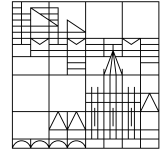


Task Sheet 2

Universität
Konstanz



Introduction to the TurtleBot 4

Deadline 10:00am May 3, 2023

Review on May 7 & 8, 2023

Lecture: *Advanced Autonomous Robotics*, Summer Term 2023

Lecturer: Prof. Dr.-Ing. Heiko Hamann

Tutor: Jonas Kuckling & Paolo Leopardi

In this exercise sheet, you will learn how to program the TurtleBot4. In all following exercises, we use the mobile robot TurtleBot 4, see Fig. 1. The TurtleBot 4 was developed by Clearpath Robotics¹ and runs on ROS 2 Humble.



Figure 1: TurtleBot 4 [source: <https://turtlebot.github.io/turtlebot4-user-manual/overview/features.html>]

The TurtleBot 4 is based on a Create® 3 and has a differential drive, a 3D camera, a LiDAR, and several infrared sensors, among other things. We will include more details about the sensors in the respective exercise sheets.

Task 2.1 Installing the TurtleBot4 packages (prepare at home)

In the past exercise, you should have already installed ROS 2 Humble. Follow now the instructions to install the TurtleBot4 packages on your computer: <https://turtlebot.github.io/turtlebot4-user-manual/setup/basic.html#user-pc>. Also install the simulation environment following these instructions: https://turtlebot.github.io/turtlebot4-user-manual/software/turtlebot4_simulator.html You can test that everything was installed correctly by launching the simulation as described here: <https://turtlebot.github.io/turtlebot4-user-manual/software/simulation.html#launching-ignition-gazebo>.

Test that your simulation is working by executing the following steps:

¹<https://clearpathrobotics.com/turtlebot-4/>

1. On the TurtleBot4 HMI, navigate up and down using the buttons labelled *3* and *4*.
2. On the TurtleBot4 HMI, navigate to the option *Undock* and select it using the the button labelled *1*.
3. After undocking the robot, use the Teleop interface to move it through the environment.

Submit a screenshot of the simulation, showing the robot at a distance from the docking station on ILIAS.

Task 2.2 Configuring your network setup (practical tutorial)

In the practical tutorial session, choose a TurtleBot4 robot and note its IP address. Follow the instructions to set up the discovery server configuration: https://turtlebot.github.io/turtlebot4-user-manual/setup/discovery_server.html#user-pc.

Note: In order to communicate with the TurtleBot4, you will need to be in the same network. If the IP address of your system does not start with `134.34.0.0/16`, then you are not connected to the same network as the TurtleBot4.

Note also: In order to see the ROS topics in the simulation, you will need to disable the use of the discovery server. The installation script will put the following line into your `.bashrc` file:

```
source /etc/turtlebot4_discovery/setup.bash
```

Comment this line and open a new terminal to get a session that does not use the discovery server. Therefore, we recommend to keep this line commented and only uncomment this line if you are working directly with the real TurtleBots.

Task 2.3 Your first TurtleBot 4 ROS 2 Node (practical tutorial)

In the practical tutorial session, connect via SSH to the TurtleBot4. On the TurtleBot4, implement your first ROS 2 node for the TurtleBot 4 following this tutorial: https://turtlebot.github.io/turtlebot4-user-manual/tutorials/first_node_python.html

You will need to demonstrate the correct functioning of this node to pass this exercise sheet.

Task 2.4 Driving the TurtleBot4 (practical tutorial)

In the practical tutorial session, follow the tutorial for driving your TurtleBot4: <https://turtlebot.github.io/turtlebot4-user-manual/tutorials/driving.html>.

Note: If you want to control the TurtleBot4 from your PC, you will need to run a relay, as the network does not support direct communication between your PC and the Create3 base of the robot. You can remap the topic of a node by passing `-ros-args -remap /old_topic:=/new_topic` to rename `old_topic` to `new_topic`. The relays can be started on the TurtleBot4 by running `ros2 launch AR2/common_ws/launch/launch_relays.yaml`.

You will need to demonstrate the driving of the robot to pass this exercise sheet.