Autonomous navigation in rough terrain

Subject: Micro- and medical technology
Thesis advisor : Dr. Björn Jensen
Expert: Dr. Thomas Nussbaumer (RUAG)
External project partner: RUAG, Bern

Autonomous robots may play an important role in various fields like search and rescue missions, reconnaissance or inspection robots in Fukushima. Autonomy requires a detailed perception of the surrounding and sophisticated algorithms to process data and make vital decisions. The PackBot is a powerful multi-terrain robot currently controlled by a human operator. The objective of this thesis is to interface the PackBot with the Robot Operating System and a 3D camera to explore the capabilities of this powerful fusion.

Task definition

The PackBot is to be interfaced with the ROS framework and the depth camera SwissRanger 4000. For this task, modifications to the robot were necessary. Combining the PackBot, ROS and the 3D camera, the robot should be able to navigate autonomously, overcome obstacles and use the camera for mapping purposes.

Implementation

To interface the robot with ROS, an additional computer has been installed on the PackBot. A system, that does not rely on external wiring has been developed, a vital condition for autonomous operation. The ROS framework has been implemented successfully and a stable communication with the PackBot was achieved.

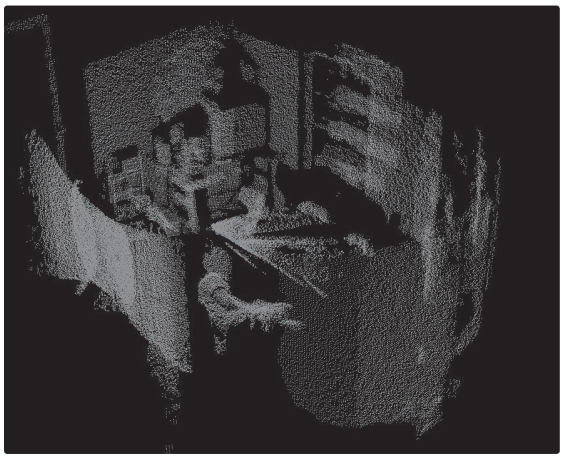
To access and process the 3D data from the camera, the Point Cloud Library, an open source library for handling point clouds, has been used. Using this library, it was possible to generate a map of the robots vicinity (see figure **panoscan**) and examine obstacles that are to be overcome.

The capabilities of the PackBot to handle difficult terrain have been examined and a obstacle avoidance using a laser scanner has been implemented. To take advantage of the robots ability to alter its configuration, a planner has been developed. This planner allows for changing the configuraiotn of the robor and overcome obstcles.

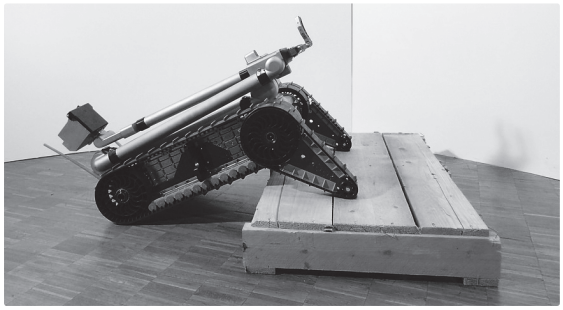
A reliably working implementation of 3D navigation could not be implemented, due to the lack of a reliable localization. A two dimensional navigation could be obtained using the navigation stack of the ROS framework, giving the robot a certain degree of autonomy.

Results

It turned out, that each of the main components (PackBot, ROS and depth camera) is extremely powerful on its own. Combining these features yields a robotic system possessing great potential. The fact that the PackBot now is interfaced with ROS opens a whole new world to developing PackBot related software.



3D panorama scan



Autonomously overcoming an obstacle

Stefan Funariu
funariu@gmx.net