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AUTONOMOUS SERVICE ROVER FOR HUMAN-ROBOT COOPERATION

Abstract

Robotics and human exploration of Moon and Mars raise new objectives for mobile planetary devices in terms of mobility, autonomy and interaction with other space assets, including humans.

To prepare for such activities, the **European Space Agency** (ESA) awarded the **Eurobot Ground Prototype** (EGP) Project to an industrial consortium lead by Thales Alenia Space Italia. Within this project, GMV is responsible of the development of the mobile platform **"EGP-Rover"** with Technical University of Zurich (ETHZ) and Joanneum Research (JR) from Austria as subcontractors.

The goal of this medium rover (1.5m x 1m) is to achieve a highly-accurate mobile system, equipped with two robot arms, either for short distance mobility in the lander vicinity or to transport an astronaut and/or another payload (up to 400 Kg) to a target location, trespassing unknown terrain.

The EGP-Rover supports various operational modes, such as finding following a moving Astronaut, or finding a specific location on the ground where the Astronaut is pointing using a special light pointing device.

The required high manoeuvrability was achieved by designing a 4-wheel rover with only two steerable wheels. The rover can then either drive on tight curves or rotate on the spot. In order to stay stable on rough outdoor terrain the EGP-Rover includes a passive rotation axis between the front and the rear part of the rover.

Autonomous navigation is based on extended Kalman filtering using a combination of low-cost inertial measurement unit, mechanical odometers, and a stereovision camera system. The stereovision system is mounted on top of the rover to provide a panoramic stereo view using a pan-tilt unit. Initial high-resolution mapping results in a Digital Elevation Map and derived products such as slope map, hazard map and roughness map. These maps are analyzed using a cost function which delivers an optimum path from the current rover position to the desired target location. In addition, the stereo vision system supports the detection and tracking of an astronaut and the detection of a light beam for spotting an interesting target point.

The EGP-Rover, equipped with the two Eurobot Arms, is currently under test by TAS-I and ESA in a dedicated Moon-like environment at Dutch Space facilities. Main focus is to evaluate, enhance and prove the abilities of the concept and its individual solutions to be a valid candidate solution for supporting future human and robotic space exploration to Moon, Mars and other Planets.