TAS Final Presentation

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Final Report

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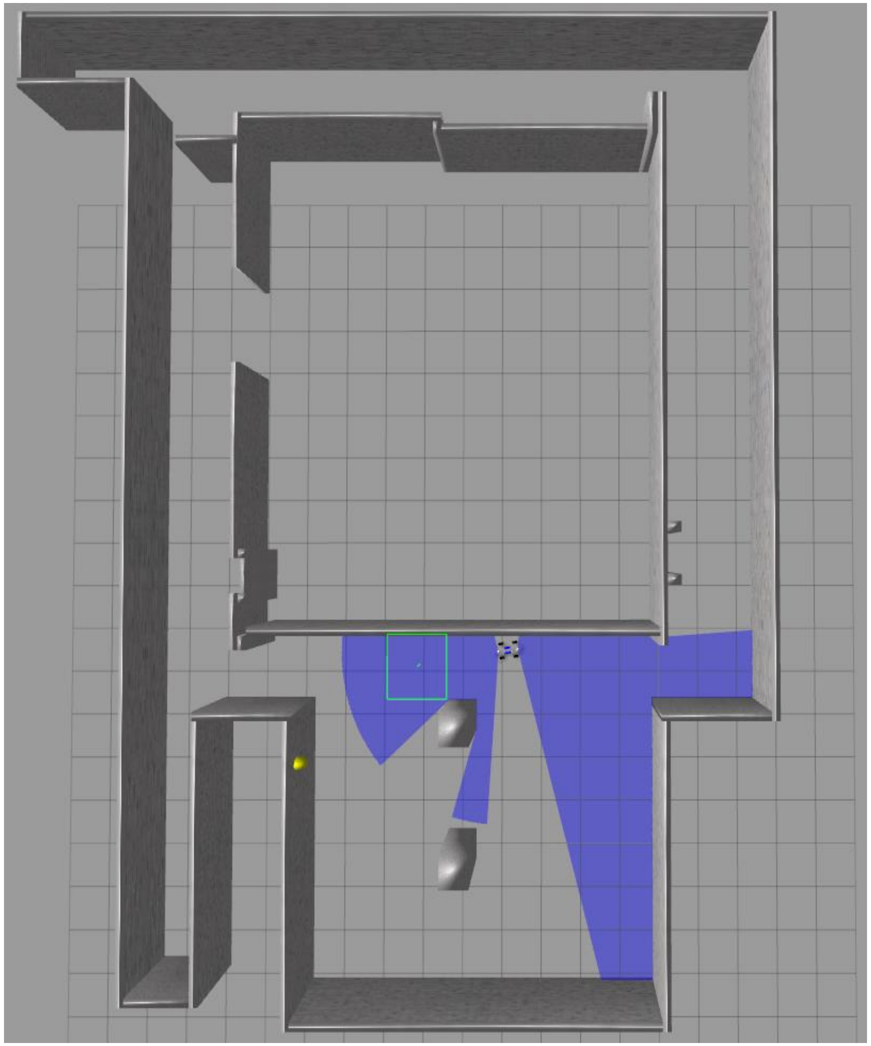
Simulation

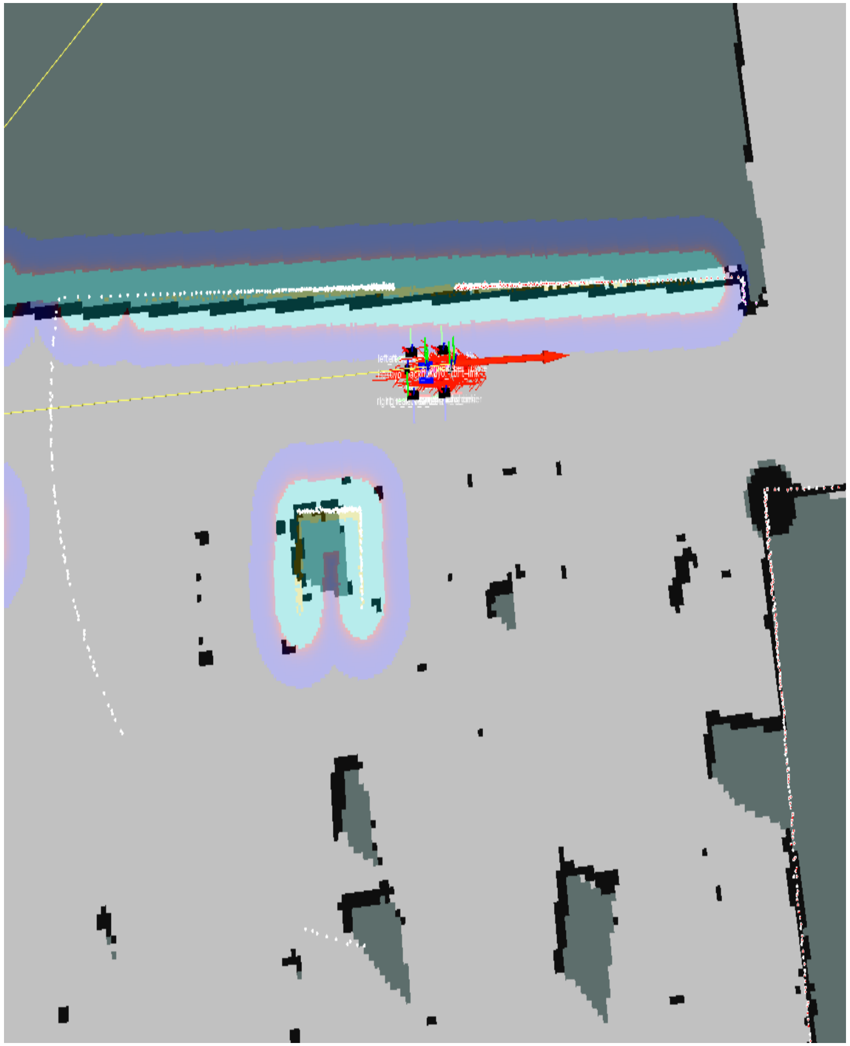
Bernd Kast

Simulator

- Useful for easier development and testing
- Based on gazebo simulator
- Ackerman_vehicle adapted:
  - Wheel and chassis dimensions changed
  - Laser scanners, imu and magnetic added
- Conversion between ackerman_msg and twist
- Walls built according to map
- Weights and center of masses not changed

Simulator – Results





Speed Control

Hubert Zimmermann

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Speed Control by using Odometry

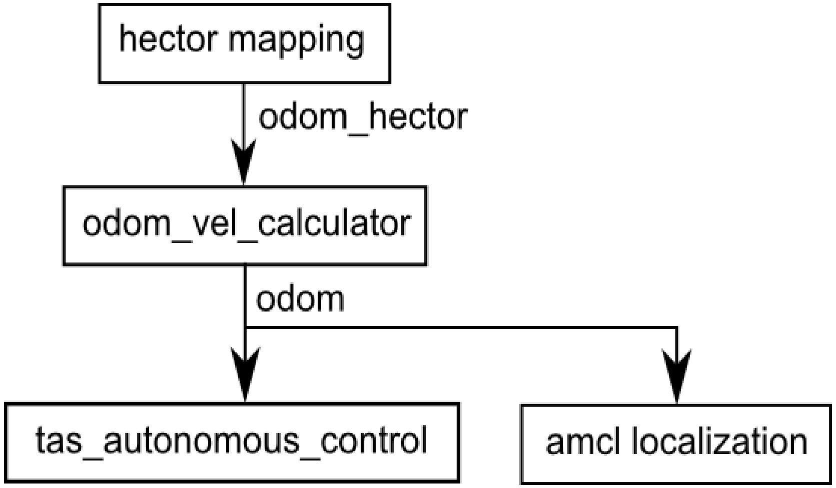
Idea:

- Subscribe odometry message from hector_mapping

- Calculate linear velocity and rotation angle out of elapsed time and two sampled points in the coordinate system

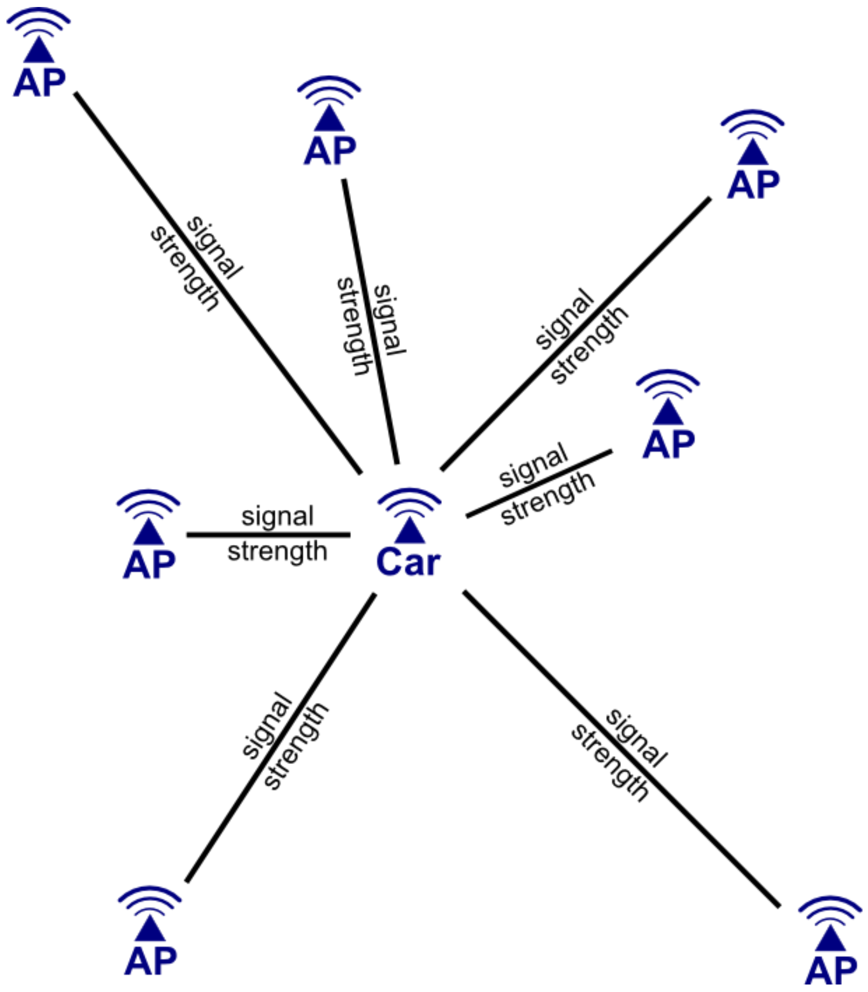
- Reduce noise of velocity-measurement by low-pass filtering

- Publish modified odom message with velocities to autonomous_control and amcl_localization



Autonomous Control Node

- Determines absolute velocity and controls it with PID-Controller
- PID-Controller was created with control_toolbox package for ROS
- Forward- and backwards-velocity are modified by seperate PID-Controllers
- Calculates the rotation velocity for controlling steering angle
- Publishes PWM-control commands to servos



Wifi Localization

Wolfgang Burger

Localization

Idea:

Signal strengths of the detected wifi signals for localization

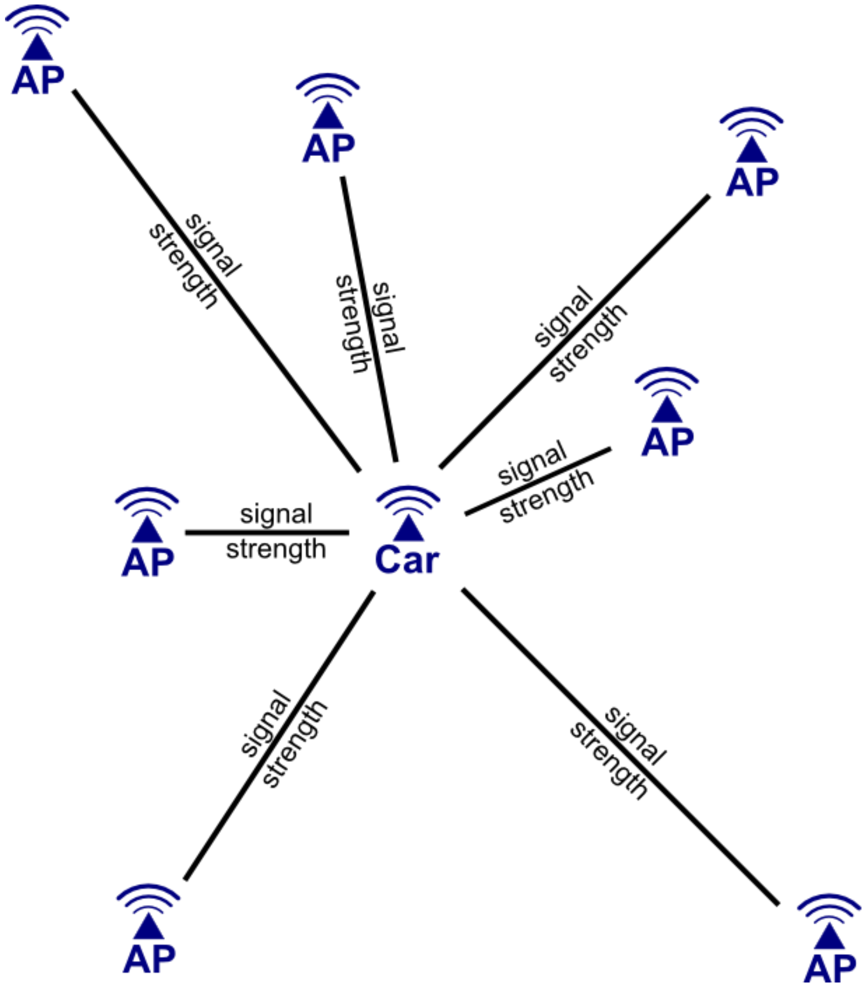
Collect samples when the car is located at the positions

Train a Feedforward Neural Network with this data

Used packages:

wifi_scan (https://github.com/RafBerkvens/wifi_scan)

wifi_localization (self-written)

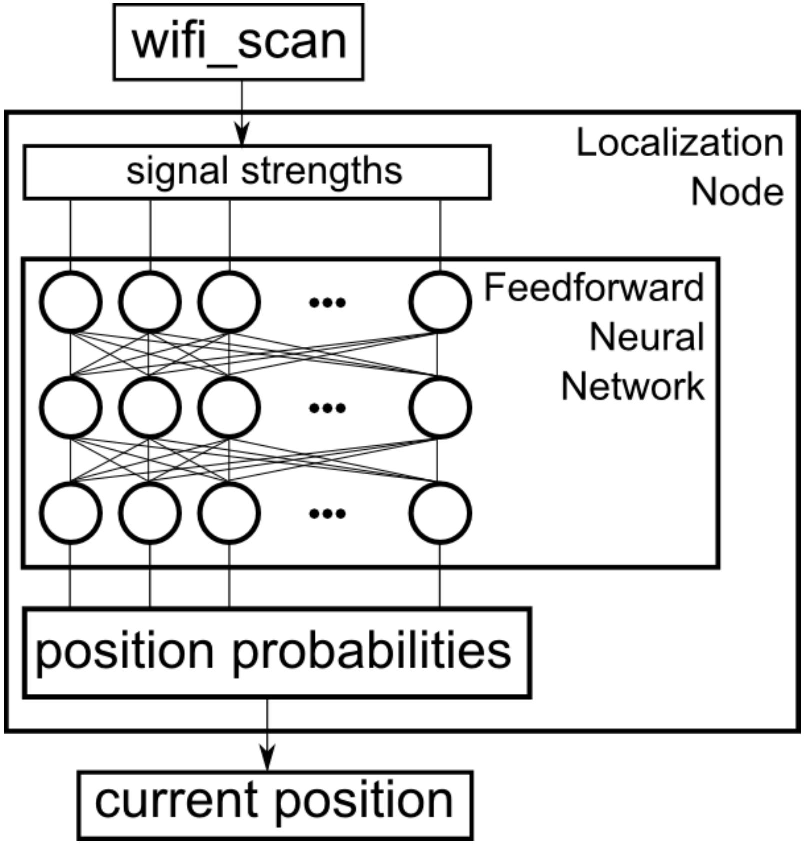


Localization

For every detected wifi we get the MAC adress of the access point and the corresponding signal strength.

Each signal strength is mapped to one input of the FFNN by using the MAC adress. If a network is not detected, the signal strength is set to a very low bottom level.

Each output of the FFNN represents the pseudo-probability that the car is in one specific position



Localization

Results:

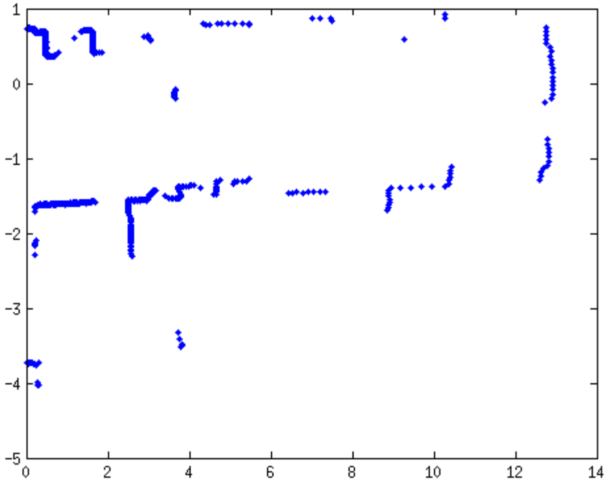
- The program is able to collect data, train the network and save it for another time so there is only need to train it once
- The localization was successfully tried on different laptops using 8 positions at the LSR floor (4 corners and in between them)
- It was not possible to get it running on the cars (we tried Gerty and Vettel) because of some issue with the wifi_scan package

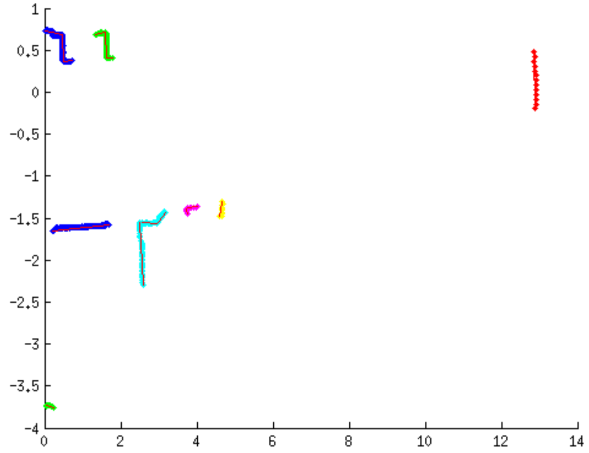
Parking Task

Martin Freundl

Parking – Box Recognition

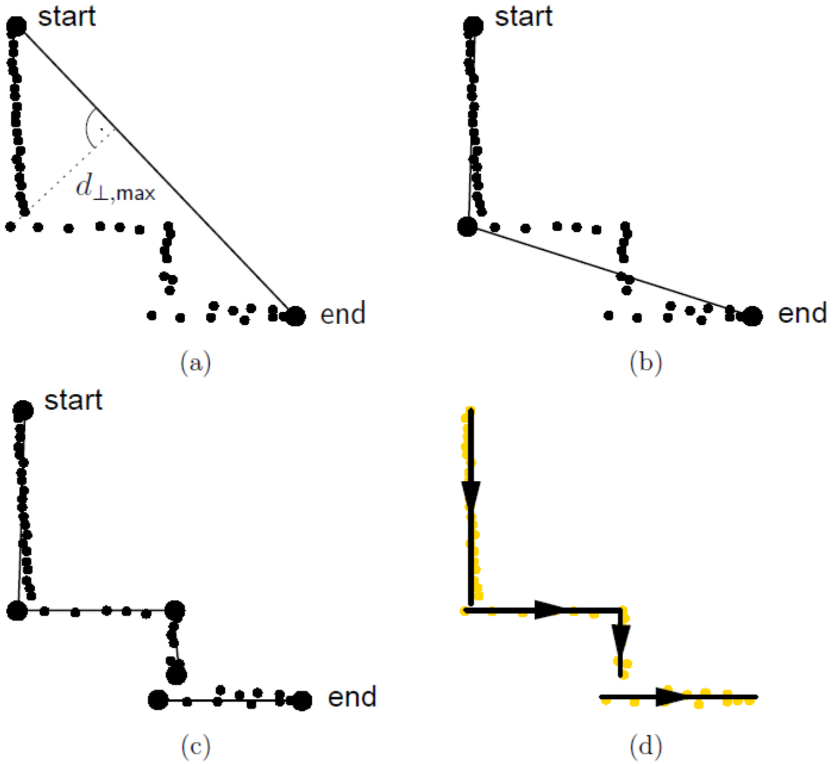
- Group neighbouring points of the laser scan into clusters
- Only select clusters with a certain number of points
- Fit lines into the remaining clusters
- Choose those clusters as boxes:
    - Consisting of 3 lines
    - 2 angles of about 90°
    - Second line is about 30 cm long (edge of DIN A4)





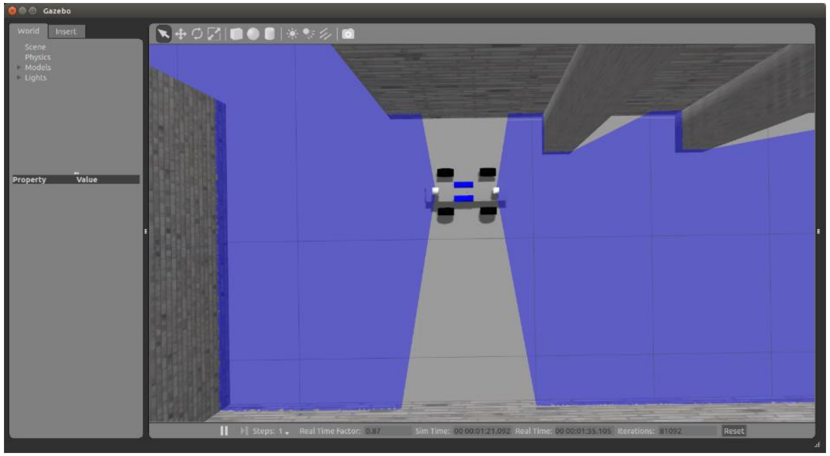
Parking – Box Recognition

- Group neighbouring points of the laser scan into clusters
- Only select clusters with a certain number of points
- Fit lines into the remaining clusters
- Choose those clusters as boxes:
  - Consisting of 3 lines
  - 2 angles of about 90°
  - Second line is about 30 cm long (edge of DIN A4)

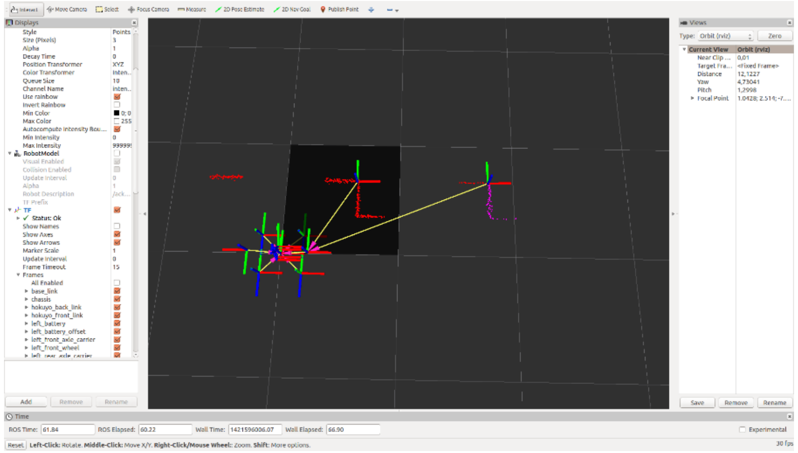


Line segment extraction within a group of scan points [1]

Parking – Steps



Steps: 1 Real Time Factor: 0.87 Sim Time: 00 00:01:21.092 Real Time: 00 00:01:35.105 Iterations: 81092



Style	Points
Size (Pixels)	3
Alpha	1
Decay Time	0
Position Transformer	XYZ
Color Transformer	Inten...
Queue Size	10
Channel Name	inten...
Use rainbow	☑
Invert Rainbow	□
Min Color	0; 0
Max Color	255
Autocompute Intensity Bou...	☑
Min Intensity	0
Max Intensity	99999
RobotModel	□
Visual Enabled	☑
Collision Enabled	□
Update Interval	0
Alpha	1
Robot Description	/ack...
TF Prefix	
TF	☑
✓ Status: Ok	
Show Names	□
Show Axes	☑
Show Arrows	☑
Marker Scale	1
Update Interval	0
Frame Timeout	15
Frames	
All Enabled	□
base_link	☑
chassis	☑
hokuyo_back_link	☑
hokuyo_front_link	☑
left_battery	☑
left_battery_offset	☑
left_front_axle_carrier	☑
left_front_wheel	☑
left_rear_axle_carrier	☑

Type: Orbit (rviz)

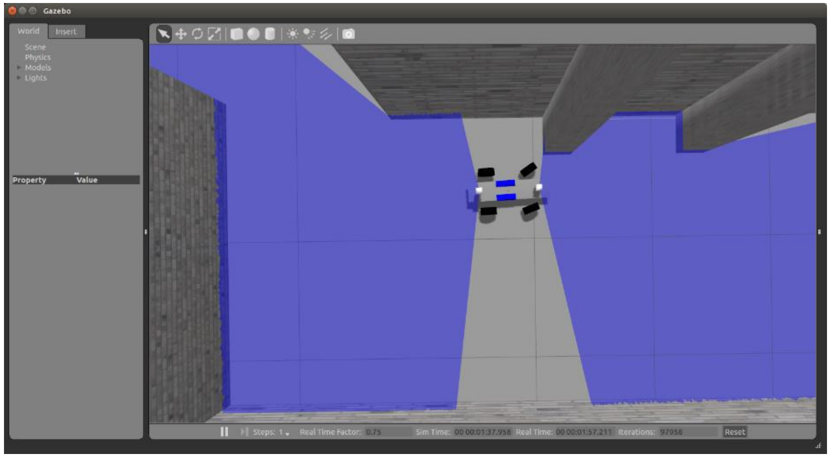
Current View	Orbit (rviz)
Near Clip ...	0,01
Target Fra...	<Fixed Frame>
Distance	12,1227
Yaw	4,73041
Pitch	1,2998
Focal Point	1.0428; 2.514; -7....

ROS Time: 61.84 ROS Elapsed: 60.22 Wall Time: 1421596006.07 Wall Elapsed: 66.90 □ Experimental

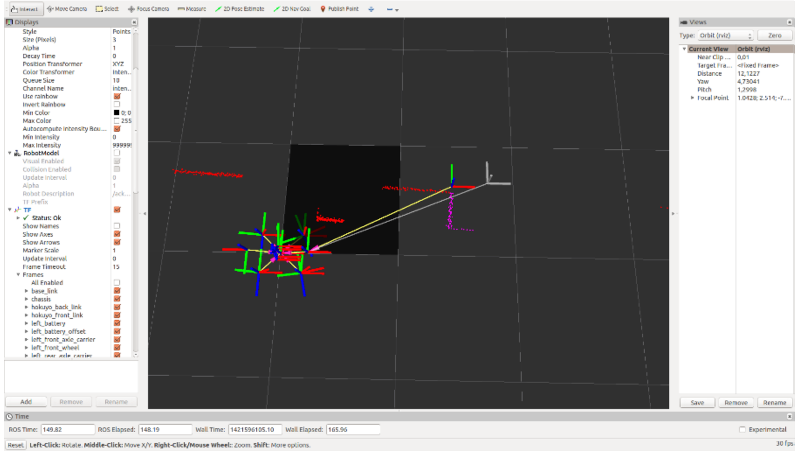
Left-Click: Rotate. **Middle-Click:** Move X/Y. **Right-Click/Mouse Wheel:**: Zoom. **Shift:** More options. 30 fps

Step 1:
Detect a gap of the right length to start the parking task.

Parking – Steps



Steps: 1 Real Time Factor: 0.75 Sim Time: 00 00:01:37.958 Real Time: 00 00:01:57.211 Iterations: 97958



Style	Points
Size (Pixels)	3
Alpha	1
Decay Time	0
Position Transformer	XYZ
Color Transformer	Inten...
Queue Size	10
Channel Name	inten...
Use rainbow	☑
Invert Rainbow	□
Min Color	0; 0
Max Color	255
Autocompute Intensity Bou...	☑
Min Intensity	0
Max Intensity	99999
RobotModel	□
Visual Enabled	☑
Collision Enabled	□
Update Interval	0
Alpha	1
Robot Description	/ack...
TF Prefix	
TF	☑
✓ Status: Ok	
Show Names	□
Show Axes	☑
Show Arrows	☑
Marker Scale	1
Update Interval	0
Frame Timeout	15
Frames	
All Enabled	□
base_link	☑
chassis	☑
hokuyo_back_link	☑
hokuyo_front_link	☑
left_battery	☑
left_battery_offset	☑
left_front_axle_carrier	☑
left_front_wheel	☑
left_rear_axle_carrier	☑

Type: Orbit (rviz)

Current View	Orbit (rviz)
Near Clip ...	0,01
Target Fra...	<Fixed Frame>
Distance	12,1227
Yaw	4,73041
Pitch	1,2998
Focal Point	1.0428; 2.514; -7....

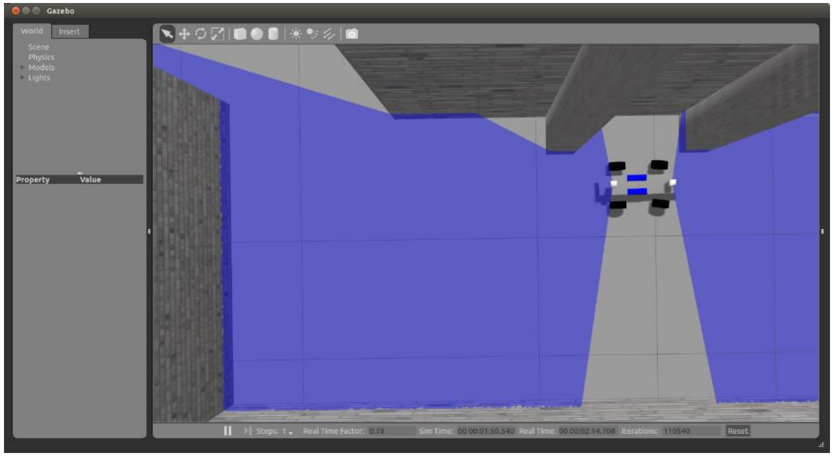
ROS Time: 149.82 ROS Elapsed: 148.19 Wall Time: 1421596105.10 Wall Elapsed: 165.96 □ Experimental

Left-Click: Rotate. **Middle-Click:** Move X/Y. **Right-Click/Mouse Wheel:**: Zoom. **Shift:** More options.

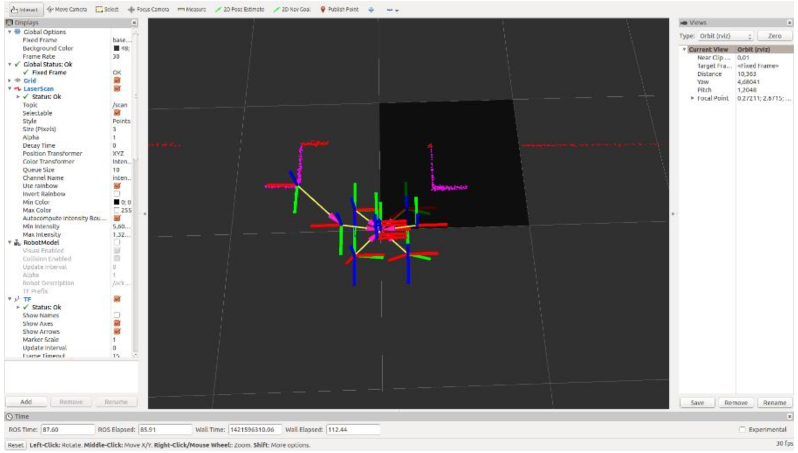
30 fps

Step 2:
Move to position 2.
Control orientation and position of the car.

Parking – Steps



Steps: 1 Real Time Factor: 0.78 Sim Time: 00 00:01:50.540 Real Time: 00 00:02:14.708 Iterations: 110540



Global Options	
Fixed Frame	base...
Background Color	48;
Frame Rate	30
✓ Global Status: Ok	
✓ Fixed Frame	OK
Grid	☑
LaserScan	☑
✓ Status: Ok	
Topic	/scan
Selectable	☑
Style	Points
Size (Pixels)	3
Alpha	1
Decay Time	0
Position Transformer	XYZ
Color Transformer	Inten...
Queue Size	10
Channel Name	inten...
Use rainbow	☑
Invert Rainbow	□
Min Color	0; 0
Max Color	255
Autocompute Intensity Bou...	☑
Min Intensity	5,60...
Max Intensity	1,32...
RobotModel	□
Visual Enabled	☑
Collision Enabled	□
Update Interval	0
Alpha	1
Robot Description	/ack...
TF Prefix	
TF	☑
✓ Status: Ok	
Show Names	□
Show Axes	☑
Show Arrows	☑
Marker Scale	1
Update Interval	0
Frame Timeout	15

Type: Orbit (rviz)

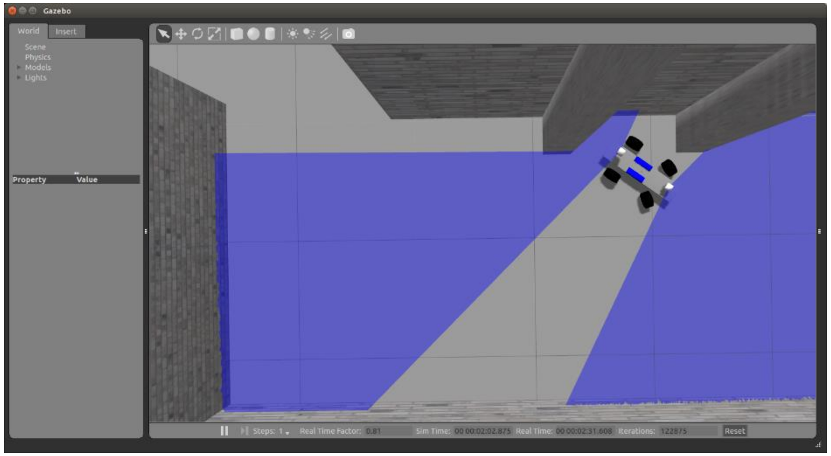
Current View	Orbit (rviz)
Near Clip ...	0,01
Target Fra...	<Fixed Frame>
Distance	10,363
Yaw	4,68041
Pitch	1,2048
Focal Point	0.27211; 2.8715; ...

ROS Time: 87.60 ROS Elapsed: 85.91 Wall Time: 1421596310.06 Wall Elapsed: 112.44 □ Experimental

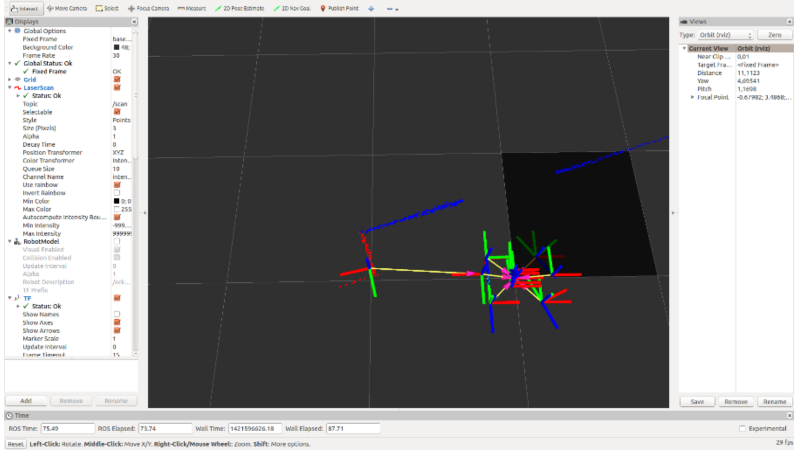
Reset **Left-Click:** Rotate. **Middle-Click:** Move X/Y. **Right-Click/Mouse Wheel:**: Zoom. **Shift**: More options. 30 fps

Step 2:
Move to position 2.
Switch to back-scanner when box in the front disappears.

Parking – Steps



Steps: 1 Real Time Factor: 0.81 Sim Time: 00 00:02:02.875 Real Time: 00 00:02:31.608 Iterations: 122875



Global Options	
Fixed Frame	base…
Background Color	■ 48;
Frame Rate	30
✓ Global Status: Ok	
✓ Fixed Frame	OK
Grid	☑
LaserScan	☑
✓ Status: Ok	
Topic	/scan
Selectable	☑
Style	Points
Size (Pixels)	3
Alpha	1
Decay Time	0
Position Transformer	XYZ
Color Transformer	Inten…
Queue Size	10
Channel Name	inten…
Use rainbow	☑
Invert Rainbow	☐
Min Color	■ 0; 0
Max Color	□ 255
Autocompute Intensity Bou…	☑
Min Intensity	-999…
Max Intensity	99999
RobotModel	☐
Visual Enabled	☑
Collision Enabled	☐
Update Interval	0
Alpha	1
Robot Description	/ack…
TF Prefix	
TF	☑
✓ Status: Ok	
Show Names	☐
Show Axes	☑
Show Arrows	☑
Marker Scale	1
Update Interval	0
Frame Timeout	15

Type: Orbit (rviz)

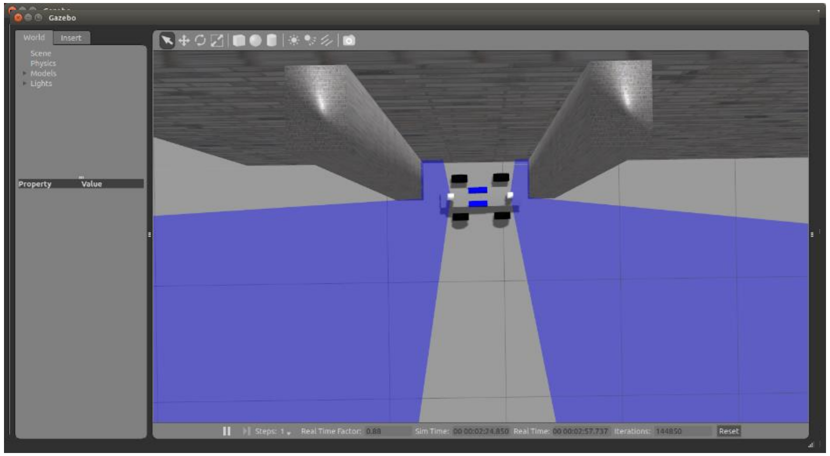
Current View	Orbit (rviz)
Near Clip …	0,01
Target Fra…	<Fixed Frame>
Distance	11,1123
Yaw	4,69541
Pitch	1,1698
Focal Point	-0.67982; 3.4868;…

ROS Time: 75.49 ROS Elapsed: 73.74 Wall Time: 1421596626.18 Wall Elapsed: 87.71 ☐ Experimental

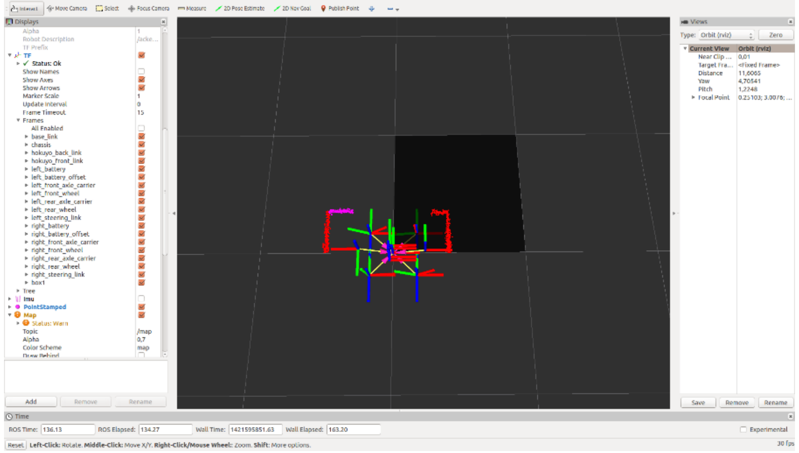
Left-Click: Rotate. **Middle-Click:** Move X/Y. **Right-Click/Mouse Wheel:**: Zoom. **Shift:** More options. 29 fps

Step 3:
Move into the gap.
Steering angle is reversed
when the car has a certain orientation to the box behind it.

Parking – Steps



Steps: 1 Real Time Factor: 0.88 Sim Time: 00 00:02:24.850 Real Time: 00 00:02:57.737 Iterations: 144850



Alpha 1
Robot Description /acke...
TF Prefix
TF ☑
Status: Ok
Show Names ☐
Show Axes ☑
Show Arrows ☑
Marker Scale 1
Update Interval 0
Frame Timeout 15
Frames
All Enabled ☐
base_link ☑
chassis ☑
hokuyo_back_link ☑
hokuyo_front_link ☑
left_battery ☑
left_battery_offset ☑
left_front_axle_carrier ☑
left_front_wheel ☑
left_rear_axle_carrier ☑
left_rear_wheel ☑
left_steering_link ☑
right_battery ☑
right_battery_offset ☑
right_front_axle_carrier ☑
right_front_wheel ☑
right_rear_axle_carrier ☑
right_rear_wheel ☑
right_steering_link ☑
box1 ☑
Tree
Imu ☐
PointStamped ☑
Map ☑
Status: Warn
Topic /map
Alpha 0,7
Color Scheme map
Draw Behind ☐

Type: Orbit (rviz)
Current View Orbit (rviz)
Near Clip ... 0,01
Target Fra... <Fixed Frame>
Distance 11,6065
Yaw 4,70541
Pitch 1,2248
Focal Point 0.25103; 3.0076; ...

ROS Time: 136.13 ROS Elapsed: 134.27 Wall Time: 1421595851.63 Wall Elapsed: 163.20 ☐ Experimental

Reset **Left-Click:** Rotate. **Middle-Click:** Move X/Y. **Right-Click/Mouse Wheel:**: Zoom. **Shift:** More options. 30 fps

Step 4:
Do a movement for correction.
Both laser scanners are used so that the car does not touch the boxes.

Parking – Results & Conclusion

- The parking task is a set of controlled movements and not just a recorded movement, so minor changes of the start position lead to the same result
- Thanks to the simulation and the velocity controller, the parking task was completely developed in the simulation and then adapted to the reality by only doing little modifications on some parameters.
- The second box needs to be higher otherwise it is not detected in the start position because the scanner is mounted on the car at a certain slope

Thanks!

T. Einsele
Localization in Indoor Environments Using a Panoramic Laser Range Finder
Dissertation [1]