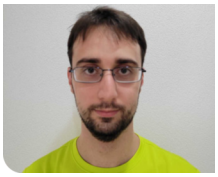
Autonomous driving for the Open Field Automation platform

Graduate



Strahinja Lukic

Timon Jenne

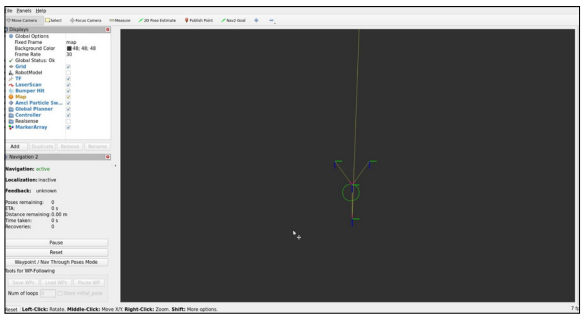
Introduction: The open source initiative ‘OFA: Open Field Automation’ of the Bern University of Applied Sciences for Agriculture, Forestry and Food Sciences (BFH-HAFL) aims to develop a platform for the modular construction of agricultural robots. The aim is to simplify the development of automated systems for agriculture and make it more cost-effective. The current focus is on the development of a robot for weed control.
The OFA initiative has two phases. In the first phase, Thomas Heeb and Micha Randegger have developed a robot platform in their bachelor's thesis that can be controlled by remote control. In the second phase, further options and extensions will be developed.

Approach / Technology: In this bachelor's thesis (Phase II), the robot's software is being expanded so that it can travel the field independently based on the specified field boundaries. The necessary sensors such as GPS and IMU were installed and configured so that the sensor data could be correctly integrated into the existing software. ROS2 (Robot Operating System) was used to ensure seamless integration of the sensor data. ROS2 specialises in ensuring efficient communication between software and hardware components. The expansion with ROS2 makes the robot more modular, which facilitates the implementation of additional sensors and components, such as a camera for weed detection. An interface was required to connect ROS2 with the existing software in EEROS. This interface between ROS2 and EEROS was developed using the existing classes of the EEROS framework. NAV2 (Navigation 2) was used to safely navigate the robot across the field. NAV2 is a very powerful software developed specifically for robot navigation. Its aim is to move a robot safely from point A to point B, avoid obstacles, dynamically choose the best path and, if necessary, stop at important points, for example to take a photo or, as in the case of the OFA robot, to destroy weeds. The sensor data from the IMU and GPS were tested for accuracy and then fed into a Kalman filter. The filtered data was used together with the odometry data to create transformation matrices. These transformation matrices contain the global position, the odometry, the position of the robot and the position of the wheels. The transformation matrices created in this way were then published in the form of ROS2-tf and transferred to NAV2 via ROS2-Topic. To create the control hierarchies between manual and automatic operation, a switch was implemented on the remote control and ROS2 Twist_mux, a software for creating input hierarchies, was used.

Result: The end result is a robot that combines the various software components of NAV2, ROS2, existing software and sensor and field data. It is able to efficiently scan a field in order to subsequently combat weeds in a targeted manner with the help of a mounted device.

OFA_Rover
Own presentment

Rviz for testing and visualisation
Own presentment



Advisor
Prof. Dr. Urs Graf

Co-Examiner
Prof. Dr. Matthias Scholer

Subject Area
Information and Communication Systems