Hector SLAM

算法原理

使用occupancy grid maps, 实时构建跟新地图. 每个激光点落在栅格地图上都会得到一个打分, 使用高斯牛顿法最大化分值.
关键公式:

得分双线性插值:

$$M(P_m) \approx \frac{y-y_0}{y_1-y_0}(\frac{x-x_0}{x_1-x_0}M(P_{11}) + \frac{x_1-x}{x_1-x_0}M(P_{01})) + \frac{y_1-y}{y_1-y_0}(\frac{x-x_0}{x_1-x_0}M(P_{10}) + \frac{x_1-x}{x_1-x_0}M(P_{00}))$$

梯度双线性插值:

$$\frac{\partial M}{\partial x}(P_m) \approx \frac{y-y_0}{y_1-y_0}(M(P_{11}) - M(P_{01})) + \frac{y_1-y}{y_1-y_0}(M(P_{10}) - M(P_{00}))$$
$$\frac{\partial M}{\partial y}(P_m) \approx \frac{x-x_0}{x_1-x_0}(M(P_{11}) - M(P_{10})) + \frac{x_1-x}{x_1-x_0}(M(P_{01}) - M(P_{00}))$$

目标函数:

$$\sum_{i=1}^{n}[1 - M(S_i(\xi)) - \nabla M(S_i(\xi))\frac{\partial S_i(\xi)}{\partial \xi}\Delta\xi))]^2 \to 0$$

得到2D的位姿(x, y, ϕ), 再通过 **EKF**, 与里程计IMU推导的位姿做融合.

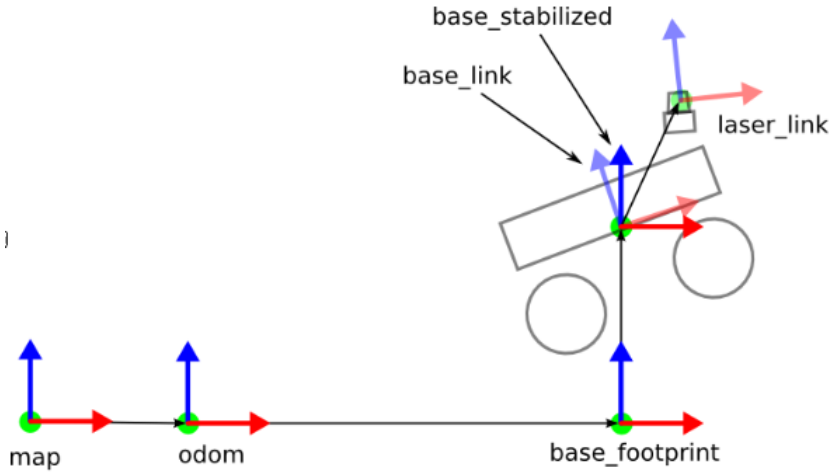
安装运行

论文中使用的测试配置:

- 编译安装
  下载代码放入ros工作空间, `catkin_make` 即可, 为了在qt5上编译, 对CMake文件需要做一定的修改, 并将include头文件由 `QtGui/QApplication` 改为 `QtWidgets/QApplication` .
- 测试运行
  修改 `hector_slam/hector_slam_launch/launch/tutorial.launch` , 添加rosbag播放node:

```
<?xml version="1.0"?>

<launch>

<arg name="geotiff_map_file_path" default="$(find hector_geotiff)/maps"/>

<param name="/use_sim_time" value="true"/>

<node pkg="rviz" type="rviz" name="rviz"
    args="-d $(find hector_slam_launch)/rviz_cfg/mapping_demo.rviz"/>

<include file="$(find hector_mapping)/launch/mapping_default.launch"/>

<include file="$(find hector_geotiff)/launch/geotiff_mapper.launch">
    <arg name="trajectory_source_frame_name" value="scanmatcher_frame"/>
    <arg name="map_file_path" value="$(arg geotiff_map_file_path)"/>
</include>

<!-- add ros bag play node -->
<node name="playbag" pkg="rosbag" type="play"
    args="--clock Team_Hector_MappingBox_Dagstuhl_Neubau.bag"/>
</launch>
```

ros input message的配置



}

gmapping数据集的运行, 对 `hector_slam/hector_mapping/launch/mapping_default.launch` 文件做如下修改:

```
<arg name="base_frame" default="base_footprint"/>
<arg name="odom_frame" default="odom"/>
<arg name="pub_map_odom_transform" default="true"/>
<arg name="scan_subscriber_queue_size" default="5"/>
<arg name="scan_topic" default="base_scan"/>
```

一个关键参数关于multi_res层数, 当测试intel lab数据时, 由于激光帧率低, 初始位姿不够好, 因此通过更多的层数来确保鲁棒性.

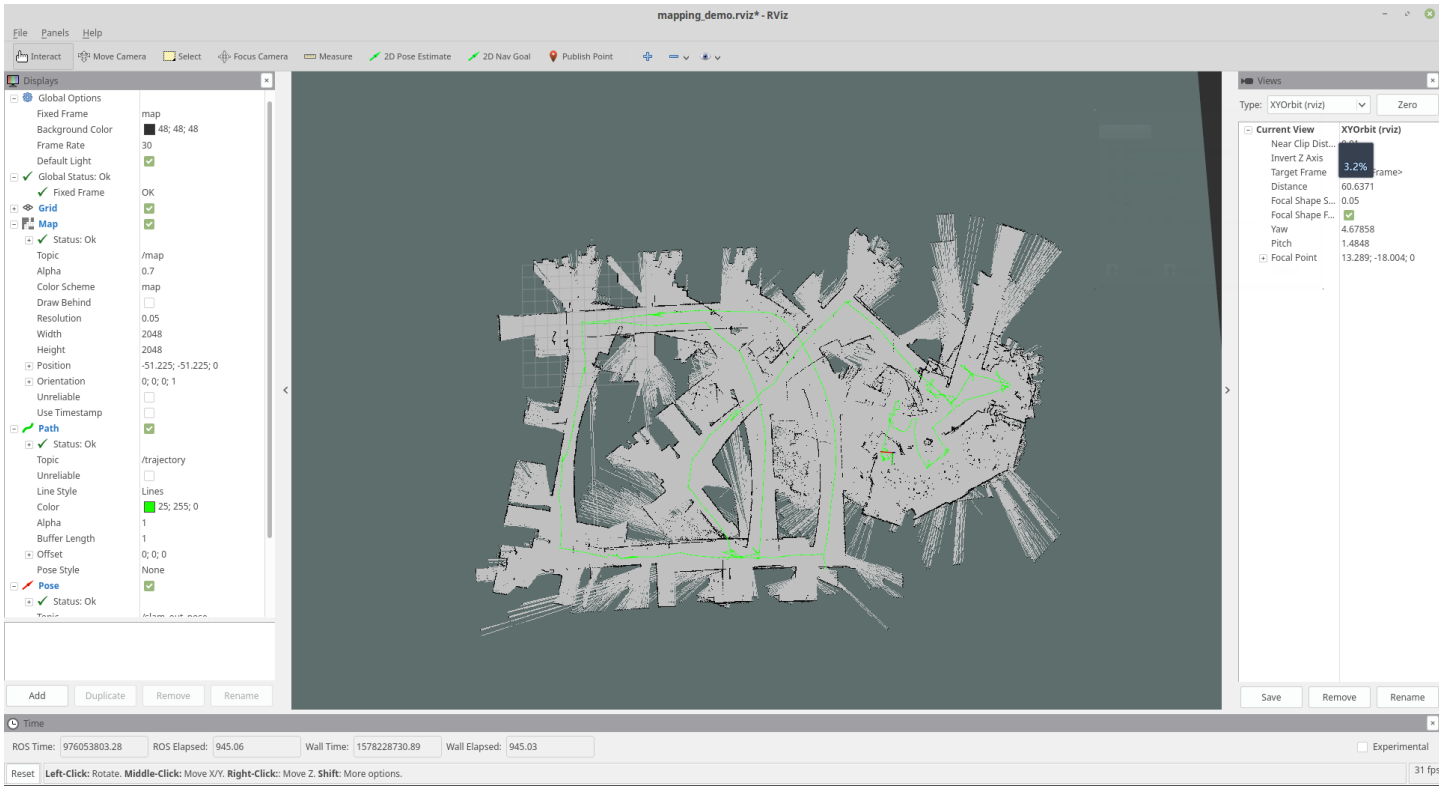
```
<param name="map_multi_res_levels" value="5" />
```

运行

```
roslaunch hector_slam_launch wegatron_scan2d.launch
```

测试

hector slam的激光配准很依赖于初始值, 效果较差, 这个和之前的实验结果一致(有比较大的优化空间). 由于没有回环检测, 因此在后期无法校正.
intel lab数据:



Reference

如何使用hector slam算法包
hector slam ros package