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

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BUILDING A LUNAR INFRASTRUCTURE WITH THE HELP OF A HETEROGENEOUS (SEMI)AUTONOMOUS MULTI-ROBOTIC TEAM

Abstract

Planetary exploration requires cooperative robotics technologies making it possible to act independently of human influence. The field of space robotics is heading in this direction. So-called multi-robotic teams, consisting of different and synchronised robots, solve problems not achievable with a single robot. This way of planetary exploration has great potential. The PRO-ACT project aims to develop and demonstrate key technologies for robotic collaborations for future ISRU plants construction on the Moon, based

on collaborative exploration of unknown areas and cooperative assembly, deployment and transport of large construction components. To demonstrate these capabilities, the following robots are being used: the Veles - a six-wheeled rover equipped with a 7 DoF arm, Mantis - a six-legged walking system and a mobile gantry -a large deployable structure with a 6 DoF end effector that can be used for payload manipulation or 3D printing. During the project, existing software and hardware developed in previous space robotic projects were further developed and integrated into the robot systems involved. Among other things, the software enables collaborative tasks such as transport, mapping, navigation, etc. Due to the Covid-19 situation, 80% of the functional integration tests and the preliminary demo-tests for defined mission scenarios were carried out remotely. Intense remote testing campaigns provided valuable experience directly applicable to future space missions. In addition PRO-ACT brings up a new way of multi-robotic cooperation. Due to Covid-19 restrictions the final demonstration cannot be conducted on site with all the robotic systems, but the mission scenarios are going to be strategically split so the robotic systems can partially perform their collaborative and cooperative tasks, by creating a VPN connection, in Poland, Germany and Spain at the same time. On-site tests were also carried out under hygienic conditions with the Mantis and Veles robots in the intermediate stage of the project. The paper describes the robot software and hardware developed as well as the single and cooperation tests carried out indoors in the analogue test field with granulate in the space exploration hall of the DFKI as well as outdoor on uneven terrain in Bremen, Germany. Also single tests of Veles were conducted indoor and outdoor in Warsaw, Poland, on firm and uneven terrain. The mobile gantry was tested at AVS facilities in Elgoibar, Spain. A dedicated sand testbed was manufactured and the gantry was remotely actuated. The paper will conclude with the results of the final demonstration of the multi-robotics team.