6. Hector Mapping Algorithm

hector_slam: http://wiki.ros.org/hector_slam

hector_slam/Tutorials: http://wiki.ros.org/hector_slam/Tutorials/SettingUpForYourRobot

hector_mapping: http://wiki.ros.org/hector_mapping

map_server: https://wiki.ros.org/map_server

6.1. Introduction

Features: hector_slam does not need to subscribe to odometer/odom messages, uses Gauss-Newton method, and directly uses lidar to estimate odometer information. However, when the robot is fast, it will slip, resulting in deviations in the mapping effect, and high requirements for sensors. When building a map, try to adjust the car's rotation speed to a lower level.

There is no method for using the odom coordinate system, excerpted from Wiki.

2. Use without odom frame

If you do not require the use of a odom frame (for example because your platform does not provide any usable odometry) you can directly publish a transformation from map to base_link:

```
<param name="pub_map_odom_transform" value="true"/>
<param name="map_frame" value="map" />
<param name="base_frame" value="base_frame" />
<param name="odom_frame" value="base_frame" />
```

6.2. Use

Note: When building a map, the slower the speed, the better the effect (note that the rotation speed should be slower). If the speed is too fast, the effect will be very poor.

6.2.1. Startup

Turn off the automatic chassis service

```
sudo supervisorctl stop ChassisServer
```

Start chassis driver command (robot side)

```
sudo supervisorctl re LaserServer #start/stop Switch radar service (indoor version)
roslaunch scout_bringup scout_mini_robot_base.launch # laser + yahboom
```

- It is necessary to ensure that the radar starts normally. If you run `rostopic echo /scan`

and the print is empty and the data cannot be obtained, the startup is abnormal. Please restart the radar service command.

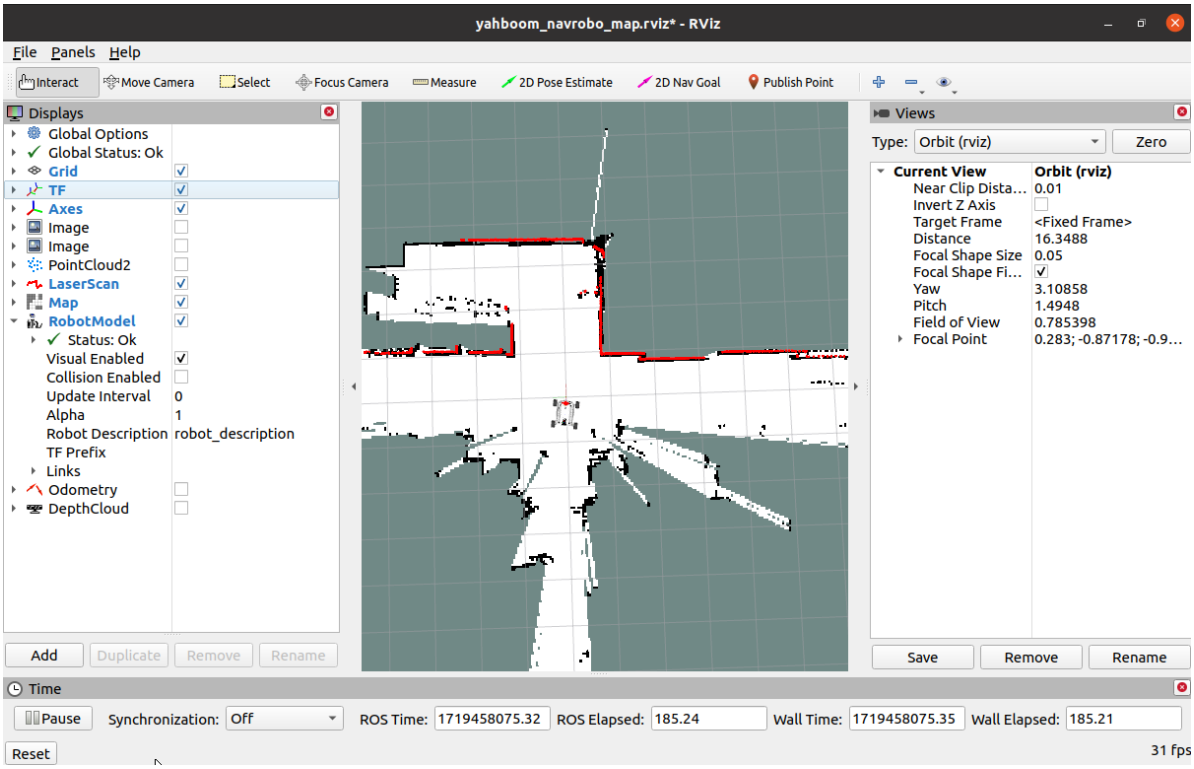
Mapping command (robot side)

```
roslaunch yahboom_navrobo_nav yahboom_navrobo_map.launch use_rviz:=false map_type:=hector
```

- [use_rviz] parameter: whether to enable rviz visualization.
- [map_type] parameter: set the mapping algorithm [hector].

Open the visualization interface (robot side)

```
roslaunch yahboom_navrobo_nav view_map.launch
```



The robot blocks a certain range of radar data. The blocking range can be adjusted or not blocked according to the actual situation. For specific operations, see [01. Radar Basic Course].

6.2.2, Control the robot

- Use the keyboard to control the robot's movement

```
roslaunch yahboom_navrobo_ctrl yahboom_keyboard.launch # Custom
```

- Use the remote control of the aircraft model to control the robot's movement

Make the robot walk through the area to be mapped and make the map as closed as possible.

There may be some scattered points during the mapping process. If the mapping environment is well closed, regular, and moves slowly, the scattering phenomenon will be much smaller.

6.2.3, Map Saving

```
# The first method
rosrun map_server map_saver -f /home/yahboom/YBAMR-COBOT-EDU-
00001/src/yahboom_navrobo_nav/maps/my_map
# The second method
bash /home/yahboom/YBAMR-COBOT-EDU-00001/src/yahboom_navrobo_nav/maps/map.sh
```

The map will be saved to the /home/yahboom/YBAMR-COBOT-EDU-00001/src/yahboom_navrobo_nav/maps/ folder, a pgm picture, a yaml file.

mymap.yaml

```
image: mymap.pgm
resolution: 0.05
origin: [-15.4,-12.2,0.0]
negate: 0
occupied_thresh: 0.65
free_thresh:  0.196
```

Parameter analysis:

- image: the path of the map file, which can be an absolute path or a relative path
- resolution: the resolution of the map, meters/pixels
- origin: the 2D pose (x, y, yaw) of the lower left corner of the map, where yaw is rotated counterclockwise (yaw=0 means no rotation). Currently, many parts of the system ignore the yaw value.
- negate: whether to reverse the meaning of white/black and free/occupied (the interpretation of the threshold is not affected)
- occupied_thresh: pixels with an occupation probability greater than this threshold will be considered fully occupied.
- free_thresh: Pixels with an occupancy probability less than this threshold are considered completely free.

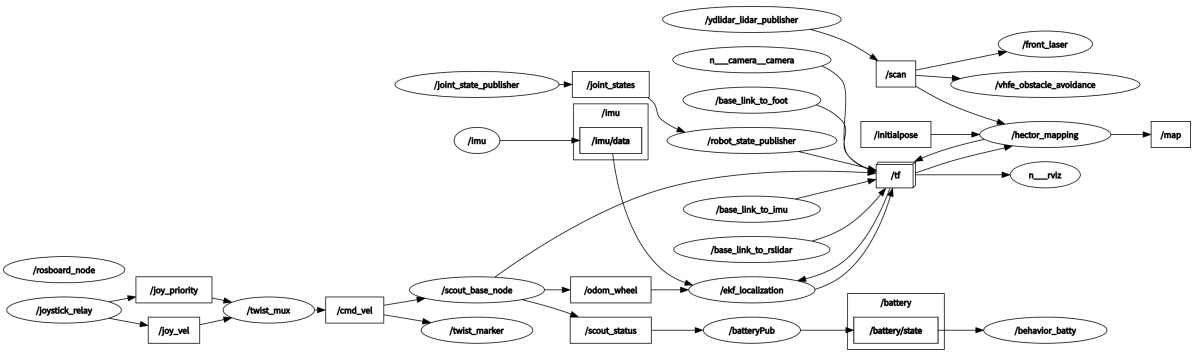
6.3. Topics and Services

Topic Subscription	Type	Description
scan	sensor_msgs/LaserScan	Depth data scanned by the laser radar
syscommand	std_msgs/String	System command. If the string equals "reset", the map and robot pose are reset to the initial state
Topic Publish	**Type**	**Description**
map_metadata	nav_msgs/MapMetaData	Publish map meta data
map	nav_msgs/OccupancyGrid	Publish map grid data
slam_out_pose	geometry_msgs/PoseStamped	Robot pose estimation without covariance
poseupdate	geometry_msgs /PoseWithCovarianceStamped	Robot pose estimation with Gaussian uncertainty estimation
Service	**Type**	**Description**
dynamic_map	nav_msgs/GetMap	Get map data
reset_map	std_srvs/Trigger	Call this service to reset the map, hector will create a brand new map from scratch. Note that this will not restart the robot's pose, it will restart from the last recorded pose.
pause_mapping	std_srvs/SetBool	Call this service to stop/start processing the laser scan.

Topic Subscription	Type	Description
restart_mapping_with_new_pose	hector_mapping/ResetMapping	Call this service to reset the map, robot pose, and restore the map (if paused)

Node View

```
rqt_graph
```



6.4, Configuration Parameters

Parameter	Type	Default Value	Description
~base_frame	String	"base_link"	Robot base coordinate system, used for positioning and laser scanning data transformation
~map_frame	String	"map"	Map coordinate system
~odom_frame	string	"odom"	Odometer coordinate system (essentially the coordinate system pointed to by map)
~map_resolution	Double	0.025(m)	Map resolution, edge length of grid unit
~map_size	Int	1024	Map size
~map_start_x	double	0.5	/map origin [0.0, 1.0] relative to the grid map on the x-axis
~map_start_y	double	0.5	/map origin [0.0, 1.0] relative to the grid map on the y-axis
~map_update_distance_thresh	double	0.4(m)	Map update threshold, from the start of an update to the straight distance reaching this parameter value on the map, update again
~map_update_angle_thresh	double	0.9(rad)	Map update threshold, from the start of an update to the rotation reaching this parameter value on the map, update again
~map_pub_period	double	2.0	Map publishing period
~map_multi_res_levels	int	3	Map multi-resolution grid levels

Parameter	Type	Default Value	Description
~update_factor_free	double	0.4	Used to update the map of free cells, the range is [0.0, 1.0]
~update_factor_occupied	double	0.9	Used to update the map of occupied cells, the range is [0.0, 1.0]
~laser_min_dist	double	0.4(m)	The minimum distance of the laser scan point, scan points less than this value will be ignored
~laser_max_dist	double	30.0(m)	The maximum distance of the laser scan point, scan points less than this value will be ignored
~laser_z_min_value	double	-1.0(m)	Relative to the minimum height of the laser radar, scan points below this value will be ignored
~laser_z_max_value	double	1.0(m)	Relative to the maximum height of the laser radar, scan points above this value will be ignored
~pub_map_odom_transform	bool	true	Whether to publish the coordinate transformation between map and odom
~output_timing	bool	false	Process the output timing information of each laser scan through ROS_INFO
~scan_subscrible_queue_size	int	5	The queue size of the scan subscriber
~pub_map_scanmatch_transform	bool	true	Whether to publish the coordinate transformation between scanmatcher and map

Parameter	Type	Default Value	Description
~tf_map_scanmatch_transform_frame_name	String	"scanmatcher_frame"	Scanmatcher coordinate system name

6.5, TF transformation

Required TF transformation	Description
laser-->base_link	Usually a fixed value, the transformation between the laser radar coordinate system and the base coordinate system, generally published by robot_state_publisher or static_transform_publisher
Published TF transformation	**Description**
map-->odom	The current estimate of the robot pose in the map frame (only provided when the parameter "pub_map_odom_transform" is true).

View tf tree

```
rosrun rqt_tf_tree rqt_tf_tree
```