreme temperatures, increased radiation intensity and abrasive lunar regolith, poses unique challenges for robotic systems. Preliminary test results with a prototype have demonstrated its effectiveness for operations such as rover-to-rover docking, surface material excavation and sensor deployment. The presented robotic arm adds a significant advancement in the capabilities of collaborative rovers by enabling a broader range of scientific investigations and resource utilization on the Moon's surface. In addition to its applicability for lunar exploration, the robotic arm presented in this paper has great potential in a variety of terrestrial applications, such as education, research, and industrial

operations. Its robust and compact construction makes it suitable for tasks such as object handling, assembly, and inspection. The development of such a compact yet highly versatile robotic arm represents a significant step forward in the field of robotics because of its potential to impact a wide range of applications beyond space exploration.