

SMART MOBILE ROBOTS FOR SPECIALIZED INSPECTIONS

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1. INTRODUCTION

Space Robotics is one of rapidly emerging fields of research, development and implementation that are supported by the European Space Agency (ESA). One of branches is *Planetary Robotics* that is targeted on exploration and exploitation of planets. Both these activities usually require application of smart mobile robots, equipped with respective sensory systems, cameras, communication systems, and actuators.

Although SkyTech Research Sp. z o.o. (STR), an SME located at the campus of the Silesian University of Technology, one of the biggest and the best technical universities in Poland, does not have direct experience in developing space robots yet, the company is capable of designing, manufacturing and putting into operation smart mobile robots, which may operate autonomously in a very demanding environment.

In the following a series of robots is briefly presented. We discuss also several functionalities of the robots that can be added to allow the robots carrying out different tasks.

2. SERIES OF SMART MOBILE ROBOTS SMR

This section concerns a series of mobile robots that is developed by STR. All the robots satisfy general requirements:

- compact rugged and sealed body, IP 67;
- autonomous DC power supply based on on-board batteries;
- skid-steer locomotion;
- modular design;
- system for easy mounting of sensors and actuators;
- modular distributed control system.

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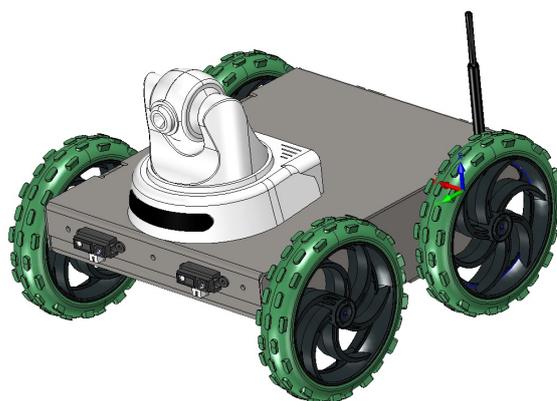


Figure 1. SMR-1 robot equipped with VCR.

The motion mechanism is based on wheels that are sufficient enough in case of small obstacles whose dimensions do not exceed diameters of wheels. Wheels are mounted on reducing gears attached to the DC motors. The complete drive is suspended in the body of the robot using elastic washers.

Main parameters concerning the series of robots are presented in Table 1. In two smaller robots two wheels on the one side of the robot are powered by one DC motor, while by bigger robots there are individual motors for each wheel.

2.1. Small inspection robots

Typical application of the smaller robots SMR-1 and SMR-2 is for inspecting smaller areas either indoors or outdoors. The robots can collect data, images and videos and send them to the remote operator station.

Small inspection robots are usually teleoperated. Although STR develops an autonomous control system for the robots, the autonomous operation is evoked by losing the communication link with the operator. In this control mode location and orientation of the robot is of vital importance. Several systems for locating and orienting robots are developed, starting from the one based

Table 1. Main parameters of the series of robots.

Type	Dimensions [mm]	Weight [kg]	Payload [kg]	Max speed [m/s]	Time of operation [h]	Range [km]
SMR-1	250 x 200	5	0.5	0.5	2	2
SMR-2	600 x 400	15	5	0.8	4	12
SMR-3	800 x 500	45	10	1.5	4	20
SMR-4	1000 x 700	125	30	2	8	10
SMR-5	1200 x 800	300	200	2.5	7	8.5

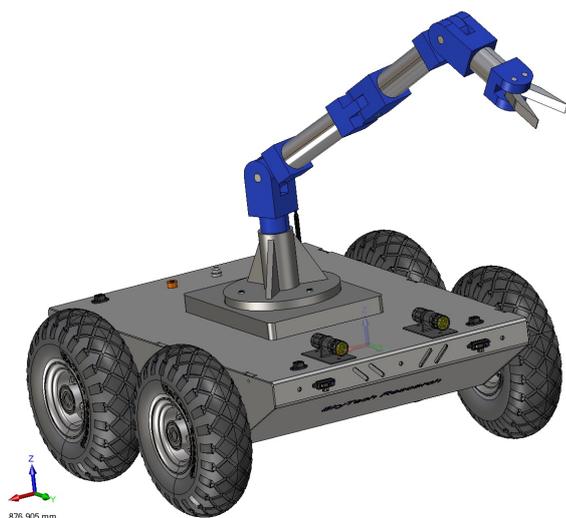


Figure 2. SMR-3 robot equipped with a manipulator.

on GPS/EGNOS in case of outdoor operation, through inertial navigation systems such as IMU, and ending in different kinds of odometry.

2.2. Utility robots

Three remaining robots of the series are the bigger ones, thus capable of undertaking more complex actions. To this end the robots may be equipped with different modular actuators. Fig. 2 presents the robot SMR-3 equipped with a manipulator, which allows carrying out some operations upon the environment (e.g. collecting dangerous objects).

These robots feature bigger range of operation and can move along quite long paths. The default mode of operation of such robots is autonomous one, which requires better location and orientation systems. Industrial electrical connectors allow using broad spectrum of optional equipment.

3. POSSIBLE MODIFICATIONS

In individual applications some special requirements may be formulated. An example of that is an explosion-proof version that can satisfy ATEX M1 requirements. STR has broad experience in developing robotic systems that fulfill this certificate. Another example of modifications can address the control system, and particularly the Human-Machine Interface.

In such cases significant modifications can be introduced, basing on a long-term collaboration between the customer and the developer of smart mobile robots – STR. Requirements of the customer can be carefully analyzed and discussed, and then concepts of solutions consulted with the end-user. Such an approach allows satisfying very advanced customers' needs.

Finally, solutions that satisfy requirements of space robotics may be included. However, this implementation usually will need better mobility that might be achieved by more complex mobility systems such as caterpillars with moving frames (*Chaos-like* arrangement built of 4 independently working tracks). Moreover, special solutions concerning electronics, communication systems, power supply systems and drives will be applied.

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