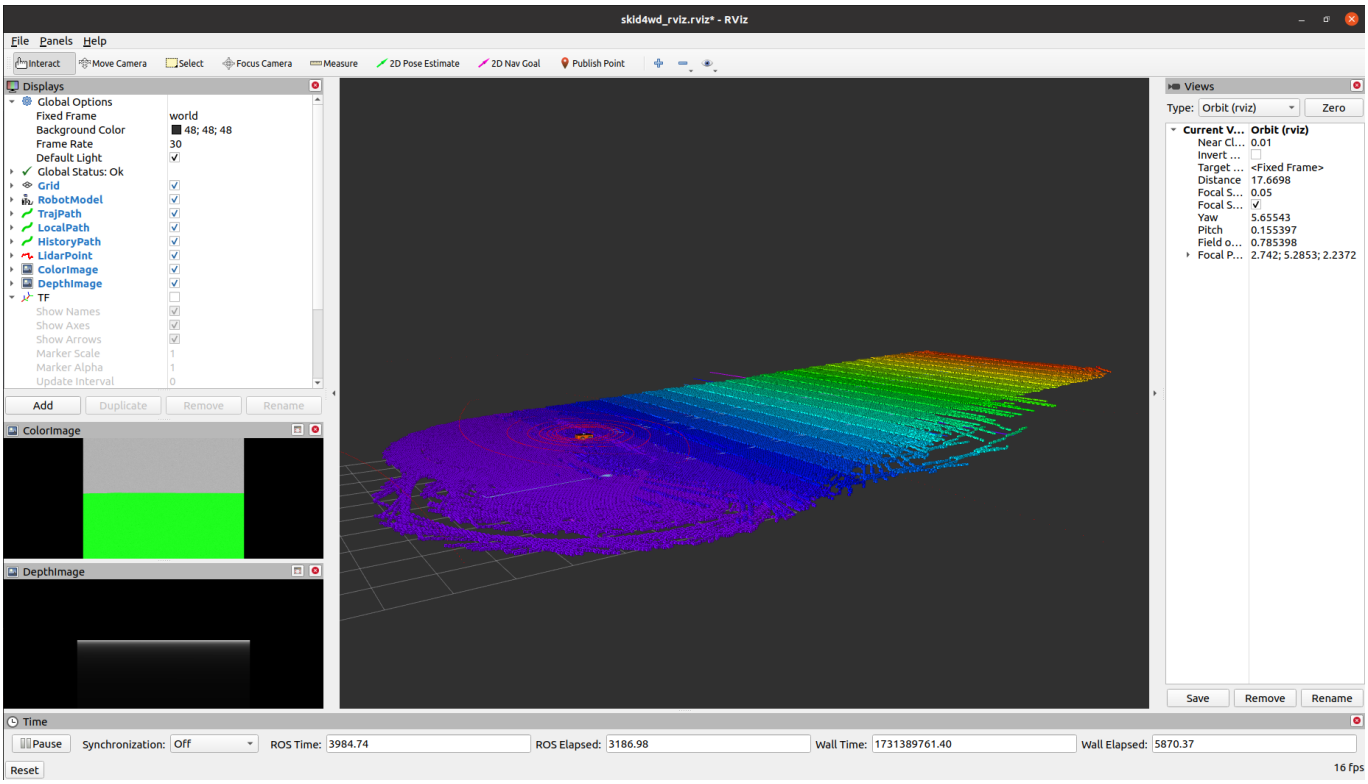
四轮差速仿真环境搭建方法

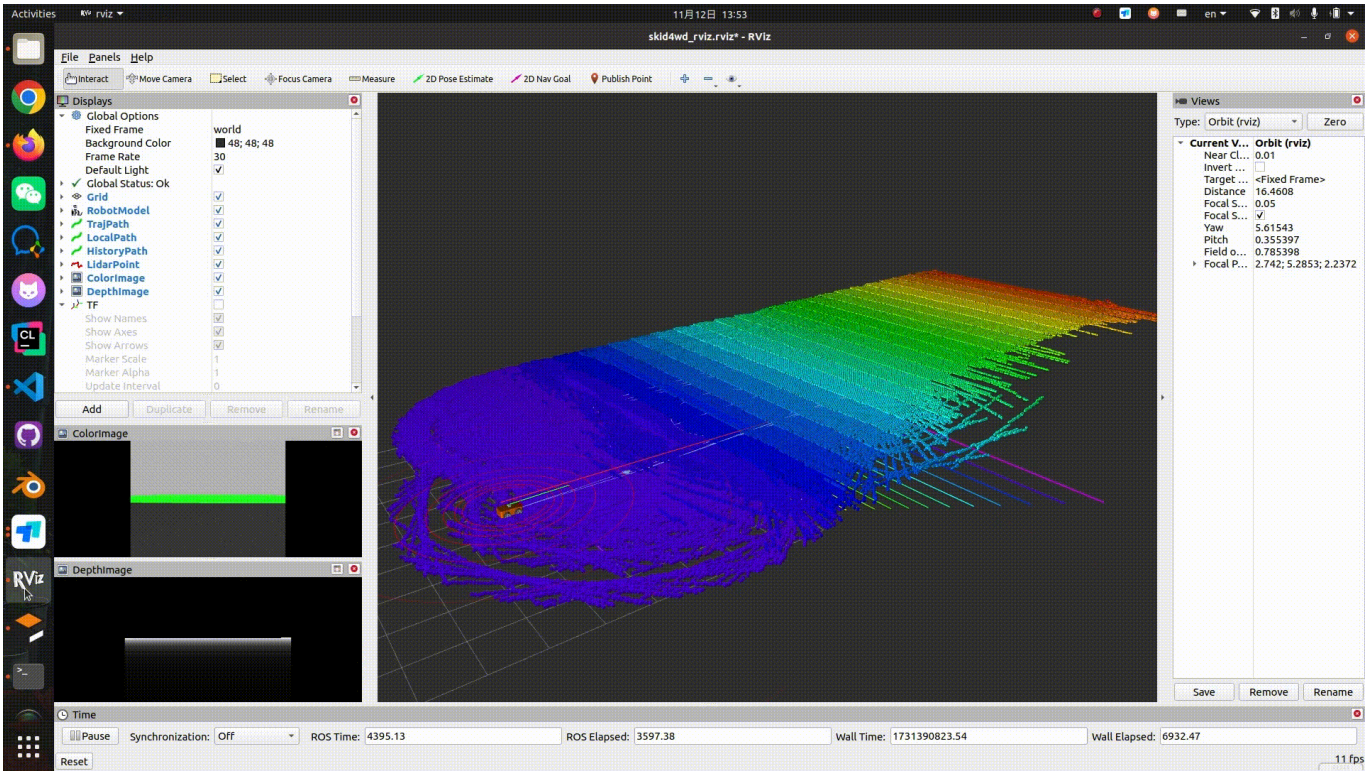
包含两个package: `mpc_follower`和`skid4wd_description`

- `mpc_follower`：使用MPC建立的planner和controller；发布参考轨迹。
- `skid4wd_description`：主要用于搭建Gazebo环境中的车辆模型和环境模型，并处理里程计信息。车辆模型中包含两种传感器：IMU,二维激光雷达和Intel D435深度相机，但控制过程中用到的里程计信息是Gazebo中模型的位置和姿态。环境模型采用Blender进行建立，对应Blender文件在`skid4wd_description/urdf/terrain.blend`。

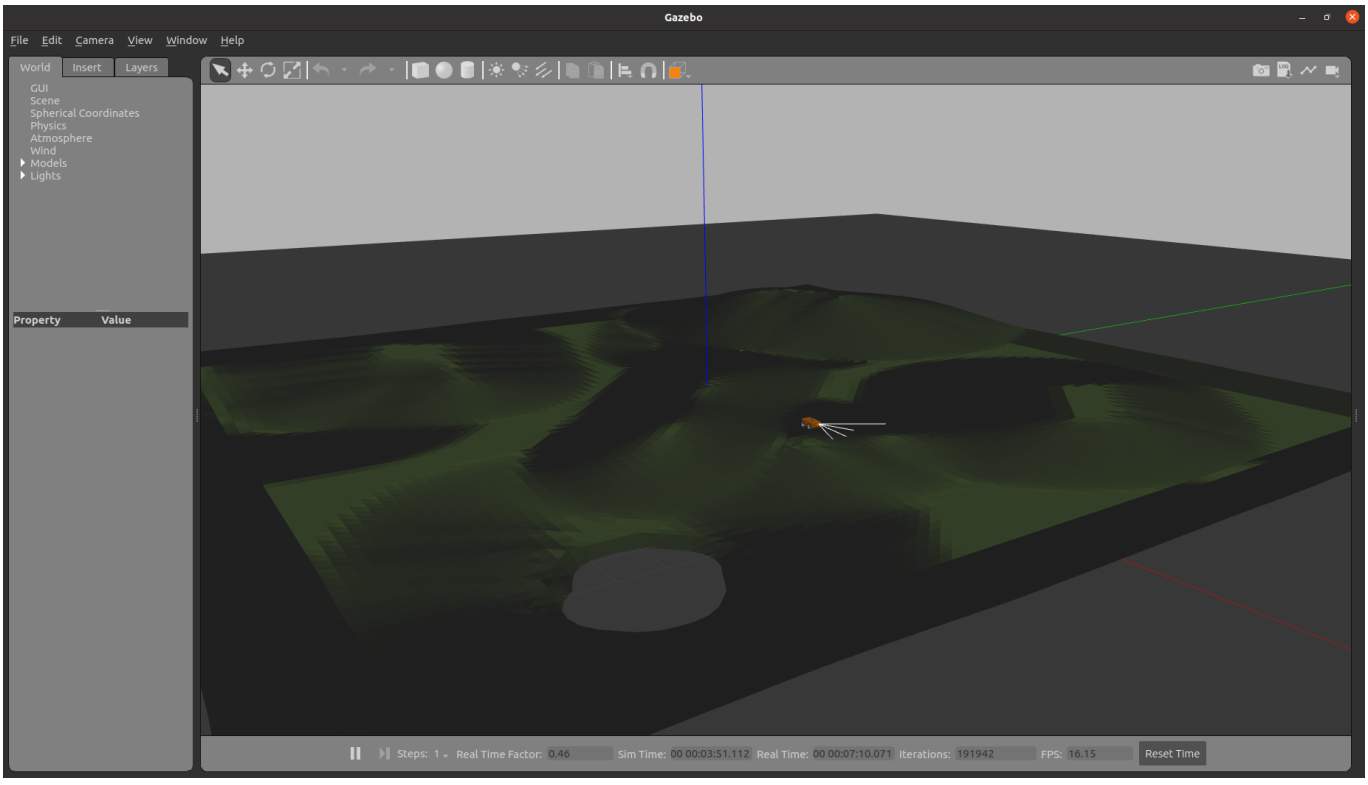
rviz静态显示效果:



rviz动态显示效果:



gazebo复杂地形:



1.环境依赖安装

安装MPC控制器的优化库依赖包

```
pip3 install casadi
```

安装rtabmap 建图依赖包

```
sudo apt install ros-noetic-rtabmap
sudo apt install ros-noetic-rtabmap-*
```

安装rviz octomap地图可视化插件

```
sudo apt-get install ros-noetic-octomap-rviz-plugins
```

2.仿真环境运行

将建立的地形模型复制到gazebo模型库所在位置

```
cd src/skid4wd_description/meshes/
cp -r Lawn/ ~/.gazebo/models
```

编译并添加环境

```
cd $your workspace$
catkin_make
source devel/setup.bash
```

运行斜坡仿真环境

```
roslaunch skid4wd_description sim_with_controller.launch
```

新建另外一个终端，运行建图文件,借助rtabmap和深度相机进行坡度建图

```
roslaunch skid4wd_description rs_rtabmap_d435.launch
```

新建另外一个终端，控制小车运动。包含两种控制模式：GUI控制和mpc_follower工具包控制，**两者选一个即可**

```
roslaunch skid4wd_description rqt_steering.launch   # GUI控制
roslaunch skid4wd_description mpc_planner.launch    # mpc_follower工具包控制
```

3. 文件结构

```
.
├── CMakeLists.txt -> /opt/ros/noetic/share/catkin/cmake/toplevel.cmake
├── figure
│   ├── gazebo.png
│   ├── map.png
│   ├── plotjuggler.png
│   └── rviz.png
├── mpc_follower                    # MPC Planner Package
│   ├── CMakeLists.txt
│   ├── launch
│   ├── package.xml
│   ├── scripts
│   │   ├── local_planner.py        # MPC_Traj_follower Node
│   │   ├── MPC.py                  # MPC class
│   │   └── traj_generate.py        # Generate Reference Trajectory Node
│   └── src
├── README.md
├── realsense_ros_gazebo         # realsense Package
└── skid4wd_description          # skid4wd Model and World Package
    ├── CMakeLists.txt
    ├── config
    │   ├── controller.yaml
    │   └── skid4wd_rviz.rviz
    ├── launch
    │   ├── controller.launch
    │   ├── mpc_planner.launch
    │   ├── rqt_steering.launch
    │   ├── rs_rtabmap_d435.launch
    │   ├── sim_with_controller.launch
    │   └── spawn.launch
    ├── meshes                   # car model and environment model
    │   ├── base_link.stl
    │   ├── Lawn                 # Lawn Model
    │   │   ├── model.config
    │   │   └── model.sdf
    │   ├── livox-mid360.dae
    │   ├── wheel.dae
    │   ├── wheel_front_left_1.stl
    │   ├── wheel_front_right_1.stl
    │   ├── wheel_rear_left_1.stl
    │   └── wheel_rear_right_1.stl
    ├── package.xml
    ├── scripts
    │   └── odom_process.py
    ├── urdf
    │   ├── livox_mid360.urdf.xacro
    │   ├── materials.xacro
    │   ├── skid4wd.gazebo
    │   ├── skid4wd.trans
    │   ├── skid4wd.xacro
    │   ├── terrain.blend
    │   └── terrain.dae
    └── worlds
```

```
        ├── box_house.world
        ├── hometown_room.world
        ├── lawn_world.world
        └── slope_world.world
```

4.数据曲线显示工具

4.1 rqt_plot 实时查看运行数据

```
rosrun rqt_plot rqt_plot
```

4.2 plotjuggler 查看rosbag离线数据包

安装PlotJuggler：

```
sudo apt-get install ros-noetic-plotjuggler
```

安装ros插件（不安装的话应该打不开.bag文件）

```
sudo apt-get install ros-noetic-plotjuggler-msgs ros-noetic-plotjuggler-ros
```

启动plotjuggler：

```
rosrun plotjuggler plotjuggler
```


PlotJuggler
App Tools Help
File
加载rosbag包
Data:
保存和加载配置文件
Layout:
Streaming
UDP Server
Start
Buffer:
5
Publishers
CSV Exporter
重新发布toptic话题
ROS /rosout Visualization
ROS Topic Re-Publisher
Timeseries List
Filter...
105 of 105
Values
rosbag包中的话题
imu
data
angular_velocity
x
y
z
angular_velocity_covariance[0;0]
angular_velocity_covariance[0;1]
angular_velocity_covariance[0;2]
angular_velocity_covariance[1;1]
angular_velocity_covariance[1;2]
angular_velocity_covariance[2;2]
header
linear_acceleration
linear_acceleration_covariance[0;0]
linear_acceleration_covariance[0;1]
linear_acceleration_covariance[0;2]
linear_acceleration_covariance[1;1]
linear_acceleration_covariance[1;2]
linear_acceleration_covariance[2;2]
orientation
orientation_covariance[0;0]
orientation_covariance[0;1]
Custom Series:
IMU
1:1
一个窗口可以显示多个变量
/imu/data/linear_acceleration/x
/imu/data/linear_acceleration/y
/imu/data/linear_acceleration/z
托过来可以在窗口中监视话题变量
/imu/data/angular_velocity/x
/imu/data/angular_velocity/y
/imu/data/angular_velocity/z
rosbag播放条
0.000
Speed:
1.0
Step size:
0.000