How to get GitHub code

1. Create a directory for the code(for this example it will be named ros2_ws_groundtruth) with the following command

   mkdir ros2_ws_groundtruth

2. Use the following command to get into your directory

   cd ros2_ws_groundtruth

3. Source ROS in this directory with the following command

   source /opt/ros/humble/setup.bash

4. Create a src directory in your created directory with the following command

   mkdir src

5. Use the following command to get into the src directory

   cd src

6. Run the following command to clone the repository into this directory

   git clone https://github.com/ryanschofield9/Ground_Truth_Ros.git

7. Go back to the root of your directory by running the following command twice (you should be back in the directory you created in step 1)

   cd ..

8. Run the following command to build the package

   colcon build

9. Run the following command to source the built package

   source install/setup.bash

Setup Instructions

1. Turn on UR5e arm (make sure small circle in the left bottom corner of the tablet is green and not red or yellow)
2. Position arm in front of the branch

3. Move the wrist 3 joint to 0 degrees (can do so with move tab on the tablet)
4. Place level on the end-effector and move wrist 1joint until the end effector is level (bubble should be in the middle)
5. Open a terminal (will refer to as terminal 1). Move into the correct folder that has the ground_truth_ros code (on armfarm laptop use this command *cd ros2_ws_groundtruth*)
6. Source ROS in terminal 1 with the following command

   source /opt/ros/humble/setup.bash

7. Plug the ethernet cable from into arm and laptop
8. Run the following rviz command to connect to the arm. Change IP address as necessary

   ros2 launch ur_robot_driver ur5e.launch.py robot_ip:=169.254.177.220 use_fake_hardware:=false

9. On tablet load external control program and hit play
10. Open another terminal (will refer to as terminal 2)
11. Source ROS in terminal 2
12. In terminal 2 run the following moveit command

    ros2 launch ur_moveit_config ur_moveit.launch.py ur_type:=ur5e

13. Open another terminal (will refer to as terminal 3)
14. Source ROS in terminal 3
15. Source the colon build in terminal 3 with the following command

    source install/setup.bash

16. Plug in the camera and arduino USB
    a. You will need to make sure you have the right USB for the camera. The code is looking for USB 0.
17. In terminal 3, run the following to command to be able to get the Arduino data

    sudo chmod 777 /dev/ttyACM0
    Password on armfarm computer: grimmlins

18. In terminal 3 run the following command to publish the Arduino data in ROS

    ros2 run ground_truth pub_tof

19. Open another terminal (will refer to as terminal 4)
20. Source ROS in terminal 4
21. Source the colon build in terminal 4

22. In terminal 4 run the following command to publish the time of flight filters in ROS

    ros2 run ground_truth filter_tof

23. Open another terminal (will refer to as terminal 5)
24. Source ROS in terminal 5
25. Source the colon build in terminal 5
26. In terminal 5 run the following command to start the GUI

    ros2 run ground_truth Gui

27. Open another terminal (will refer to as terminal 6)
28. Source ROS in terminal 6
29. Source the colon build in terminal 6
30. In terminal 6 run the following command to run all other needed ROS nodes

    ros2 launch ground_truth ground_truth_launch.py

31. On the GUI hit the change controller button twice
32. Go to the rviz moveit window and in the bottom left corner of the rviz moveit window to save this starting position for future trials
33. Make sure to remove the cap on the camera.

What to do between runs to prepare for the next run

1. Change the controller to the scaled_joint_trajectory controller by hitting the change controller button (may have to hit the button twice, but in terminal 5 you can see which controller is activated each time you hit the button).
2. Go to the rviz moveit window and hit plan and execute
3. If you want to change starting positions
    a. Use the rviz moveit window to move the end effector in the x, y, z position
    b. Once in a good position, hit plan and execute
4. Continue the process in step 3 until you are in a good position
5. Make sure to hit reset in the bottom left corner of the rviz moveit window to save this starting position for the next trial

How to go through a run

1. On the GUI make sure the tree, branch, and trial number is correct
2. Make sure the end effector is at the right angle for the run (If the branch is a trunk, the angel should be 90 degrees. If not the angle should be 0). If the angle is wrong hit the rotate button on the GUI to get to the correct angle. After the rotation go to the rviz moveit window and in the bottom left corner of the rviz moveit window to save this starting position for future trials
3. Measure the distance from the branch and the TOF sensors. Enter that into the GUI

4. Measure the diameter of the branch. Enter that into the GUI
5. Hit Start on the GUI start the trial
6. A popup will appear that says “Is the contact pole disattached?”. Disattach the contact pole and hit yes on the popup (the trial will not start until you hit yes)
7. The arm will start moving and collecting time of flight data. The graph of the fillter TOF data will appear on the screen. You must close the graph to continue the trial
    a. If the data looks bad, go to the how to end a run mid-trial safely section
8. The arm will then take a video and perform optical flow. A graph will appear showing the frame of the video used for optical flow (upper right corner), the optical flow image (upper left corner), the processed optical flow image (lower left corner), and the scoring box chosen (lower right corner). You must close this graph to continue the trial.
    a. If the graph looks bad, go to the how to end a run mid-trial safely section
9. A popup will appear that says “Is the contact pole attached?”. Attach the contact pole and hit yes on the popup (the trial will not continue until you hit yes)
10. The arm will now move toward the branch until it makes contact with the branch
11. Enter the contact position of the contact pole (if center input “center”, if left of the center input “left”, if right of the center input “right”)
12. Enter any notes about the run as necessary (you can leave blank if you want
13. To save the data from this run, hit save on the GUI
14. If you are going to do another trial be sure to change the tree, branch, or trial number to make sure the data is saved correctly (if a trial with the 3 number the same is run, the data will not save).
15. If you want to end this session hit exit on the GUI. A popup will appear that says “Are you sure you want to exit?”. Hit “Yes” to exit
16. If an error occurs in the launch file during the run following the instructions in the how to end a run mid-trial safely section

How to end a run mid-trial safely (no data loss).

1. Run *cntrl c* in terminal 6 (terminal where launch file was run
2. Close any graphs that are open
3. If you stopped the run due to the graph of the TOF data looking bad
    a. Run *cntrl c* in terminal 3 and 4
    b. Rerun the following command in terminal 3

        ros2 run ground_truth pub_tof

    c. Rerun the following command in terminal 4

        ros2 run ground_truth filter_tof

4. Follow the instructions in the what to do between runs to prepare for the next run section