

Autonomous navigation in rough terrain

Subject: Robotics

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In the field of outdoor robotics numerous mobile robots already exist which are successfully operated all around the world. However in terms of autonomy there is still an enormous development potential. Therefore this bachelor thesis focuses on designing and implementing an autonomous stair climbing feature for a PackBot 510 EOD.

Task definition

Practical tests with the PackBot 510 EOD are to be made in order to determine the most suitable sequence for climbing stairs autonomously. The according software is to be developed in C++ within the ROS framework. A possible application location is provided by competing in the ELROB 2014 in Warsaw in collaboration with the BFH TI robotics lab.

Implementation

After testing the PackBots behavior when operating on stairs a simple yet reliable sequence of movements has been selected. The according software then was divided into two parts: a ROS node for stair detection and a second one for stair climbing. The first node handles the reception of the stairs via the PackBots TOF camera and the processing of its sensor data with the Point Cloud Library (PCL). Furthermore the slope of the stairs, the distance and the orientation of the PackBot towards the stairs are calculated in this part. These three parameters are necessary for controlling the robot accordingly in the next step.

The second node “stair climbing” executes the necessary steps for overcoming stairs with the PackBot based on the information given by the node “stair de-

tection”. The robot aligns itself in front of the stairs backwards and close to the first step. Knowing the slope of the stairs allows aligning the PackBot with the same angle by lifting it on its own flaps. This ensures a safe landing on the first two steps with great stability due to the PackBots rubber tracks. From this point on the robot is safe to climb the stairs backwards.

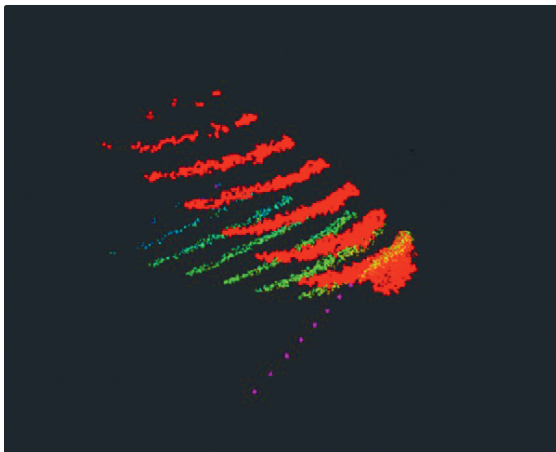
In order to allow an efficient use of these two ROS nodes have been implemented within the ROS actionlib. This ROS feature allows setting up “stair detection on demand” from within the stair climbing node. Instead of continuously processing the 3D sensor data a request to detect and process nearby stairs can be sent by the operator as soon as he identifies nearby stairs.

Results

The processing of the stairs from given point cloud data works reliably and efficient. The according parameters are correctly calculated. For controlling the PackBot in front and on the stairs a ROS node has been developed. The implemented ROS actionlib allows executing two nodes in a most efficient way. By competing in a typical EOD scenario at the ELROB 2014 in Warsaw the PackBots potential to autonomous operation has been confirmed further.



Valentin Raschke



Stairs and the according floor as a point cloud model



PackBot 510 EOD performing at the ELROB 2014