

ubuntu16.04kinetic + realsenseD435i相机 + UR3的手眼标定_运维_txy12029047的博客-CSDN博客

一、前期准备

首先，在完成这篇博客涉及到的工作之前，参考了以下博主的链接。在此，向他们辛勤的付出 表示深深的感谢~~~~

realsenseD435i相机标定的链接 https://blog.csdn.net/weixin_40628128/article/details/95945945 这条链接强烈推荐~~~~~

手眼标定的相关链接 https://blog.csdn.net/weixin_40799950/article/details/83657626

<https://blog.csdn.net/zhong970187013/article/details/81098175>

https://blog.csdn.net/sinat_23853639/article/details/80276848

<http://www.pjianshen.com/article/3722406638/>

<https://zhuanlan.zhihu.com/p/33441113>

<https://zhuanlan.zhihu.com/p/33777424>

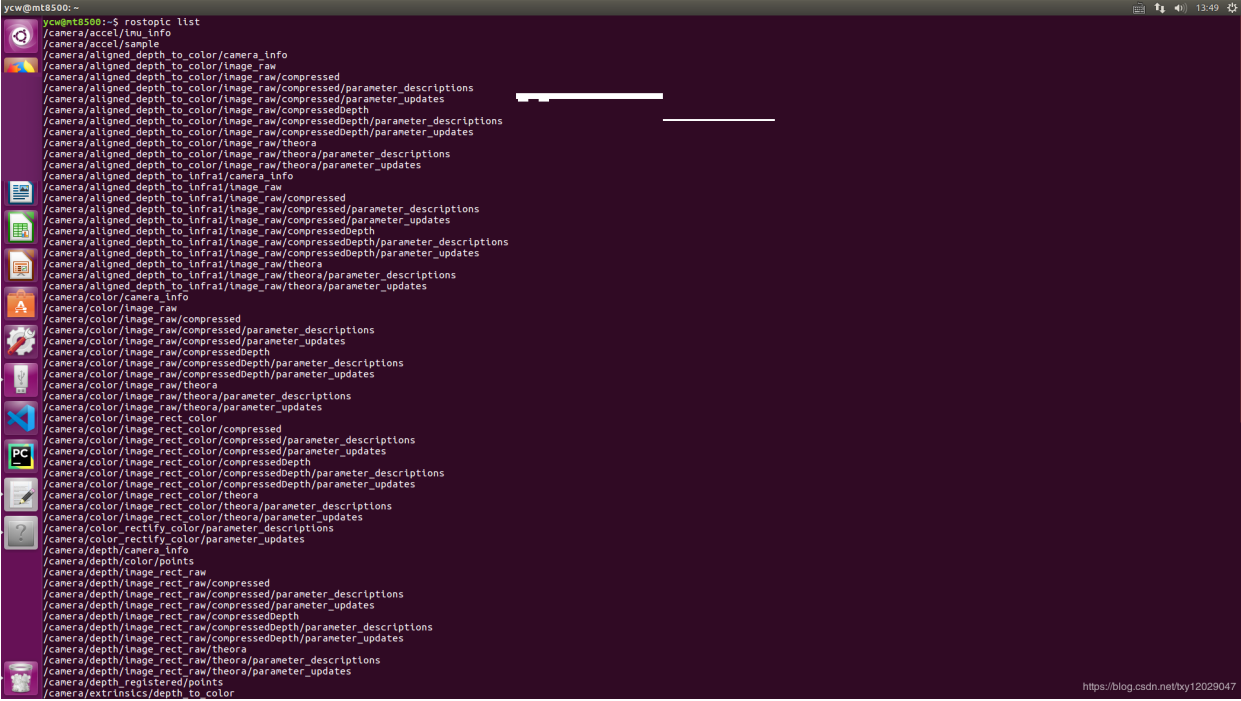
其次，在进行手眼标定前需要安装easy_handeye aruco_ros vision_visp等便于实现手眼标定的功能包。具体的安装步骤参见如上链接提供的方法。

成功安装这些依赖项之后，根据easy_handeye/docs/example_launch/ur5_kinect_calibration.launch 提供的文件编写自己启动标定程序时用到的 launch文件。博主这里面使用的文件命名:ur3_realsense_calibration.launch。该文件内容如下:

```
1.
2. <arg name="namespace_prefix" default="ur3_realsense_handeyecalibration" />
3.
4. <arg name="robot_ip" doc="The IP address of the UR5 robot" />
5.
6. <arg name="marker_size" doc="Size of the ArUco marker used, in meters" default="0.15" />
7. <arg name="marker_id" doc="The ID of the ArUco marker used" default="582" />
8.
9.
10.
11.
12.
13.
14.
15. <node name="aruco_tracker" pkg="aruco_ros" type="single">
16. <remap from="/camera_info" to="/camera/color/camera_info" />
17. <remap from="/image" to="/camera/color/image_raw" />
18. <param name="image_is_rectified" value="true"/>
19. <param name="marker_size" value="0.15"/>
20. <param name="marker_id" value="582"/>
21. <param name="reference_frame" value="camera_color_frame"/>
22. <param name="camera_frame" value="camera_color_frame"/>
23. <param name="marker_frame" value="camera_marker" />
24.
25.
26.
27.
28.
29.
30.
31.
32.
33.
34.
35.
36. <include file="$(find easy_handeye)/launch/calibrate.launch" >
37. <arg name="namespace_prefix" value="$(arg namespace_prefix)" />
38. <arg name="eye_on_hand" value="false" />
39.
40. <arg name="tracking_base_frame" value="camera_color_frame" />
41. <arg name="tracking_marker_frame" value="camera_marker" />
42. <arg name="robot_base_frame" value="base_link" />
43. <arg name="robot_effector_frame" value="wrist_3_link" />
44.
45. <arg name="freehand_robot_movement" value="false" />
46. <arg name="robot_velocity_scaling" value="0.5" />
47. <arg name="robot_acceleration_scaling" value="0.2" />
48.
49.
50.
```

在这文件里面为了避免出现一些不必要的问题，把启动相机的程序、启动机器人的程序屏蔽掉，实验时单独运行。

这里面标定板的ID是582，其可以在 aruco里面下载，标定板的尺寸单位是米。涉及到相机参数的映射关系时，需要启动相机节点，运行 rostopic list查找相机发布的话题，对应原文件里面的ur5_kinect_calibration.launch文件进行修改即可。



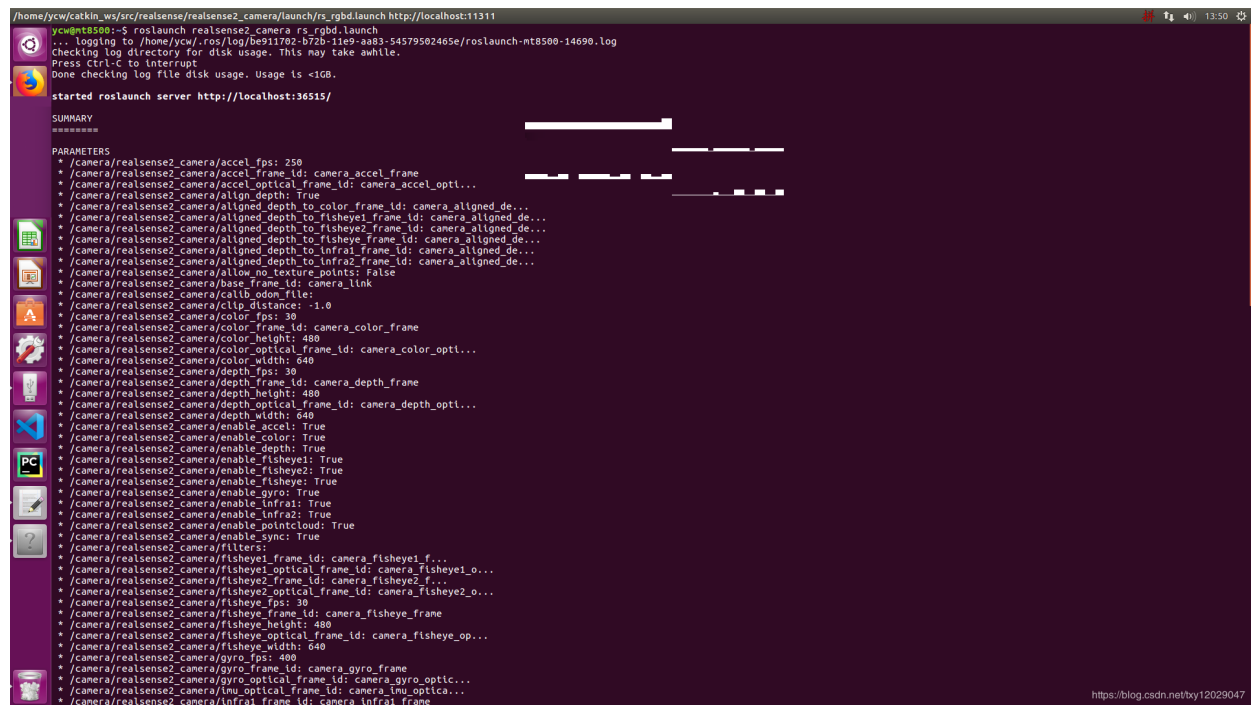
将修改好的launch文件放到与ur5_kinect_calibration.launch同一文件夹下。

二、标定过程

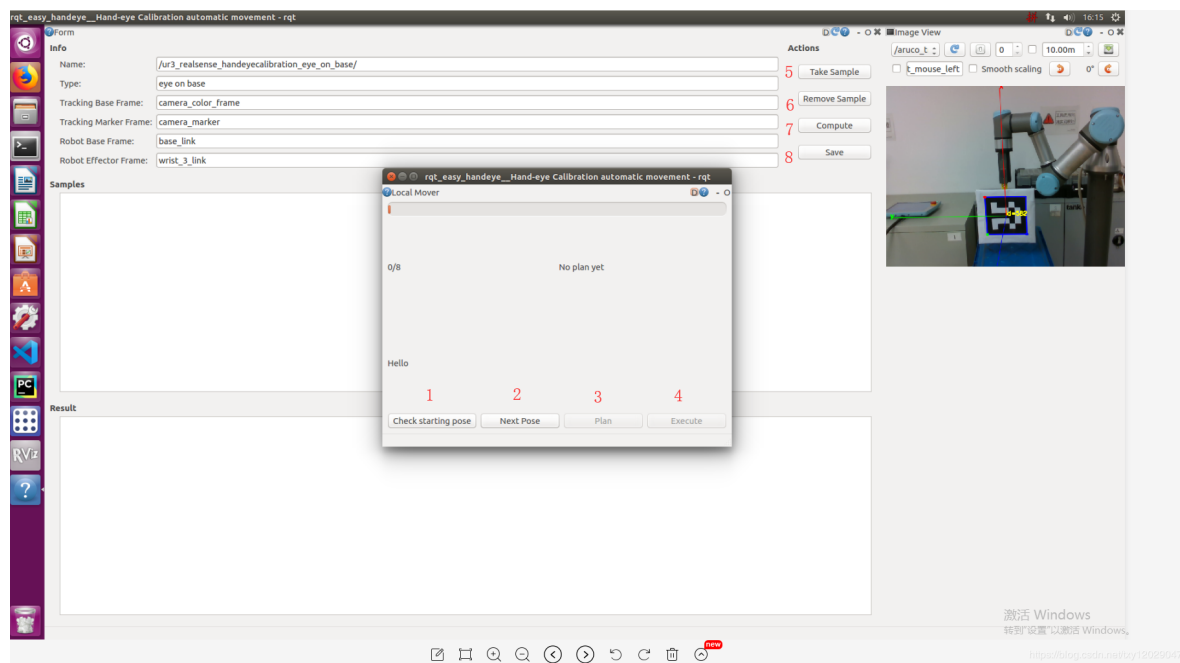
- 1、启动UR3机器人: roslaunch ur_modern_driver ur3_bringup.launch robot_ip:=192.168.1.196

通过 move it 控制机械臂动作 方式1:roslaunch ur3_moveit_config ur3_moveit_planning_execution.launch
roslaunch ur3_moveit_config moveit_rviz.launch config:=true
方式2:roslaunch ur3_moveit_config ur3_moveit_planning_execution.launch sim:=true

2、启动 realsenseD435i 相机 .roslaunch realsense2_camera rs_camera.launch

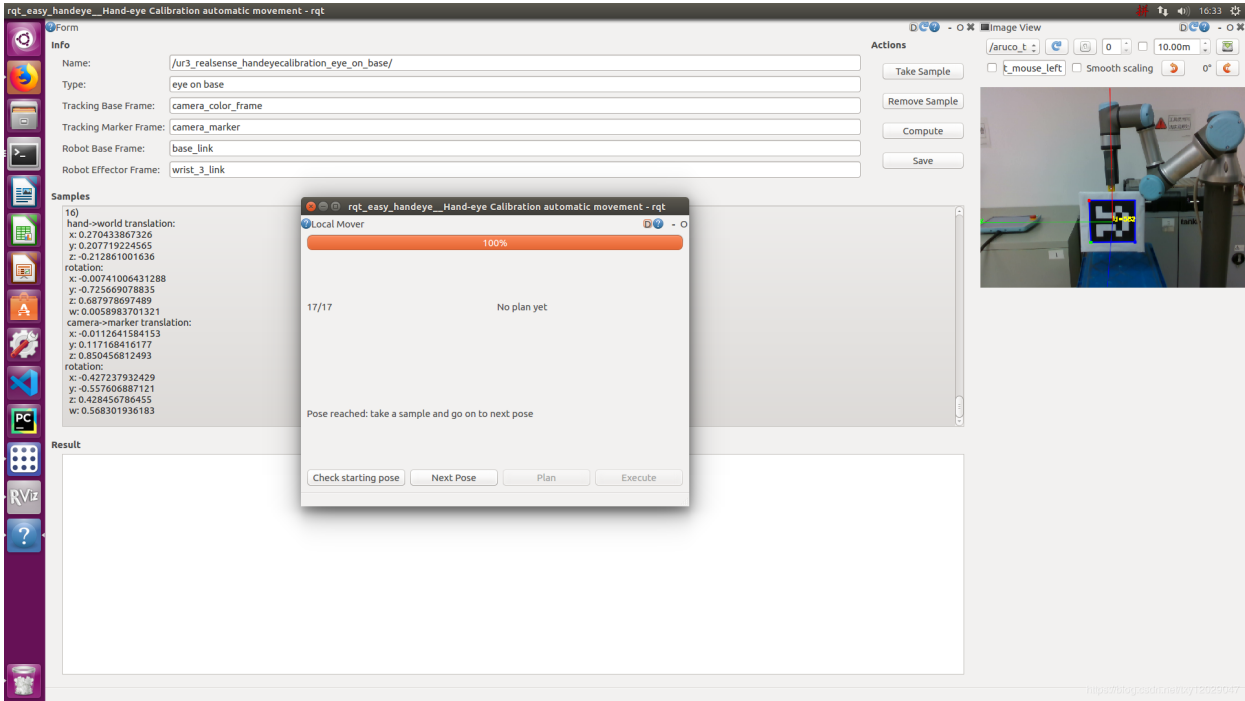


3、启动标定程序:roslaunch ur3_realsense_calibration.launch



在这里需要注意的是在启动这个launch文件时，需要打开rqt_easy_handeye菜单栏选择Plugins—visualization—image view，选择/aruco_tracker/result，使其显示标定板被识别的图像，这样在后续的采集过程中才能成功。

采集步骤为：1-2-3-4-5-2345（重复甚至全部采集完）-7-8（保存结果）一般是采集17次机器人的不同位置，也有采集8次的。后来我改成采集17次的了。采集17次之后的结果如下图所示：



4. 将标定的结果实时显示出来:

方式1:查看home隐藏文件夹.rqt/easy_handeye下标定结果文件yaml。将变换矩阵按照以下格式写 static_transform_publisher.launch文件改写一个实时 (100hz) 发布位置转换关系的launch文件, 放在easy_handeye/easy_handeye/launch(和之前的ur3_realsense_calibration.launch 在一个包里), 这里的args 分别对应x y z qx qy qz qw frame_id child_frame_id period_in_ms。

启动static_transform_publisher.launch文件 roslaunch static_transform_publisher.launch

1. <node pkg="tf" type="static_transform_publisher" name="Link1_broadcaster" args="0.7810954111863362 0.4362160638790268 0.16301827937001387 -0.20452635132067903 -0.7688849381709477 0.5396310162123635 0.275287649216088 base_link camera_link 100" />
2. <node pkg="tf" type="static_transform_publisher" name="Link1_broadcaster" args="0.7810954111863362 0.4362160638790268 0.16301827937001387 -0.20452635132067903 -0.7688849381709477 0.5396310162123635 0.275287649216088 base_link camera_link 100" />
- 3.

方式2:利用easy_handeye文件夹下面的publish.launch文件。将static_transform_publisher添加在该launch文件的末尾处, 如下:

- 1.
2. <node pkg="tf" type="static_transform_publisher" name="Link1_broadcaster" args="0.7810954111863362 0.4362160638790268 0.16301827937001387 -0.20452635132067903 -0.7688849381709477 0.5396310162123635 0.275287649216088 base_link camera_link 100" />

启动 roslaunch easy_handeye publish.launch eye_on_hand:=false namespace_prefix:=ur3_realsense_handeyecalibration即可将获得的手眼标定结果成功的发布出去。

```
you@mt8500:~$ roslaunch easy_handeye publish.launch eye_on_hand:=false namespace_prefix:=ur3_realsense_handeyecalibration
... logging to /home/you/.ros/log/c9404fde-b74e-11e9-aad3-54579502405e/roslaunch-mt8500-23197.log
Checking log directory for disk usage. This may take awhile.
Press Ctrl-C to interrupt
Done checking log file disk usage. Usage is 4GB.

started roslaunch server http://localhost:38735/

SUMMARY
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PARAMETERS
 * /roslaunch: kinetic
 * /rosversion: 1.12.14
 * /ur3_realsense_handeyecalibration_eye_on_base/eye_on_hand: False
 * /ur3_realsense_handeyecalibration_eye_on_base/inverse: False
 * /ur3_realsense_handeyecalibration_eye_on_base/robot_base_frame:
 * /ur3_realsense_handeyecalibration_eye_on_base/tracking_base_frame:

NOTES
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 /ur3_realsense_handeyecalibration_eye_on_base/
   handeye_publisher_mt8500_23197_4187236605042140357 (easy_handeye/publish.py)
 /
   link1_broadcaster (tf/static_transform_publisher)

ROS_MASTER_URI=http://localhost:11311

process[ur3_realsense_handeyecalibration_eye_on_base/handeye_publisher_mt8500_23197_4187236605042140357-1]: started with pid [23214]
process[link1_broadcaster-2]: started with pid [23215]
[INFO] [1565871679.938555]: loading calibration parameters into namespace /ur3_realsense_handeyecalibration
```

到现在为止, 机器人手眼标定的工作已全部结束, 欢迎各位小伙伴们留言评论, 大家共同进步~~~~~