Exercise Session 1

Theory

- ROS architecture
- ROS master, nodes, and topics
- Console commands
- Catkin workspace and build system
- Launch-files

Exercise

Get to know ROS by inspecting the simulation of a Super Mega Bot (SMB) robot.

1. Setup the SMB simulation:
    a. Download the "`smb_common.zip`" zipped file on the course Moodle website.
    b. Unzip it and place it in the "`~/Workspaces/smb_ws/src`" directory

    Compile the `smb_gazebo` package with catkin.

2. Launch the simulation with `smb_gazebo` roslaunch and inspect the created nodes and their topics using (Lecture 1 Slides 35/36, 16/17):

    ```
    rosnode list
    rostopic list
    rostopic echo [TOPIC]
    rostopic hz [TOPIC]
    rqt_graph
    ```

    For more information take a look at the slides or:
    http://wiki.ros.org/rostopic
    http://wiki.ros.org/rosnode

    Note: There are known issues and errors that will pop out. Refer to the last two sections of this document on ways to deal with them.

3. Command a desired velocity to the robot from the terminal (`rostopic pub [TOPIC]`) (Lecture 1 Slide 18)

4. Use **teleop_twist_keyboard** to control your robot using the keyboard. Find it online and compile it from its source! Use `git clone` to clone the repository to your workspace `~/Workspace/smb_ws`. (Lecture 1 Slides 31-33)

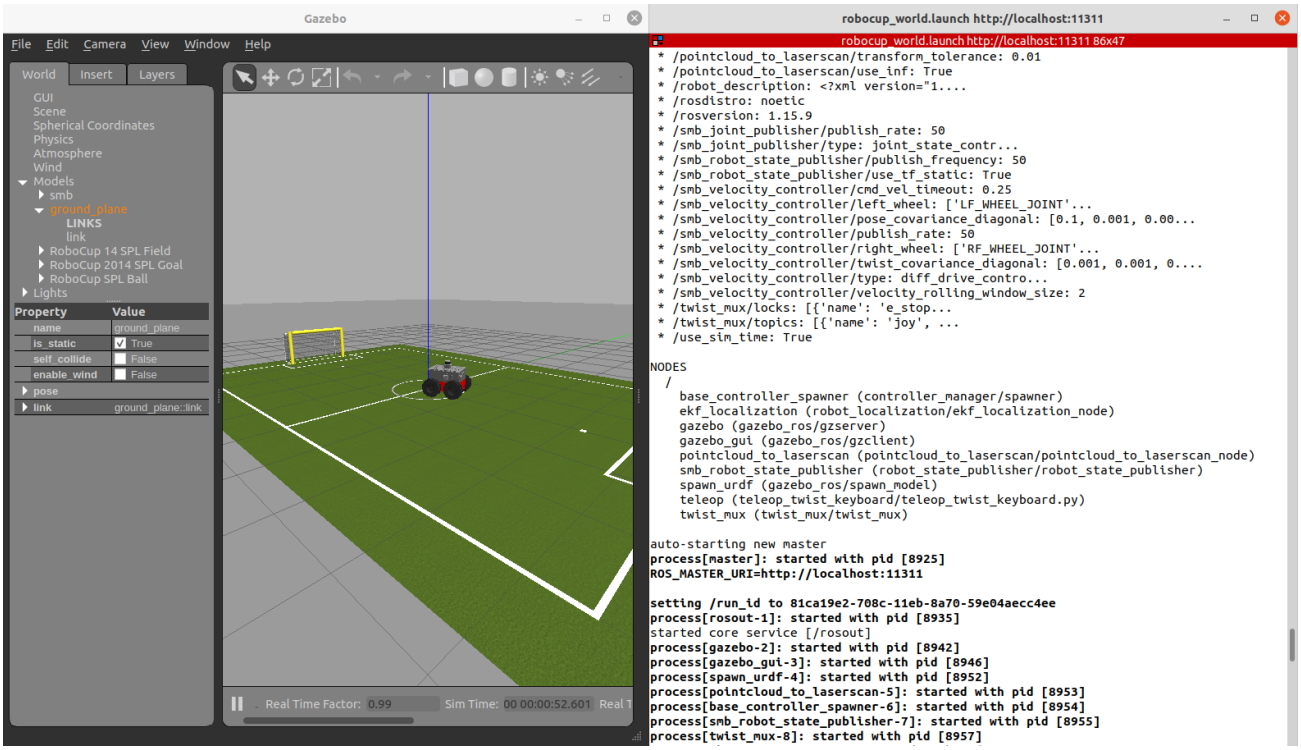
    For a short git overview see:
    http://rogerdudler.github.io/git-guide/files/git_cheat_sheet.pdf

For more interactive tutorial (deeper dive – not necessary for the course but useful):
https://learngitbranching.js.org/

5. Write a new launch file in smb_gazebo with the following content (Lecture 1 Slides 35-39):
   - smb simulation with a different world:

   Tip: This should be done using the `<include></include>` tag of launch files.

   Include `smb_gazebo.launch` file and change the `world_file` argument to a world from the directory `/usr/share/gazebo-11/worlds` (e.g. `worlds/robocup14_spl_field.world`). This might take a little while to load the first time. Note that the world_name is with respect to `/usr/share/gazebo-11/`



Left: Gazebo with Robocup14 World, *Right*: First lines of output when starting the launch file you have to set up

Evaluation

- ❏ Check if teleop_twist_keyboard is compiled from source (`roscd teleop_twist_keyboard` should show the `smb_ws` folder) [40%]
- ❏ Start the launch file. This should bring everything up that's needed to drive SMB with the keyboard as shown in the above image. [60%]

Hints

- If the robot stops again after sending the velocity command, specify the publisher's rate. Check out: `rostopic pub --help`.
- You may have some missing packages (e.g. twist_mux). You can install them via apt.

Troubleshooting

When building the ROS workspace, you may encounter the following error:

```
CMake Error at /opt/ros/noetic/share/catkin/cmake/catkinConfig.cmake:83
(find_package):
  Could not find a package configuration file provided by
  "hector_gazebo_plugins" with any of the following names:

    hector_gazebo_pluginsConfig.cmake
    hector_gazebo_plugins-config.cmake

  Add the installation prefix of "hector_gazebo_plugins" to
CMAKE_PREFIX_PATH
  or set "hector_gazebo_plugins_DIR" to a directory containing one of the
  above files.  If "hector_gazebo_plugins" provides a separate development
  package or SDK, be sure it has been installed.
```

This happens when catkin cannot find the mentioned package (in this case “hector_gazebo_plugins”) in your workspace directory or in the global ROS installation directory: “/opt/ros/noetic/share” (Lecture 1 Slide 27 – ${ROS_PACKAGE_PATH})

There are two ways to resolve this:

1. **Through pre-built binaries:**

   Install the package globally using its debian package:

   ```
   sudo apt install ros-noetic-<package-name>
   ```

   In this case, the <package-name> corresponds to “hector-gazebo-plugins”. This step will install the package into the ROS global installation path.

   ```
   ls /opt/ros/noetic/share | grep "hector_gazebo_plugins"
   ```

   Note: For Debian installation, you need to replace all underscores (“_”) in the package name with hyphens (“-”)

2. **From source:**

   Copy the package locally into your workspace (through version control tools like git, or downloading the zip file) and rebuild the workspace:

   ```
   cd ~/Workspace/smb_ws/src
   git clone https://github.com/tu-darmstadt-ros-pkg/hector_gazebo.git
   ```

   Note: When copying a package to your local workspace, it is given preference over the globally installed package.

When running your nodes through `rosrun` or `roslaunch`, sometimes you may encounter errors such as:

```
ERROR: cannot launch node of type [twist_mux/twist_mux]: twist_mux
ROS path [0]=/opt/ros/noetic/share/ros
ROS path
[1]=/home/mayank/Workspaces/smb_ws/src/hector_gazebo/hector_gazebo_plugins
ROS path [2]=/home/mayank/Workspaces/smb_ws/src/smb_common/smb_control
ROS path [3]=/home/mayank/Workspaces/smb_ws/src/smb_common/smb_description
ROS path [4]=/home/mayank/Workspaces/smb_ws/src/smb_common/smb_gazebo
ROS path [5]=/opt/ros/noetic/share
```

These normally correspond to runtime dependencies that are not checked for during building your packages. The displayed paths show the locations where `catkin` tried to find the package that is missing (in this case “twist_mux”). The list of paths it looks at is specified in the environment variable **`ROS_PACKAGE_PATH`** (Lecture 1 Slide 27)

Resolving these dependencies follows a similar procedure as the one mentioned before.

Known Issues

The following is a list of known simulation issues. Please ignore them.

1. Missing “model.config”

```
[Err] [InsertModelWidget.cc:402] Missing model.config for model
"/home/mayank/Workspaces/smb_ws/src/smb_common/smb_gazebo/config"
[Err] [InsertModelWidget.cc:402] Missing model.config for model
"/home/mayank/Workspaces/smb_ws/src/smb_common/smb_gazebo/include"
[Err] [InsertModelWidget.cc:402] Missing model.config for model
"/home/mayank/Workspaces/smb_ws/src/smb_common/smb_gazebo/launch"
[Err] [InsertModelWidget.cc:402] Missing model.config for model
"/home/mayank/Workspaces/smb_ws/src/smb_common/smb_gazebo/src"
```

```
[Err] [InsertModelWidget.cc:402] Missing model.config for model
"/home/mayank/Workspaces/smb_ws/src/smb_common/smb_gazebo/worlds"
```

2. Service call timeout

```
[Err] [Scene.cc:227] Service call[/shadow_caster_material_name] timed out
[Err] [Scene.cc:249] Service call[/shadow_caster_render_back_faces] timed out
```