3. Assignment, Introduction to Robotics WS18/19

1. (7 Points)
Look at the source code of the *simple_drive_control* and *simple_parking_maneuver* packages: https://github.com/AutoModelCar/catkin_ws_user/tree/version-3/src

You should have a copy of these two packages in your forked repository.
Now modify the parking maneuver to be able to park with the model car in an area of 1,20m length and 40cm width.

If you are doing only small changes on the code, it is possible to edit the source files in the running SSH session directly on the odroid with a terminal text editor. Otherwise it is recommended to work on the local copy on your machine and copy the files later with the **scp** command to the car.

Hints:

To clone and compile please execute the following steps in your repo in a subfolder assignment3:

```
git clone -b version-3 https://github.com/AutoModelCar/catkin_ws_user.git
cd catkin_ws_user/
catkin build simple_parking_maneuver
source devel/setup.bash
```

Then you need to start the service:

```
roslaunch simple_parking_maneuver simple_parking_maneuver.launch
```

You can call the service by:

```
rosservice call /simple_parking_maneuver/backward_longitudinal "direction: 'left'"
```

Tune the parameters in order to have an appropriate parking maneuver (car parks into an empty spot between two cars) in the files (but in your own repo):

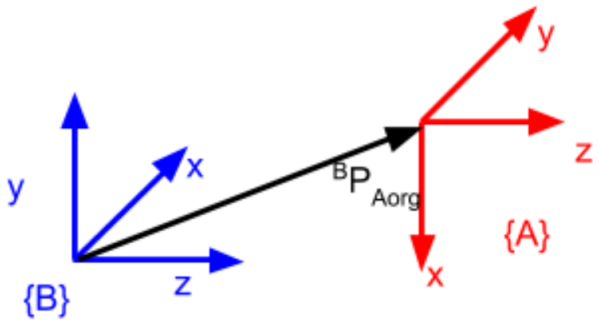
https://github.com/AutoModelCar/catkin_ws_user/blob/version-3/src/simple_parking_maneuver/src/parking_maneuver.py

https://github.com/AutoModelCar/catkin_ws_user/blob/version-3/src/simple_drive_control/src/drive_control.py

Commit the source code to your catkin_ws_user git repository. Show the result in a live demo with the car in the lab AND attach a video file, put a link to your source code in your final pdf.

2. (1 Point)

The following coordinate frames are given:



Please provide the homogeneous transformation matrix ${}^{B}_{A}T$, which maps a vector represented in coordinate frame $\{A\}$ into the coordinate frame $\{B\}$. The translation vector between both coordinate frames is ${}^{B}P_{Aorg} = (-1, 4, 5)$.

3. (1 Point)

Rotate a vector (2, 0, 0) using quaternion rotation by -3π/2 around axis (0,0,1), what is the resulting vector? Provide the calculation steps.

What are the axis and the angle which are represented by this quaternion:
(0.5 , -0.5 , -0.5 , 0.5) ?

4. (1 Point)

Assume, you have the following vectors for coordinate axes of frame (or coordinate system) {A} , where “sqrt” stands for “square root”, e.g. sqrt(4) = 2 :

{A} : x = (-sqrt(0.5), sqrt(0.5) ,0) ; y = (sqrt(0.5), sqrt(0.5),0)
Calculate the vector for the z-axis of this frame {A}.

5. (2 Bonus Points, not mandatory)

Drive two circles with the model car, the first one with radius of approx 1 m. The first circle shall be driven on the track. The second circle shall be driven using the same vehicle parameters, but on the carpet. Now measure the second circle’s radius. Write both radii down.

6. (0 Points, not mandatory)

Record the current published ROS data on your machine with the command:

rosbag record -a

After a while you can terminate recording (Ctrl+C) and find a file with the ending **.bag**.

When you are not connected to the car, you are now able to work with the data by running:

rosbag play -l bagfilename.bag