T-REX2.0 USER MANUAL

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Before powering the robot for the first time, any individual or organization must read and understand this information prior to using the equipment. For any questions regarding its operation, please contact us at support@agilex.ai. All assembly instructions and guidelines outlined in other sections of this manual must be strictly followed. Particular attention should be paid to the text related to warning signs.

Document Version

Version	Edition	Date	Editor	remarks
1	V1.0	2026/1/29	Khalil Lee	new document

Important Security Information

The information in this manual does not cover the design, installation, or operation of a complete robotic system, nor does it include all peripheral devices that may affect the safety of such a system. The design and use of the complete system must comply with the safety requirements established by the standards and regulations of the country where the robot is installed. Integrators and end-users of T-REX 2.0 are responsible for ensuring compliance with applicable national laws and regulations and for ensuring that the complete robotic application poses no significant hazards. This includes, but is not limited to, the following:

Effectiveness and Responsibility

- Conduct a risk assessment for the complete robotic system
- Connect the additional safety devices for other machinery as defined in the risk assessment
- Confirm that the design and installation of all peripheral devices for the entire robotic system, including both software and hardware systems, are accurate.
- This robot does not possess the complete set of safety features found in autonomous mobile robots, such as automatic collision prevention, fall prevention, and biological approach warning systems, though its capabilities extend beyond those described above. The relevant functions require integrators and end-users to conduct safety assessments in compliance with applicable regulations and feasible legal requirements, ensuring that the finalized robot poses no significant hazards or safety risks during practical deployment.
- Collect all documents from the technical documentation: including the risk assessment and this manual.
- Be aware of potential safety risks before operating and using the equipment.

Safety Precautions

- For first-time use, please read this manual carefully to understand the basic operating procedures and specifications.
- For remote operation, select a relatively open area for use. The vehicle itself does not come equipped with any automatic obstacle avoidance sensors.
- For use in ambient temperatures ranging from-10°C to 40°C.
- Unless the vehicle has a custom IP protection rating, its waterproof and dustproof rating is IP22.

Environment

- For first-time use, please read this manual carefully to understand the basic operating procedures and specifications.
- Use remote control operation in relatively open areas.
- For use in ambient temperatures ranging from-10°C to 40°C.

- Do not use in environments containing corrosive or flammable gases, or near combustible substances.
- Do not use around heaters or large winding resistors and other heat-generating components.
- It is recommended to use an altitude not exceeding 1000 meters.
- It is recommended that the daily temperature variation in the environment not exceed 25°C.

check up

- Ensure the battery is fully charged.
- Ensure there are no obvious abnormalities.
- Check whether the remote control's battery has sufficient charge.

Operational Instructions

- Ensure the surrounding area is relatively open during operation.
- Remote control within line-of-sight.
- When the device receives a low battery warning, charge it promptly.
- If the device malfunctions, stop using it immediately to avoid further damage.
- If the device malfunctions, contact the relevant technical staff. Do not attempt to resolve the issue yourself.

Battery Care Tips

- The T-REX 2.0 battery is not fully charged upon delivery. The current battery level can be checked via the LED indicator on the robot's rear. Do not wait until the battery is completely depleted before charging; recharge promptly when the battery level drops below 15% (indicated by the red battery indicator flashing). Storage conditions: The optimal storage temperature ranges from-10°C to 40°C. When the battery is not in use, it should be charged and discharged approximately once every month until reaching full voltage before storage. Never place the battery in direct contact with fire, heat it, or store it in high-temperature environments.
- Charging: The battery must be charged using the dedicated lithium battery charger or the optional charging station. Do not charge the battery below 0°C, and do not use batteries, power supplies, or chargers that are not the original manufacturer's standard components.

Safety Precautions

- If you have any questions about the usage, please follow the relevant instruction manual or consult the technical staff.

- Before operating the equipment, assess the on-site conditions to avoid safety incidents caused by improper operation.
- In an emergency, press the emergency stop button to shut off the power supply.
- Do not modify the internal device structure without technical support or permission.
- If the device malfunctions, stop using it immediately to avoid further damage.
- If the device malfunctions, contact the relevant technical staff. Do not attempt to resolve the issue yourself.

1. Introduction to T-REX 2.0

T-REX 2.0 is a programmable differential-wheel robot—a brushless motor-driven, variable-height adaptive off-road robot. Compared to conventional differential-wheel robots, T-REX 2.0 demonstrates significant advantages on ordinary concrete, asphalt, and uneven surfaces, offering higher speed and flexibility, enhanced adaptability to complex terrains, improved jumping capability, and extended single-trip endurance. Unlike foot-type robots, T-REX 2.0 not only moves faster but also enables obstacle crossing to some extent. Combining the strengths of both differential-wheel and foot-type robots, T-REX 2.0 is suitable for diverse complex terrains. Equipped with devices such as stereo cameras and LiDAR, it finds applications in unmanned inspection, security, scientific research, and education.

1.1 Product List

name	quantity
T-REX 2.0 Robot	×1
Battery charger (DC 24V)	×1
telecontroller	×1

1.2 Performance Parameters

parameter type	project	metric

Mechanical Parameters	Squat posture: length × width × height (mm)	266*335*215
	Standing posture: length × width × height (mm)	246*335*362
	Preparation weight (kg)	5.8
	Battery Type	Ternary lithium battery
	Battery Parameters	24V 5AH
	Power drive motor	2
	Left and right jaw motors	4
	Park mode	Servo brake
	Motion Type	2 wheel Differential
performance parameter	levels of protection	IP22
	Maximum safe speed (m/s)	1
	Minimum turning radius (mm)	0 mm (spin mode)
	Maximum climbing ability (°)	20°
	Obstacle clearance height (mm)	100
	load （kg）	< 1
	Maximum battery life (h)	2
	charging interval	2H
	Charging Method	Wired charging / Charging station charging / Rapid battery swapping
controlling parameter	control model	Remote Control Upper-level computer control mode
	telecontroller	Effective range: 50 m
	communication interface	Wired networks, wireless networks
	Secondary development interface	ROS2(Jetson Orin Nano)、CAN

1.3 Development Requirements

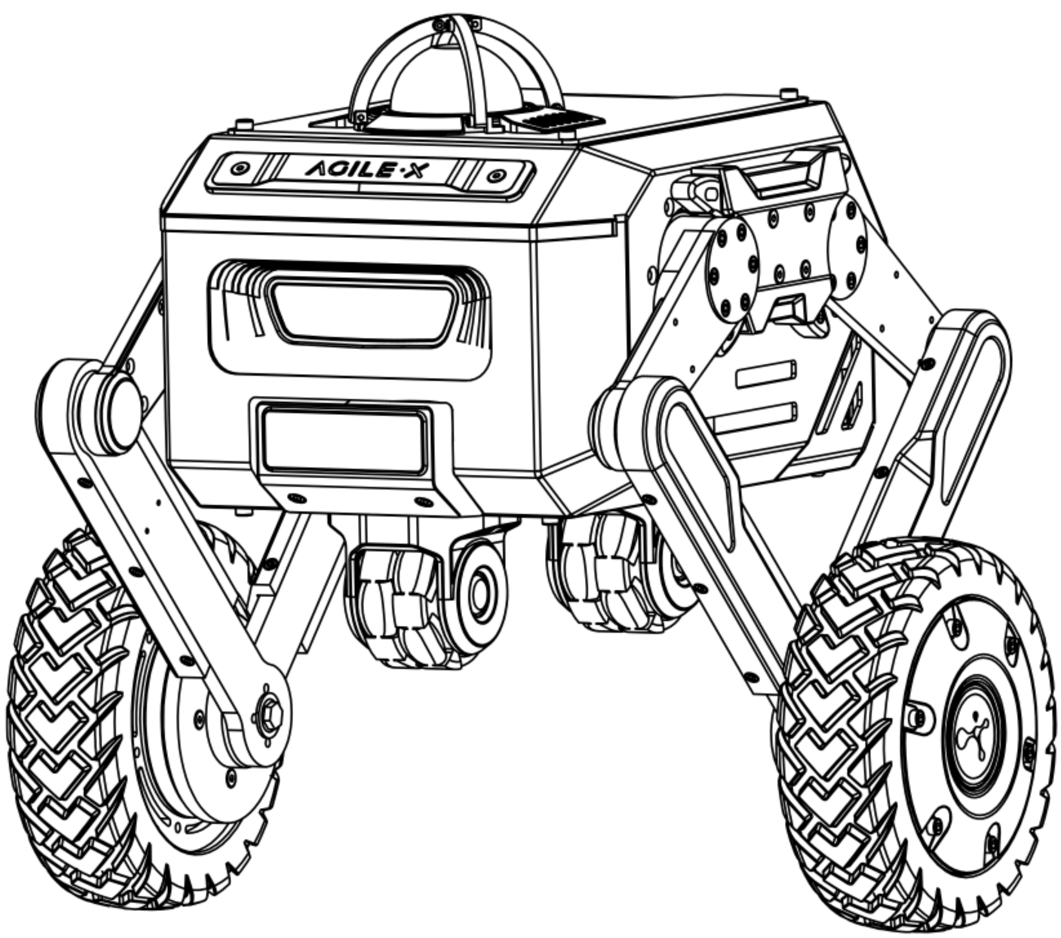
The T-REX 2.0 comes standard with a remote control, allowing users to operate the robot for mode switching, movement, and steering commands. Users can also perform secondary development using the ROS2 platform.

After powering on, you can connect a monitor, keyboard, and mouse via the HDMI port panel located on the rear of the T-REX 2.0.

After connecting, log in with: username: agilex password: agx

2. Basic Introduction

This section provides a basic introduction to the T-REX 2.0 differential-wheel-legged robot, enabling users and developers to gain a fundamental understanding of the system.



The T-REX 2.0 adopts an integrated and intelligent design philosophy, featuring a high-strength hub in its power module paired with a powerful direct-drive hub motor, enabling exceptional off-road capability and high-speed performance. Powered by high-torque joint motors, it moves flexibly across diverse terrains with adaptive capabilities. The T-REX 2.0 is more compact and aerodynamic, incorporating the Jetson Orin Nano platform at its rear for easy secondary development by customers.

2.1 Status Indicator

Users can determine the vehicle's status using the LED lights located at the rear of the robot. Specific parameters are listed in Table 2.1.

state	description
blue light	The current battery level information can be viewed via the LED light located on the rear of the robot.
Red light flashing	When the battery BMS SOC drops below 15%, the vehicle displays a flashing red light as an alert. If the SOC falls below 10%, the T-REX automatically cuts off the robot's power supply to prevent battery damage.
Detailed status information	Get via the ROS interface

Table 2.1 LED Display Light Information

2.2. Electrical Interface Specifications

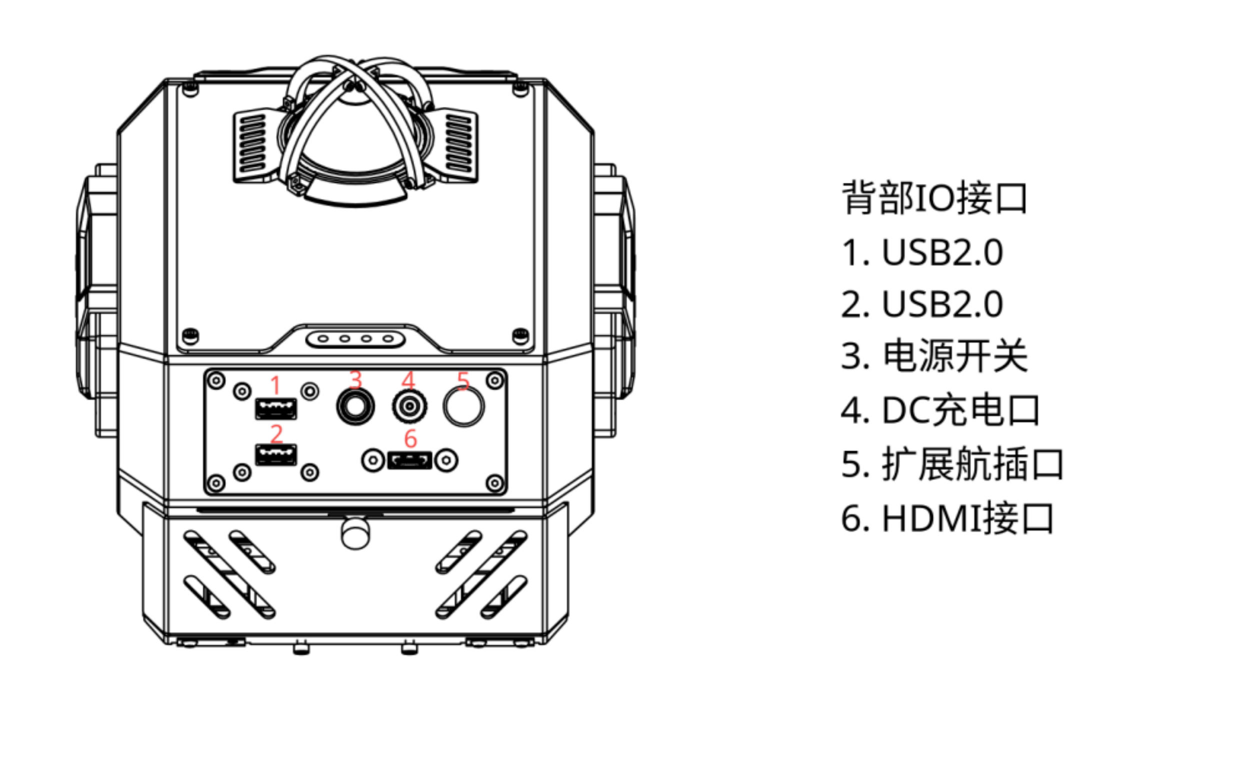


Figure 2.2.1 Tail View

The T-REX 2.0 robot features a DC interface at its rear. When the battery voltage falls below the safe threshold, power supply is automatically cut off. Users should note that before reaching this critical voltage, the robot's rear LED indicator will flash red to alert users, emphasizing the importance of maintaining proper charging during operation.

2.3. Remote Control Instructions

Figure 2.3.1 Schematic diagram of the remote control

As shown in the figure above, the button functions are defined as follows: SWB is the control mode selection lever—setting it to the top position activates the stop mode, the middle position activates the start mode, and the bottom position activates the navigation mode; to start the industrial computer, switch to the navigation mode first. SWC is the height control lever—setting it to the top position sets the highest posture, the middle position sets the intermediate posture, and the bottom position sets the lowest posture.

When the SWD is set to the top position, it moves freely at a fixed height; when set to the bottom position, it performs high-order free-height motion.

KEY1 button on the left side of the remote control back panel: One-touch jump

Zero point calibration:

First, set the SWA lever to the highest position; then set the SWB to the highest position; next, set the SWC to the highest position; finally, set the SWD to the highest position.

Press both joysticks simultaneously toward the center top of the remote control, then click the button on the left side of the remote's back panel. The buzzer sounding indicates successful setup.

3 Usage and Development

This section primarily covers the basic operations and usage of the T-REX 2.0 robot, detailing how to perform secondary development on the T-REX 2.0 robot using the Jetson Orin Nano platform and the Ubuntu operating system.

3.1 Usage and Operation

check up

Check the status of the T-REX 2.0 robot.

Check whether the T-REX 2.0 robot exhibits any obvious abnormalities; if so, contact after-sales support.

Start and shutdown:

The rear button is a power switch; pressing it turns on the power and activates the robot.

charge：

Check the battery voltage; the normal range is 24V. If the LED light at the rear of the robot flashes red, it indicates low battery voltage—charge promptly. This product comes with a built-in charger by default. Insert the charger's plug into the charging port on the chassis, connect it to the power source, and turn on the charger's switch to initiate charging.

3.2 T-REX 2.0 ROS User Manual

ROS provides standard operating system services, including hardware abstraction, low-level device control, implementation of common functions, inter-process messaging, and data packet management. Built on a graph-based architecture, ROS enables processes across different nodes to receive, publish, and aggregate various types of information (such as sensor data, control commands, status updates, and planning information).

Development Preparation

Hardware Preparation

● Laptop X1

● T-REX 2.0 Robot X1

Use the example environment for explanation

● Ubuntu 22.04 LTS

● ROS2 Humble

● Git

ROS Installation and Environment Configuration

For detailed installation instructions, refer to: https://wiki.ros.org/noetic/Installation/Ubuntu

3.3 ROS Development Package Directory and User Manual

The operating procedure is described as follows:

1. Start the LiDAR driver node

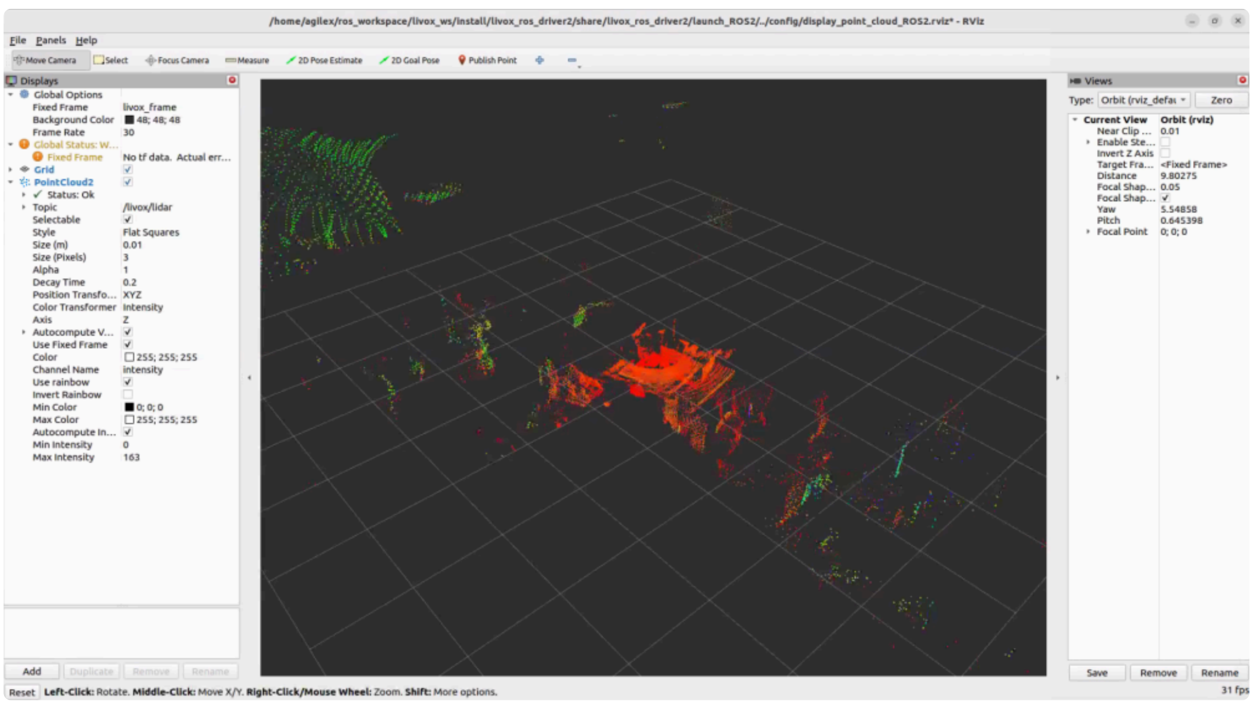
This node powers the LiDAR unit at the top of the T-REX 2.0. When operating normally, it generates a Point Cloud 2 dataset, which can be visualized in Rviz2.

Example usage:

cd ros_workspace/livox_ws

source install/setup.bash

ros2 launch livox_ros_driver2 rviz_MID360_launch.py



2. Start the GLIM laser inertial里程 gauge

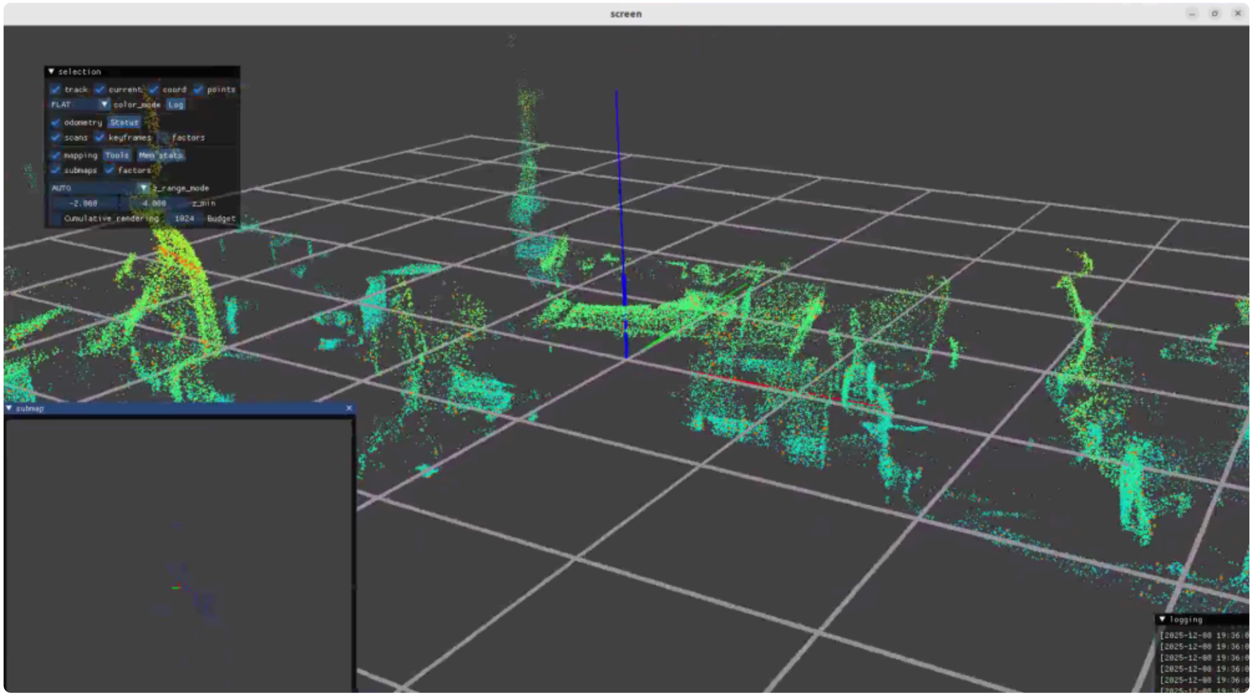
By utilizing the point cloud from LiDAR and IMU data processed through the GLIM algorithm to generate a GLIM laser inertial里程ometer, the robot's spatial position can be accurately determined while simultaneously constructing a point cloud. This data is automatically saved to the /tmp/dump directory upon program termination.

Example usage:

cd ros_workspace/glim_ws

source install/setup.bash

ros2 run glim_ros glim_rosnode



The point cloud editing feature allows you to edit and merge saved point clouds.

Example usage:

- Start Point Cloud Editor:

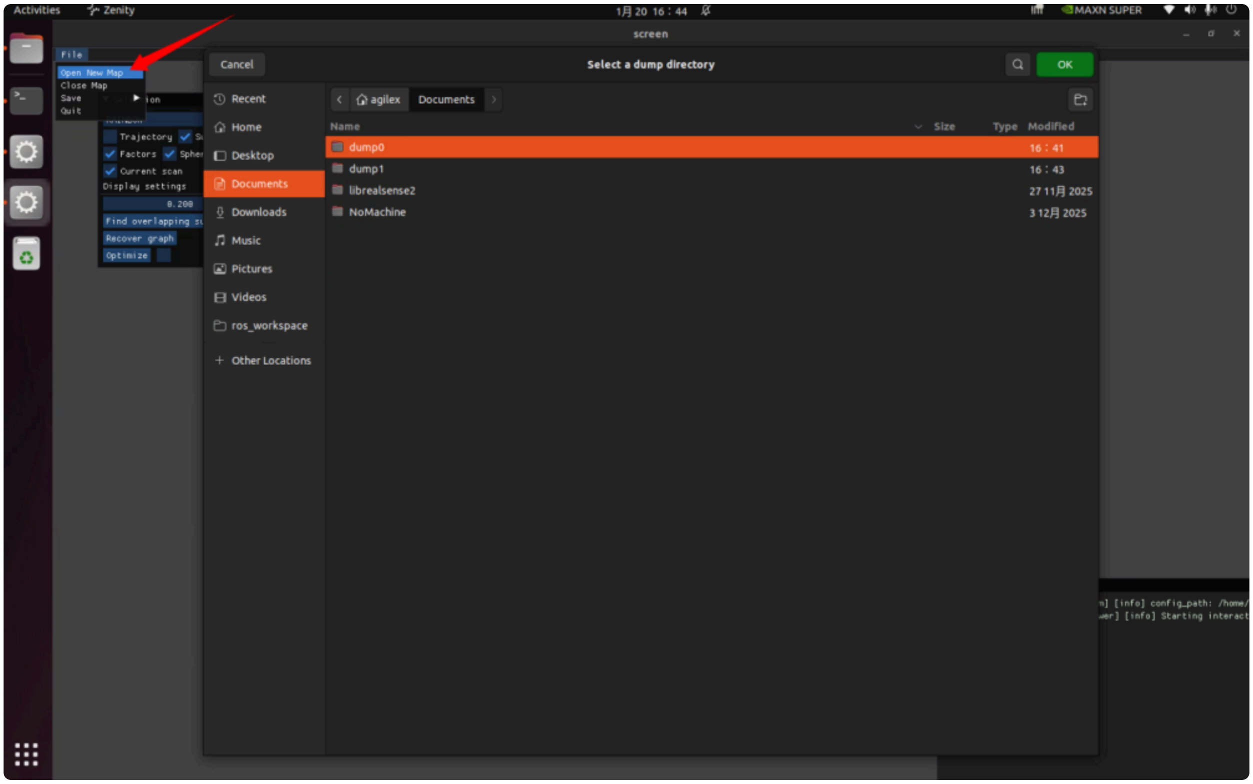
ros2 run glim_ros offline_viewer

- Map Union

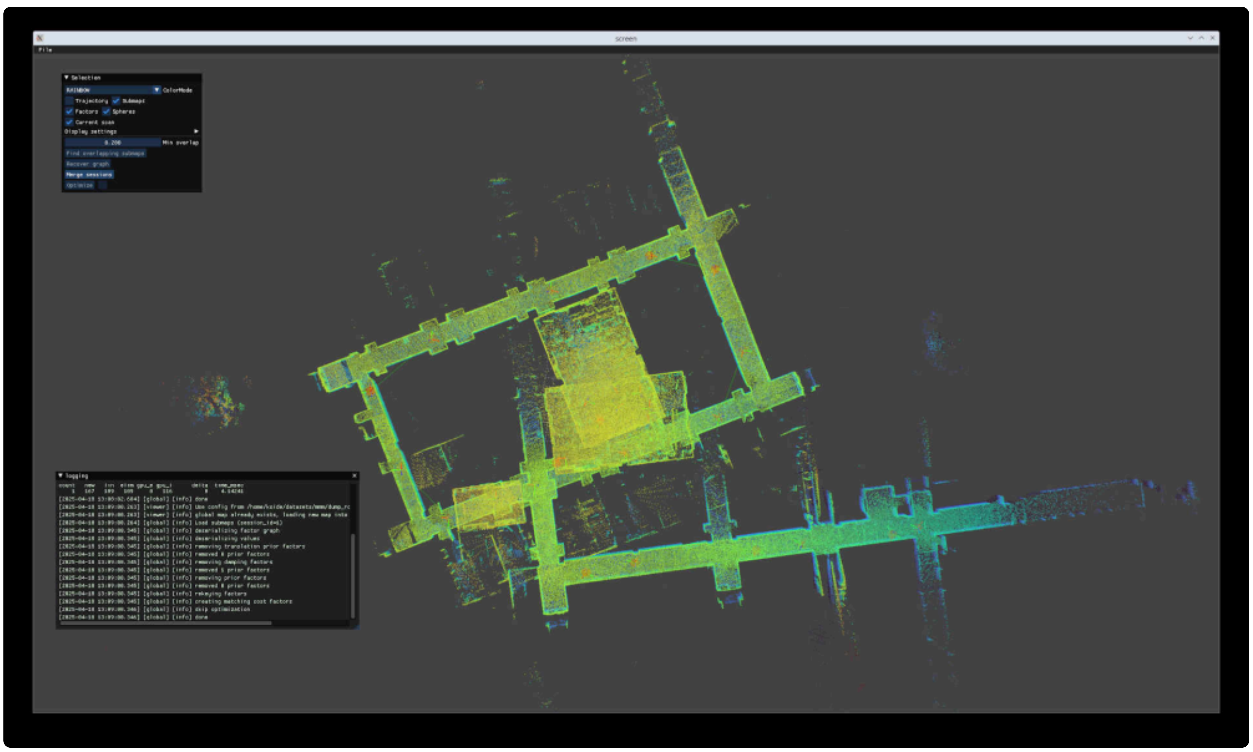
Use the offline viewer to merge multiple map drawing sessions into a single map

When a warning such as [global] [warning] X34-> E69 is missing appears, the map data may be corrupted, and merging corrupted map data could result in optimization failure. Before initiating a merge session, ensure that all map data is intact. You can repair corrupted maps by clicking Recover Graph.修复 each map individually: load the corrupted map → repair → save → close, then repeat the process for the next map.

1. Open the first session: File-> Open New Map-> Select the first dump directory-> Choose Yes in the dialog box to enable optimization

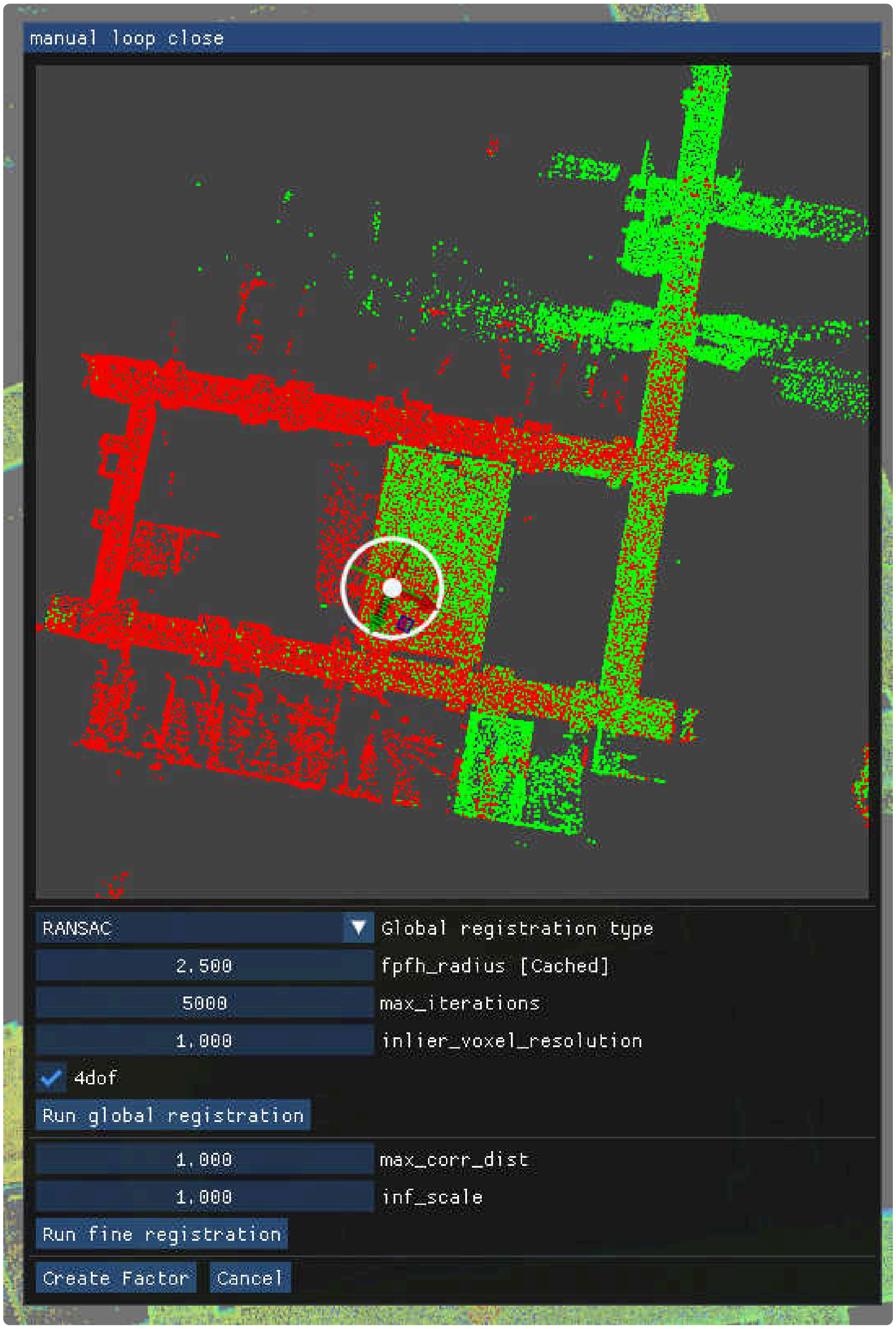


1. Open the second session: File-> Open Additional Map-> Select the second dump directory



1. Click Merge Sessions
2. Select the default registration parameter set (Indoor or Outdoor), then click OK
3. Align point clouds using automatic or manual methods: -Automatic alignment: Run global registration and verify if the point clouds are roughly aligned. -Manual alignment: Use the Gizmo UI to roughly align the source points (green) with the target points (red).
4. Click Run fine registration to perform ICP matching.

5. Click Create factor to merge sessions

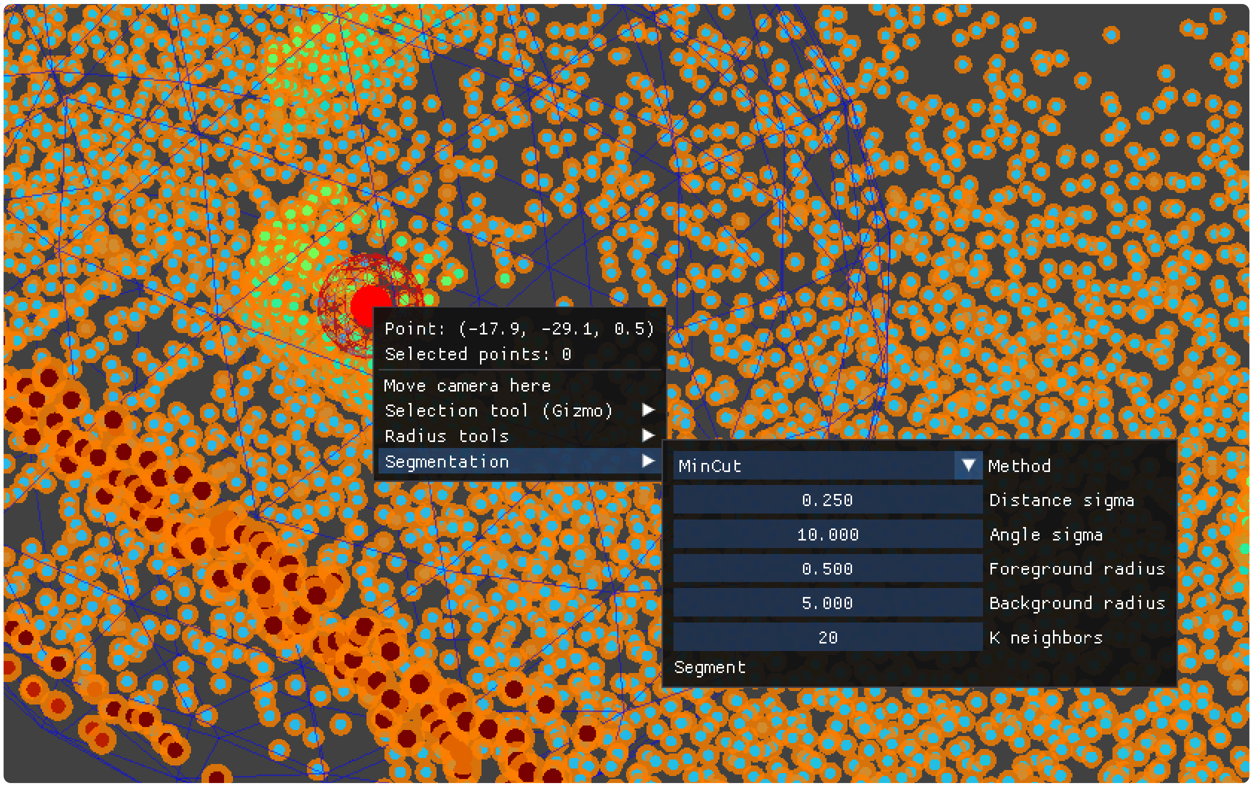


1. Click Find overlapping submaps to create matching cost factors between overlapping subgraphs. This improves global consistency across sessions.

- Start Point Cloud Editor

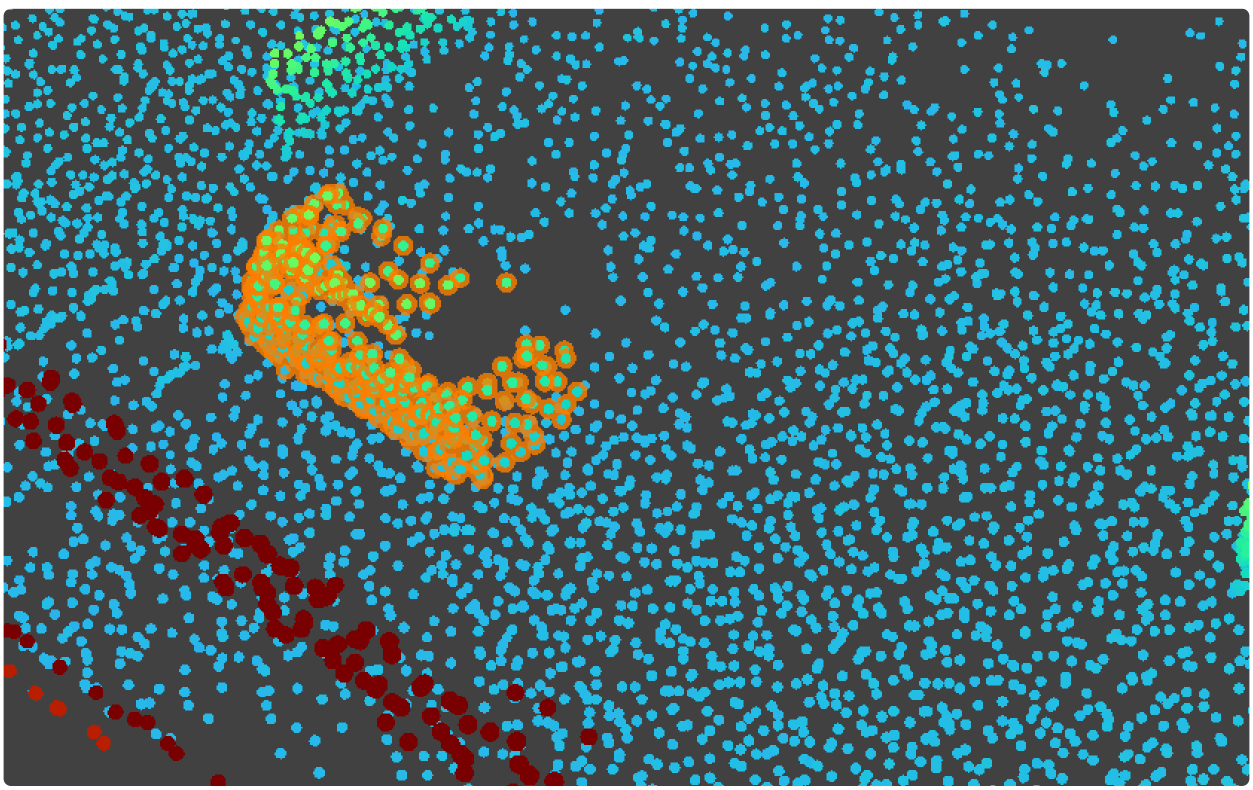
ros2 run glim_ros offline_viewer

1. Open the completed point cloud map file-> Open New Map-> Select the directory and click Open
2. Right-click the point on the object to remove and open the context menu

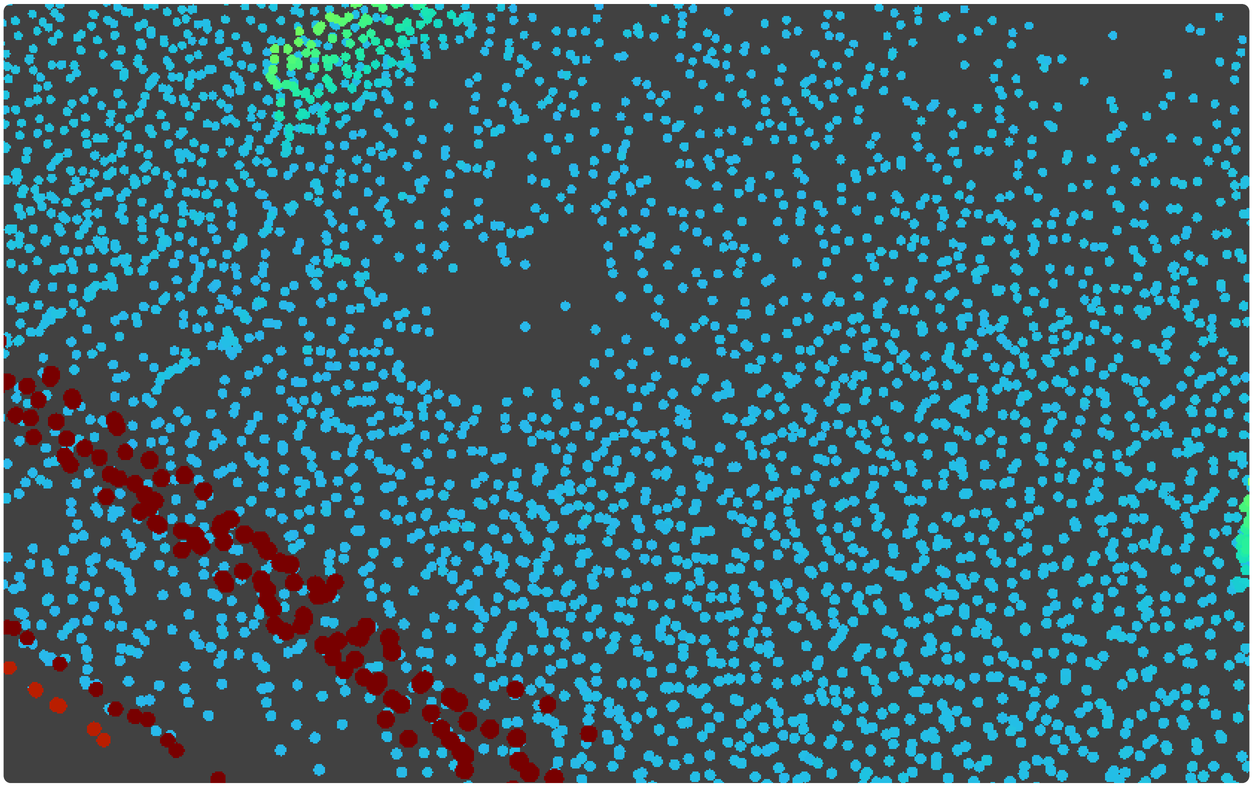


Segmentation-Select MinCut-Adjust Foreground radius and Background radius-Points within the foreground radius (represented by red spheres) are marked as foreground-Points outside the background radius (represented by blue spheres) are marked as background

1. Click Segment to split the object



1. Click the Remove selected points button to remove the selected points from the map



3. PCL2 Point Cloud Conversion Node

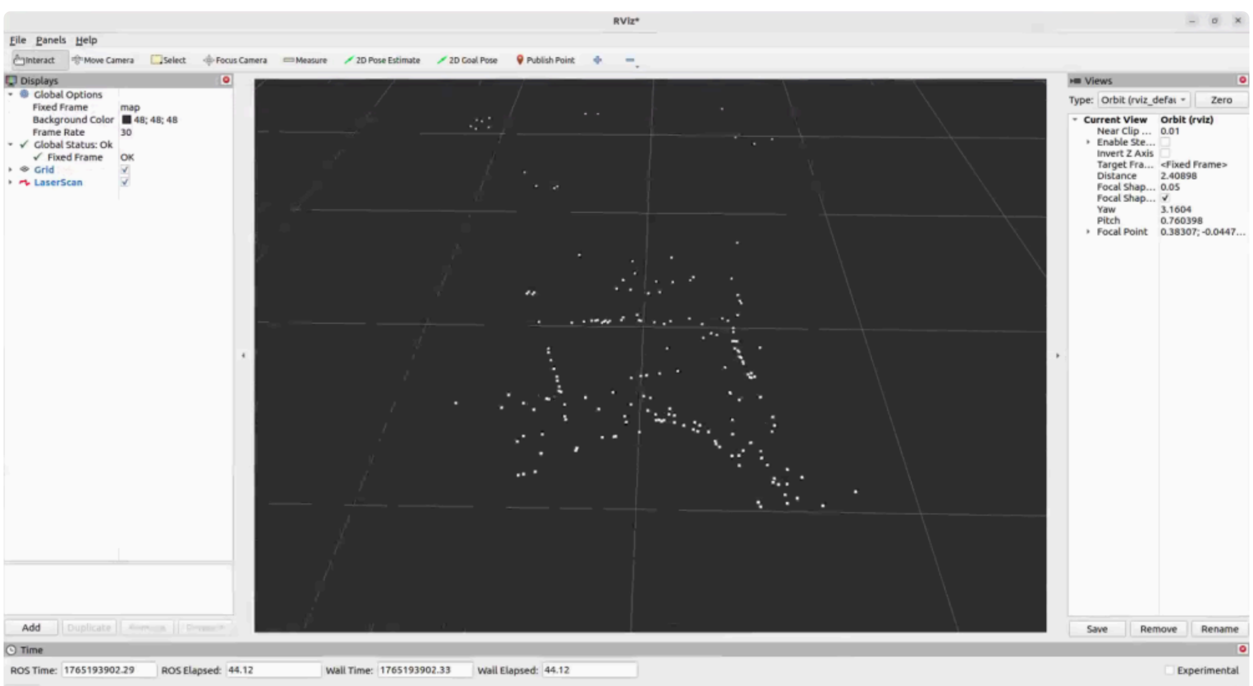
The PCL2 point cloud conversion node converts PointCloud2 into a LaserScan-style point cloud.

Example usage:

cd ros_workspace/slamtoolbox_ws

source install/setup.bash

ros2 launch pointcloud_to_laserscan sample_lidar_to_laserscan_launch.py



4. Launch the slam_toolbox mapping node

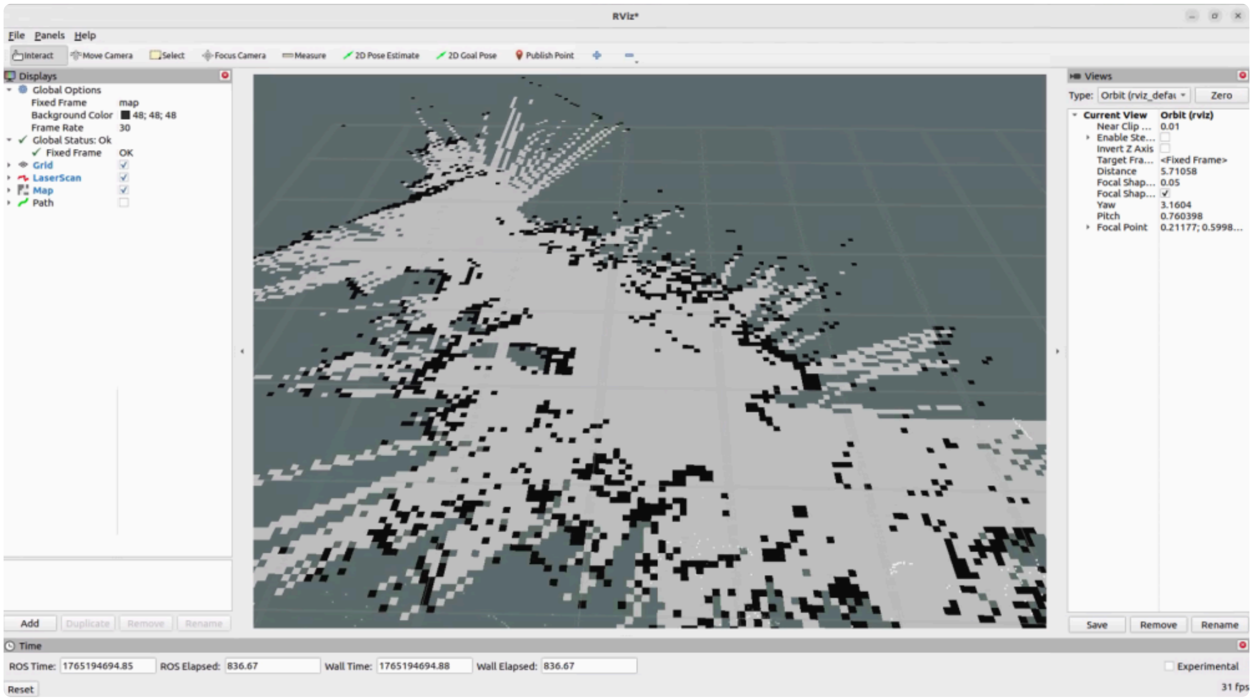
Use the slam_toolbox to implement the mapping functionality of T-REX2.0

Example usage:

cd ros_workspace/slamtoolbox_ws

source install/setup.bash

ros2 launch slam_toolbox online_async_launch.py



Save Map:

ros2 run nav2_server map_saver_cli

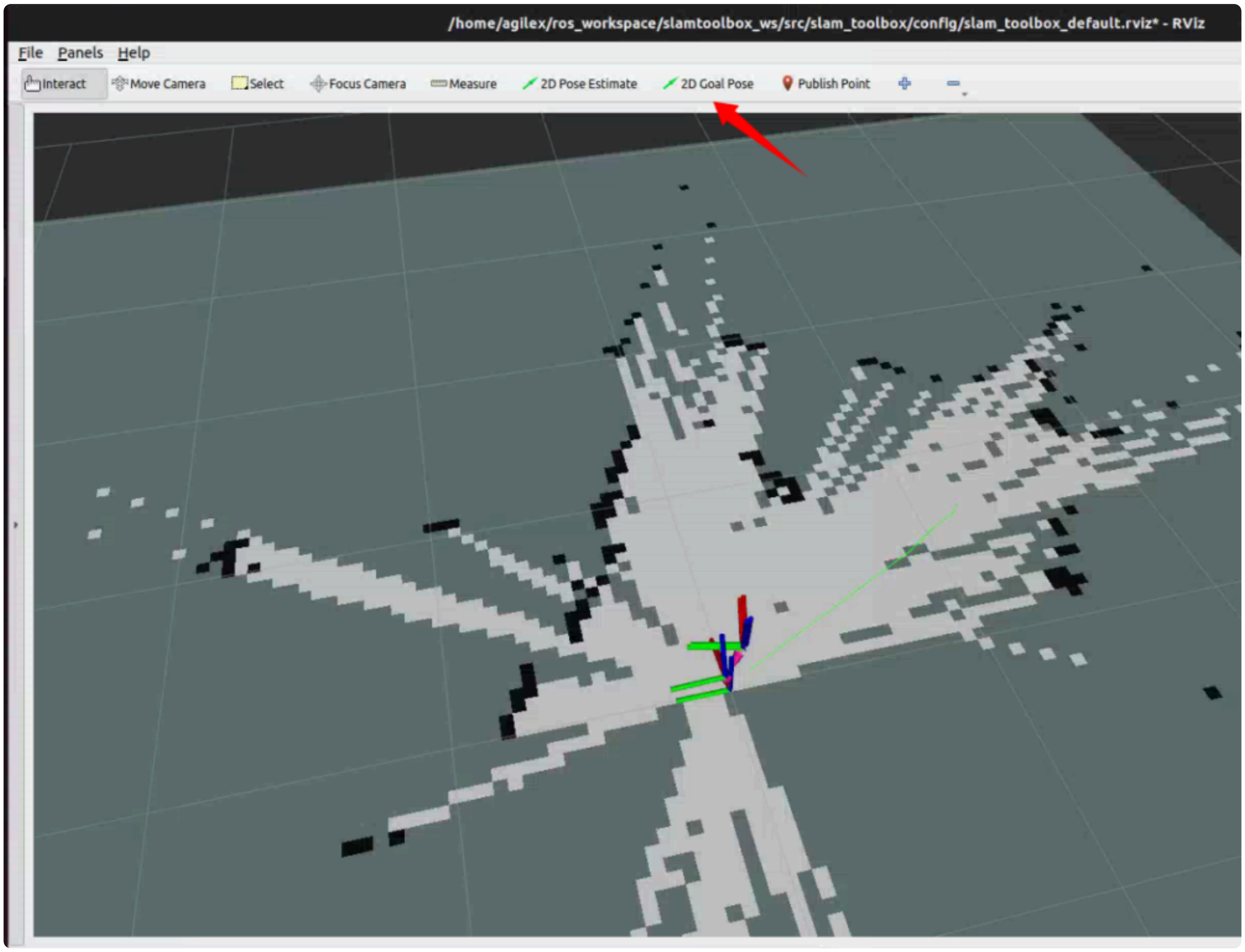
Or serialized to

ros_workspace/slamtoolbox_ws

ros service call /slam_toolbox/serialize_map slam_toolbox/srv/SerializePoseGraph "filename: 'pose_graph.data'"

5. MV2 Navigation and Path Planning Node

In Rviz2, use the 2D Goal Pose to specify the desired target point.



T-REX 2.0 can plan the path.

Example usage:

cd ros_workspace/slamtoolbox_ws

source install/setup.bash

ros2 launch slam_toolbox trex_nav.launch.py

6. Launch the T-REX 2.0 chassis drive node

The starting node can then control the chassis of the T-REX 2.0 via ROS2 to initiate movement.

cd ros_workspace/trex2_ws

source install/setup.bash

bash bringup_can2usb_500k.bash

ros2 launch trex_base trex_base.launch.py

You can use the keyboard to test whether the node can control the T-REX 2.0 properly.

ros2 run teleop_twist_keyboard teleop_twist_keyboard

```
This node takes keypresses from the keyboard and publishes them
as Twist/TwistStamped messages. It works best with a US keyboard layout.
---------------------------
Moving around:
   u    i    o
   j    k    l
   m    ,    .

For Holonomic mode (strafing), hold down the shift key:
---------------------------
   U    I    O
   J    K    L
   M    <    >

t : up (+z)
b : down (-z)

anything else : stop

q/z : increase/decrease max speeds by 10%
w/x : increase/decrease only linear speed by 10%
e/c : increase/decrease only angular speed by 10%

CTRL-C to quit

currently:      speed 0.50      turn 1.00
```

Use i to move forward, j to move backward, l to turn left, and j to turn right.

7. Launch the T-REX 2.0 camera driver node

Example usage:

cd ros_workspace/orbbec_ws

source install setup.bash

ros2 launch orbbec_camera astra.launch.py

Since the camera is installed upside down, use the image flipping node to rotate the image upright if needed.

cd ros_workspace/orbbec_ws

source install setup.bash

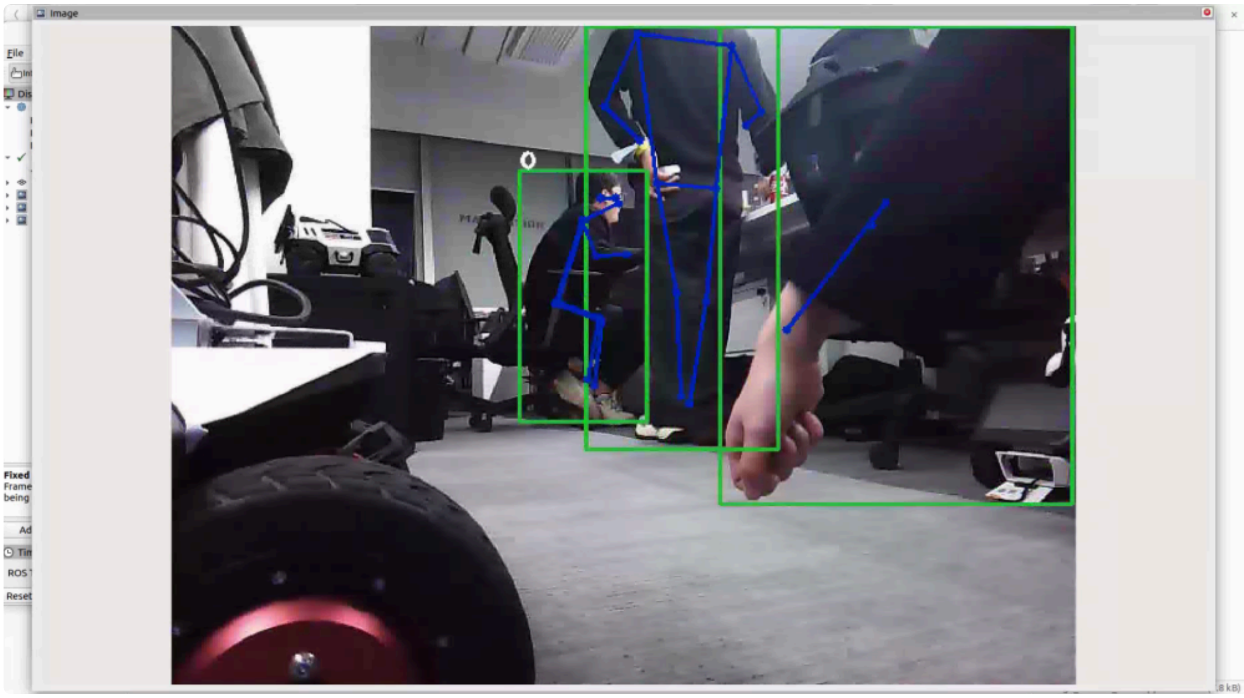
ros2 run image_rotator image_rotate_node

You can run the visual recognition node test to check if the camera function is working properly.

cd ros_workspace/trtyolo_ws

source install/setup.bash

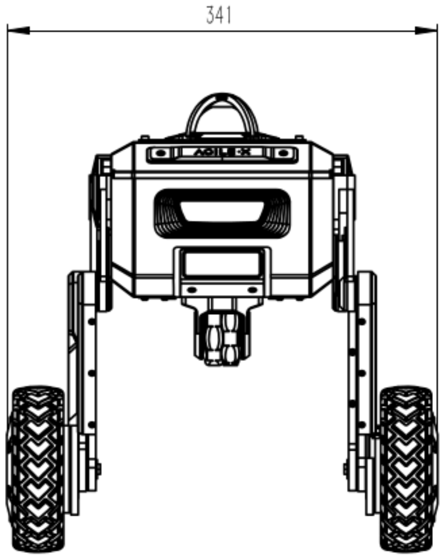
ros2 launch trt_yolo yolo11n_det.launch.py



3.4 Description of the Vehicle Body Coordinate System

With the center of the vehicle body as the origin, the forward direction is the positive x-axis, the left direction is the positive y-axis, and the upward direction is the positive z-axis.

4. Product Dimensions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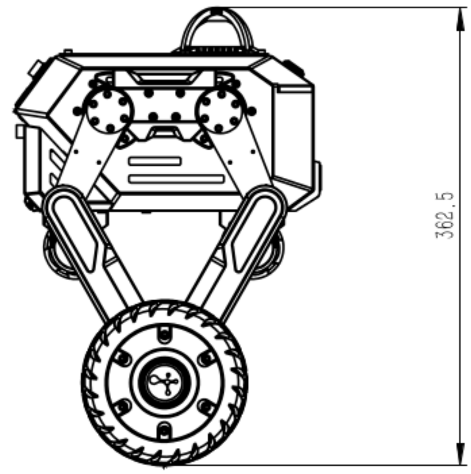
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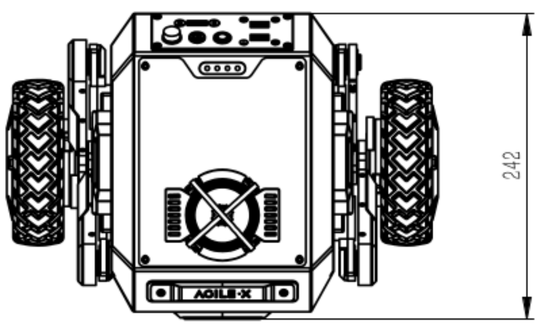
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