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Hector SLAM Tutorials

Tutorial 1: Introduction to hector_slam

Ref http://emanual.robotis.com/docs/en/platform/turtlebot3/simulation/#ros-packages-for-gazebo

- Specify model of the turtlebot 3 you are using. Since we are using Gazebo, model name is not so important. Just pick one of the models.
  export TURTLEBOT3_MODEL=waffle_pi
  NOTE: You have to export each time from each terminal before calling the necessary ros functions. If you do not want to do this, you can add this to .bashrc file.
- Open Gazebo environment with specified world environment
  roslaunch turtlebot3_gazebo turtlebot3_world.launch
- Launch the hector_slam
  roslaunch turtlebot3_slam turtlebot3_slam.launch slam_methods:=hector
- Move turtlebot 3 with keyboard
  roslaunch turtlebot3_teleop turtlebot3_teleop_key.launch
- You can now see the map in Rviz Screen.

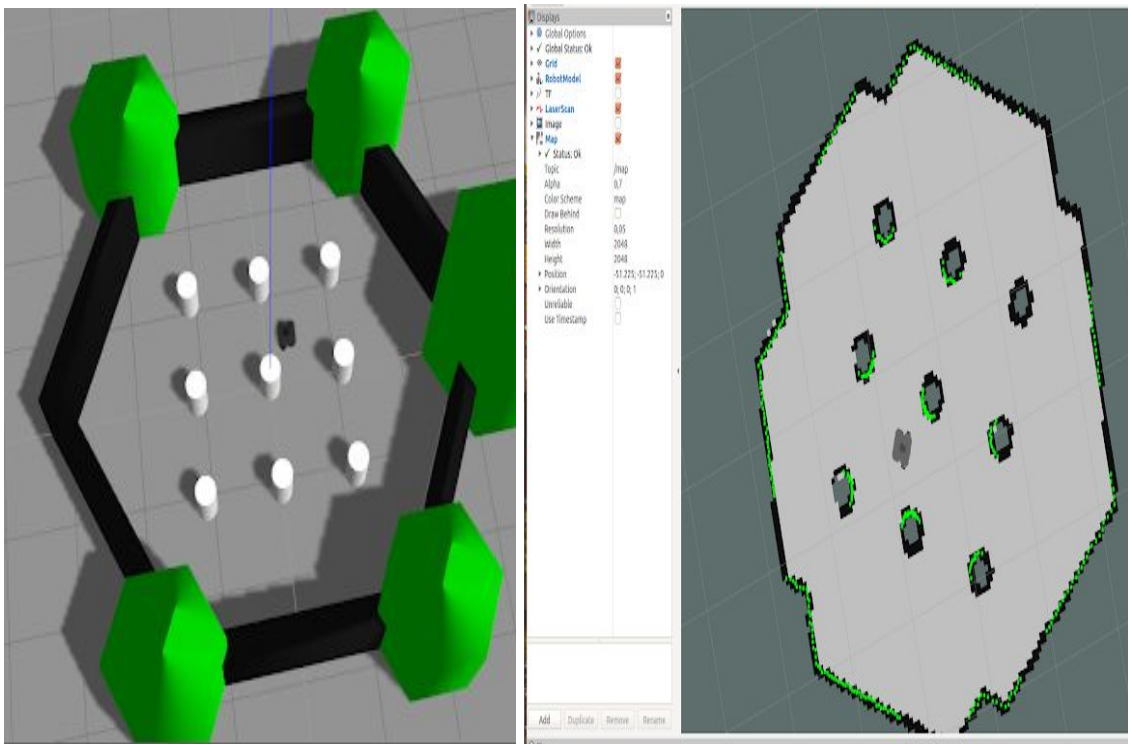

Figure 1: Simulation environment in Gazebo (left) and resulted map in rviz (right)

- After obtained full map you can save it to anywhere you like.
  rosrun map_server map_saver -f ~/map1

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Tutorial 2: Move Turtlebot 3 using rosbag file

Generally people want to make a comparison with different configurations and for these situations using teleoperation to move turtlebot 3 does not make any sense. For these situations, one can record the movement of turtlebot 3 with teleop just one time using rosbag and then this rosbag file can be used to move turtlebot 3 in the same way every time.

- Open Gazebo environment with specified world environment
  roslaunch turtlebot3_gazebo turtlebot3_world.launch
- Launch the hector_slam
  roslaunch turtlebot3_slam turtlebot3_slam.launch slam_methods:=hector
- Go to our example rosbag file that keeps movement commands to turtlebot 3.
  cd ros_ws/bagfiles
- Play our bagfile.
  rosbag play turtlebot3_movement.bag

NOTE: We used waffle_pi as TURTLEBOT3_MODEL. It is highly possible that this bag file is specific to waffle_pi. If you are using another model, you need to save your own bag file.

Tutorial 3: Customize LIDAR Parameters in Gazebo

- Go to turtlebot3_description
  cd ros_ws/src/turtlebot3/turtlebot3_description
- Go to urdf directory. Open turtlebot3_waffle_pi.gazebo.xacro (if you use different model change it accordingly)
  cd urdf & gedit turtlebot3_waffle_pi.gazebo.xacro
  NOTE: It is a good idea to copy original xacro file if you need to use default values later.
- Change LIDAR parameters as you wish. We modified with our own LIDAR parameters as can be seen in Figure 1.

```
<gazebo reference="base_scan">
  <material>Gazebo/FlatBlack</material>
  <sensor type="ray" name="lds_lfcd_sensor">
    <pose>0 0 0 0 0 0</pose>
    <visualize>$(arg laser_visual)</visualize>
    <update_rate>4</update_rate>
    <ray>
      <scan>
        <horizontal>
          <samples>128</samples>
          <resolution>1</resolution>
          <min_angle>0.0</min_angle>
          <max_angle>6.28319</max_angle>
        </horizontal>
      </scan>
      <range>
        <min>0.10</min>
        <max>3.0</max>
        <resolution>0.002</resolution>
      </range>
      <noise>
        <type>gaussian</type>
        <mean>0.0</mean>
        <stddev>0.01</stddev>
      </noise>
    </ray>
    <plugin name="gazebo_ros_lds_lfcd_controller" filename="libgazebo_ros_laser.so">
      <topicName>scan</topicName>
      <frameName>base_scan</frameName>
    </plugin>
  </sensor>
</gazebo>
```

Figure 1: Manipulated turtlebot 3 LIDAR parameters

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Tutorial 4: Hector_SLAM with your own data and without Gazebo simulation
Reference: https://www.youtube.com/watch?v=3C_eRtSoU78

- Go to hector_slam_launch directory
  cd ros_ws/src/hector_slam/hector_slam_launch/launch
- Our launch file is named as oko_hector_launcher.launch. This file calls the main launch file in ros_ws/src/hector_slam/hector_mapping/launch/oko_hector_mapping.launch
  You can use these launch files to create your own launch files later.
- Call our launch file. Do not forget to source setup.bash!
  roslaunch hector_slam_launch oko_hector_launcher.launch
- Go to bagfiles directory and play our bag file.
  cd ros_ws/bagfiles & rosbag play turtlebot3_scan2.bag --clock
  NOTE: Please note that this bag file only publishes laser scan data to /scan topic. We do not use any odometry information.
- If everything is okay, you should be able to see Rviz output like below:

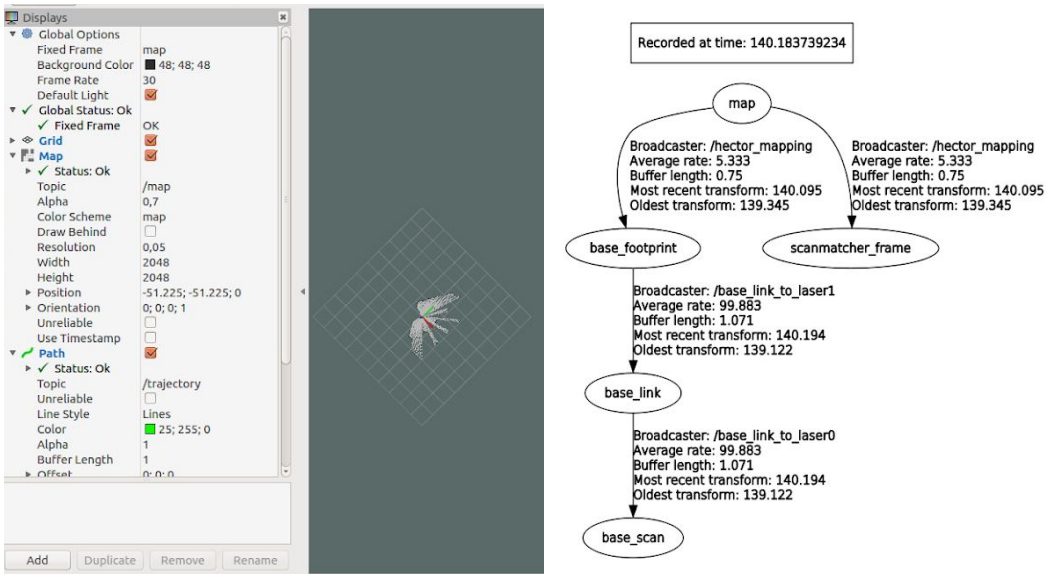

Figure 1: Rviz output (left) and TF tree (right)

Important NOTE: Hector_slam package needs specific transform tree(tf) configuration to work properly. In our case, required transformations are done by robot_state_publisher in launch files. For more information one can check hector_slam tutorial.

Important NOTE: You can also use our launcher with a real data without saving as a rosbag file. LIDAR should publish to /scan topic by default, but it can be changed by modifying launch files mentioned before. However, one should set set /use_sim_time parameter as false while using real time data. On the other hand, it should be set true to use with rosbag files.