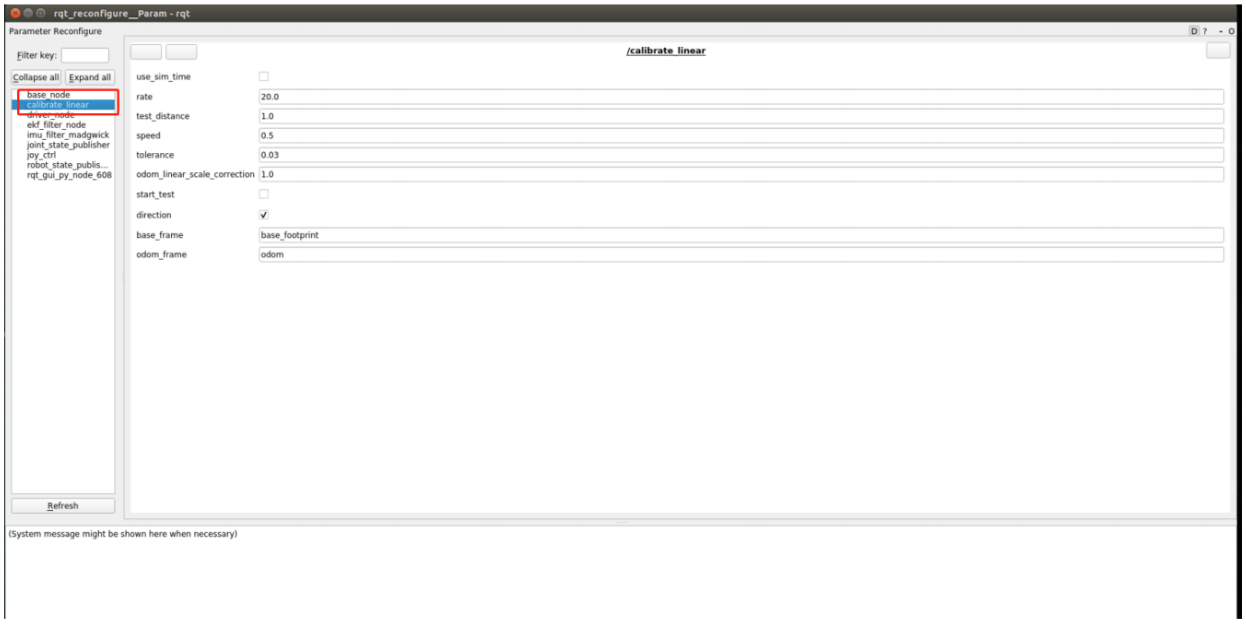
5、Robot calibration

After starting the program, combined with the encoder on the car, we can calibrate the linear and angular velocities of the car by adjusting the parameters

1、Run sample code

Taking our company's product Rosmaster-X3 as an example, the terminal enters the following command to start,

```
#Drive of chassis trolley
ros2 launch yahboomcar_bringup yahboomcar_bringup_X3_launch.py
#Calibrate the linear speed of the car
ros2 run yahboomcar_bringup calibrate_linear_X3
#Calibrated angular velocity
ros2 run yahboomcar_bringup calibrate_angular_X3
#Dynamic parameter adjustment
ros2 run rqt_reconfigure rqt_reconfigure
```



/calibrate_linear

use_sim_time	☐
rate	20.0
test_distance	1.0
speed	0.5
tolerance	0.03
odom_linear_scale_correction	1.0
start_test	☐
direction	✓
base_frame	base_footprint
odom_frame	odom

Taking the calibration of linear speed as an example, click on "start_test" to calibrate the linear speed in the x-direction of the car, and observe whether the car has moved the test_ The distance is set to 1m by default. The distance that can be customized for testing before calibration must be a decimal. After setting, click on the blank space and the program will automatically write it in. If the distance the car moves exceeds the acceptable error range (the value of the tolerance variable), then set odom_ Linear_ Scale_ The value of correction. The following are the meanings of each parameter.

parameter	Parameter Description
rate	Release frequency (without modification)
test_distance	Test line speed distance

parameter	Parameter Description
speed	The magnitude of linear velocity
tolerance	The size of acceptable error values
odim_linear_scale_correction	Coefficient of proportion
start_test	start test
direction	Direction (Linear speed test X (1) Y (0) direction)
base_frame	Monitor the parent coordinates of TF transformation
odom_frame	Monitor the sub coordinates of TF changes

The variable settings for testing angular velocity are generally consistent, but it is a test_ Distance changed to test_ Angle test angle and speed has changed to angular velocity size.

2、Analysis of program core source code

This program mainly uses TF to monitor the transformation between coordinates, by monitoring the base_ Coordinate transformation between footprint and odom to let the robot know "how far I have traveled/how many degrees I have turned"

```
#Monitoring TF transformation
def get_position(self):
    try:
        now = rclpy.time.Time()
        trans = self.tf_buffer.lookup_transform(self.odom_frame,self.base_frame,now)
    return trans
    except (LookupException, ConnectivityException, ExtrapolationException):
    self.get_logger().info('transform not ready')
    raise
    return
#Obtain the current xy coordinates and calculate the distance based on the previous
xy coordinates
self.position.x = self.get_position().transform.translation.x
self.position.y = self.get_position().transform.translation.y
print("self.position.x: ",self.position.x)
print("self.position.y: ",self.position.y)
distance = sqrt(pow((self.position.x - self.x_start), 2) +
    pow((self.position.y - self.y_start), 2))
distance *= self.odom_linear_scale_correction
```

Calibrate_ Angular_ The core code of X3 is as follows，

```
#Here we also monitor TF transformation and obtain the current position and attitude
information, but here we also do transformation, which converts Quaternion to Euler
angles,and then we'll go back
```

```
def get_odom_angle(self):
    try:
        now = rclpy.time.Time()
        rot = self.tf_buffer.lookup_transform(self.odom_frame,self.base_frame,now)
        #print("oring_rot: ",rot.transform.rotation)
        cacl_rot = PyKDL.Rotation.Quaternion(rot.transform.rotation.x,
        rot.transform.rotation.y, rot.transform.rotation.z,
rot.transform.rotation.w)
        #print("cacl_rot: ",cacl_rot)
        angle_rot = cacl_rot.GetRPY()[2]
        #print("angle_rot: ",angle_rot)
    except (LookupException, ConnectivityException, ExtrapolationException):
    self.get_logger().info('transform not ready')
    return
#Calculate rotation angle
self.odom_angle = self.get_odom_angle()
self.delta_angle = self.odom_angular_scale_correction *
self.normalize_angle(self.odom_angle - self.first_angle)
```

The published TF transformation is in base_ The code path for the node published by this node is as follows,

```
~/driver_ws/src/yahboomcar_base_node/src/base_node_X3
```

This node will receive/vel_ Raw's data, through mathematical calculations, was released for odom data, while TF transformation was also released. The core code is as follows,

```
//Calculate the value of xy coordinate and xyzw Quaternion. The xy two-point
coordinate represents the position, and the xyzw Quaternion represents the attitude

double delta_heading = angular_velocity_z_ * vel_dt_; //radians
double delta_x = (linear_velocity_x_ * cos(heading_)-
linear_velocity_y_*sin(heading_)) * vel_dt_; //m
double delta_y = (linear_velocity_x_ *
sin(heading_)+linear_velocity_y_*cos(heading_)) * vel_dt_; //m
x_pos_ += delta_x;
y_pos_ += delta_y;
heading_ += delta_heading;
tf2::Quaternion myQuaternion;
geometry_msgs::msg::Quaternion odom_quat ;
myQuaternion.setRPY(0.00,0.00,heading_ );
#Publish TF Transform
geometry_msgs::msg::TransformStamped t;
rclcpp::Time now = this->get_clock()->now();
t.header.stamp = now;
t.header.frame_id = "odom";
t.child_frame_id = "base_footprint";
t.transform.translation.x = x_pos_;
t.transform.translation.y = y_pos_;
t.transform.translation.z = 0.0;
t.transform.rotation.x = myQuaternion.x();
```

```
t.transform.rotation.y = myQuaternion.y();
t.transform.rotation.z = myQuaternion.z();
t.transform.rotation.w = myQuaternion.w();
tf_broadcaster_->sendTransform(t);
```