TIAGo Training Sessions

Mobile base control and navigation

PAL ROBOTICS

Introduction

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PAL ROBOTICS

Moving the base

Take the priority with the joystick

Move the base forward and backward

Turn left and right

Increase linear speed

Decrease linear speed

Increase angular speed

Decrease angular speed

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Drive wheels control

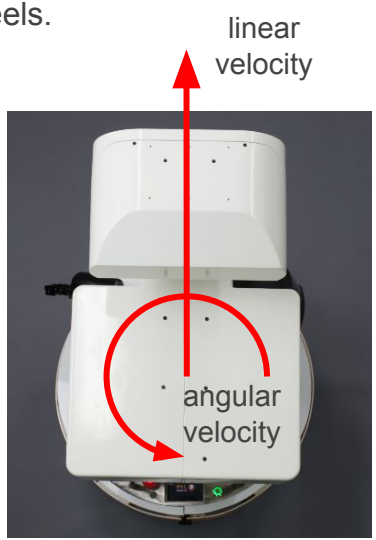
- The lowest level control of the drive wheels is provided by the following topic:

  `/mobile_base_controller/cmd_vel`

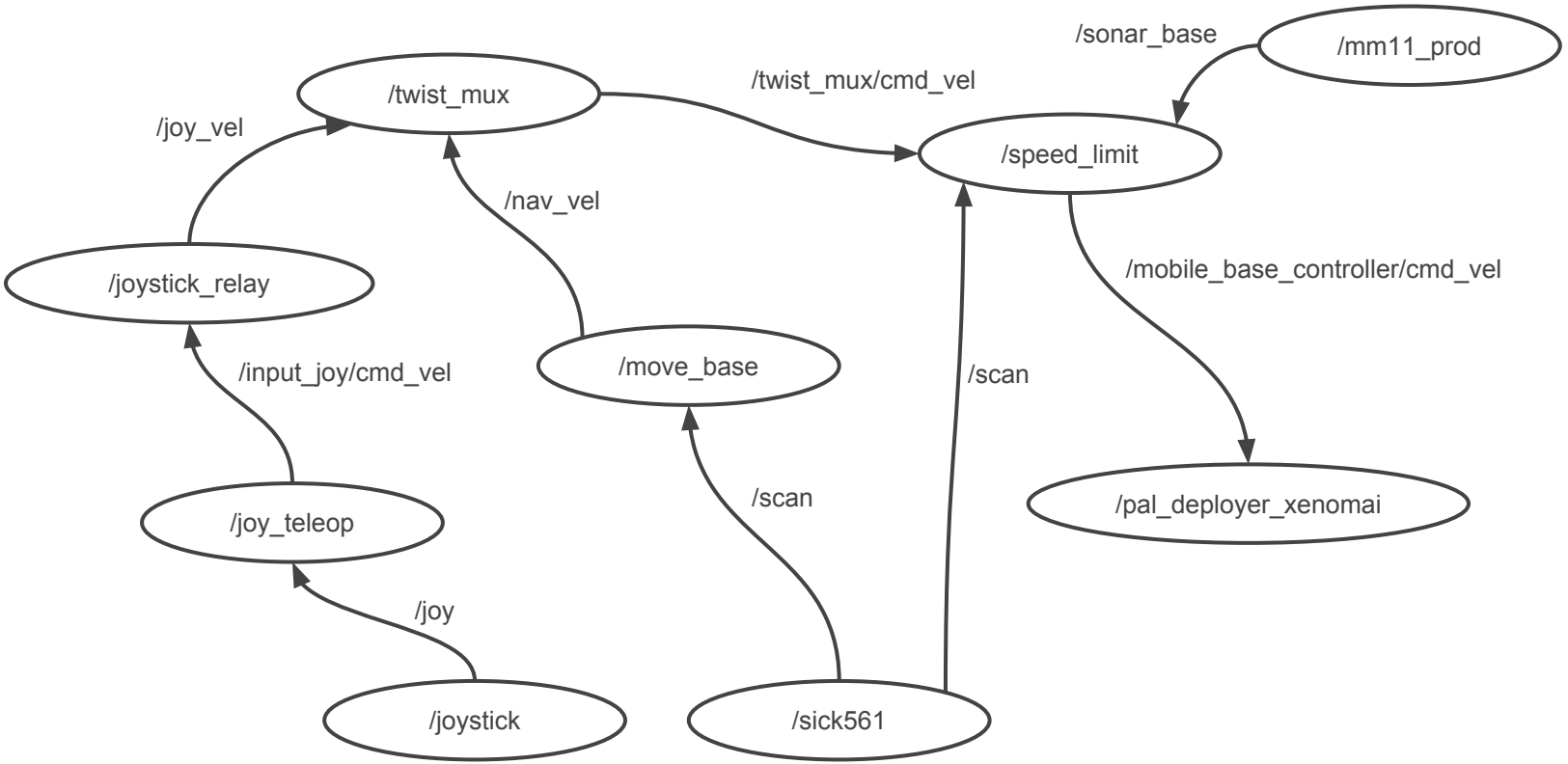
  which is of type geometry_msgs/Twist, and contains the following fields:

  Vector3 linear
  Vector3 angular

  These are the desired linear and angular velocities for the mobile base, which are internally translated to the required angular velocities of each one of the two drive wheels.



Wheels command diagram (I)



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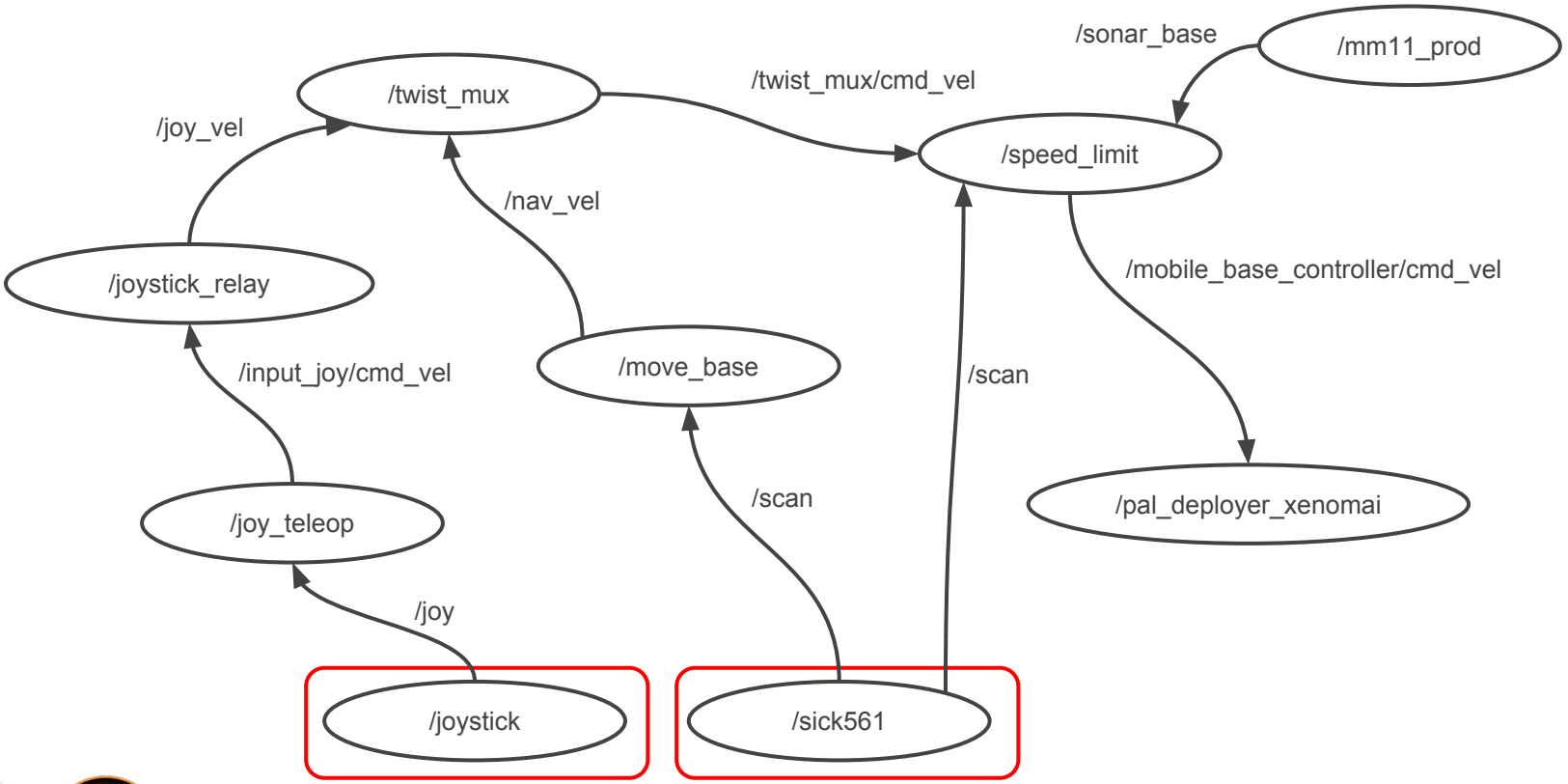
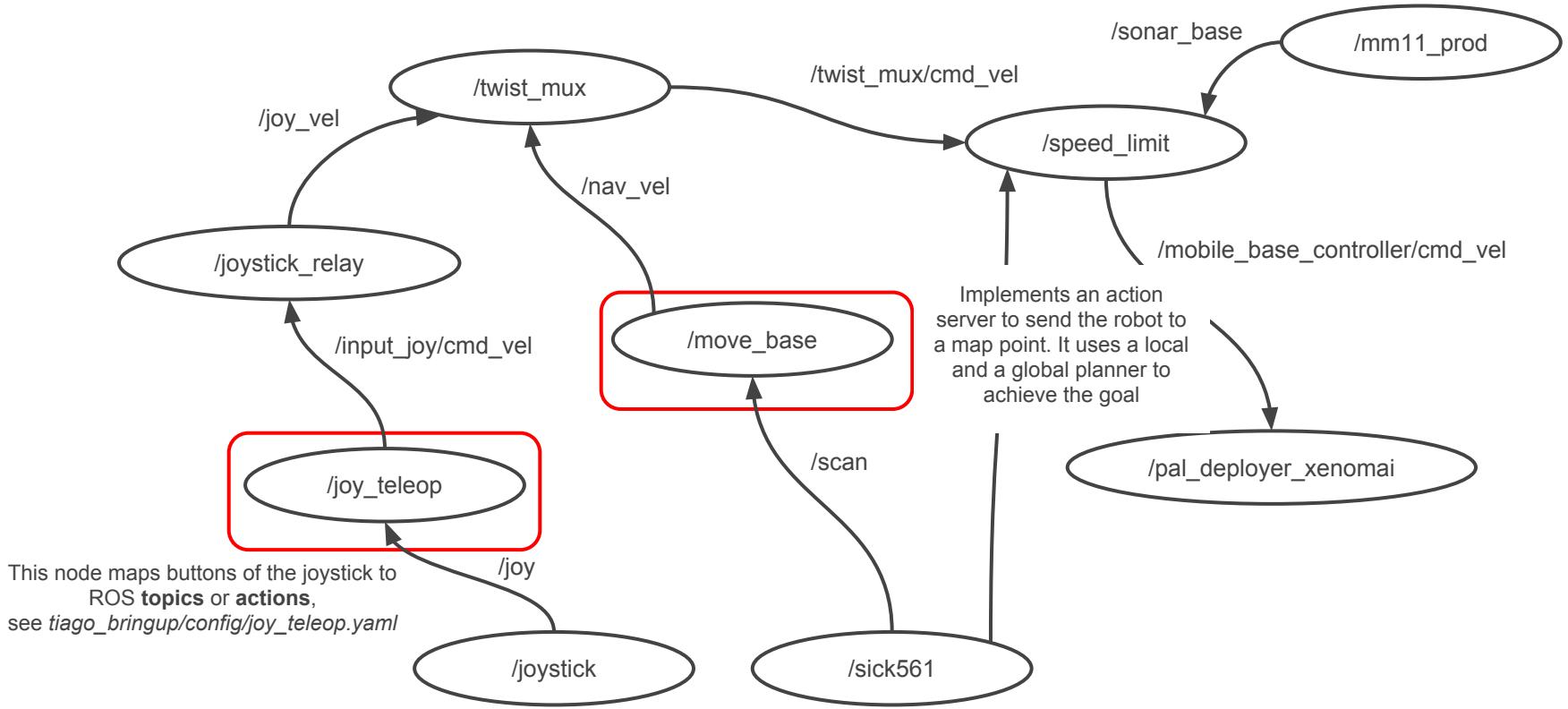
Wheels command diagram (II)



Wheels command diagram (III)



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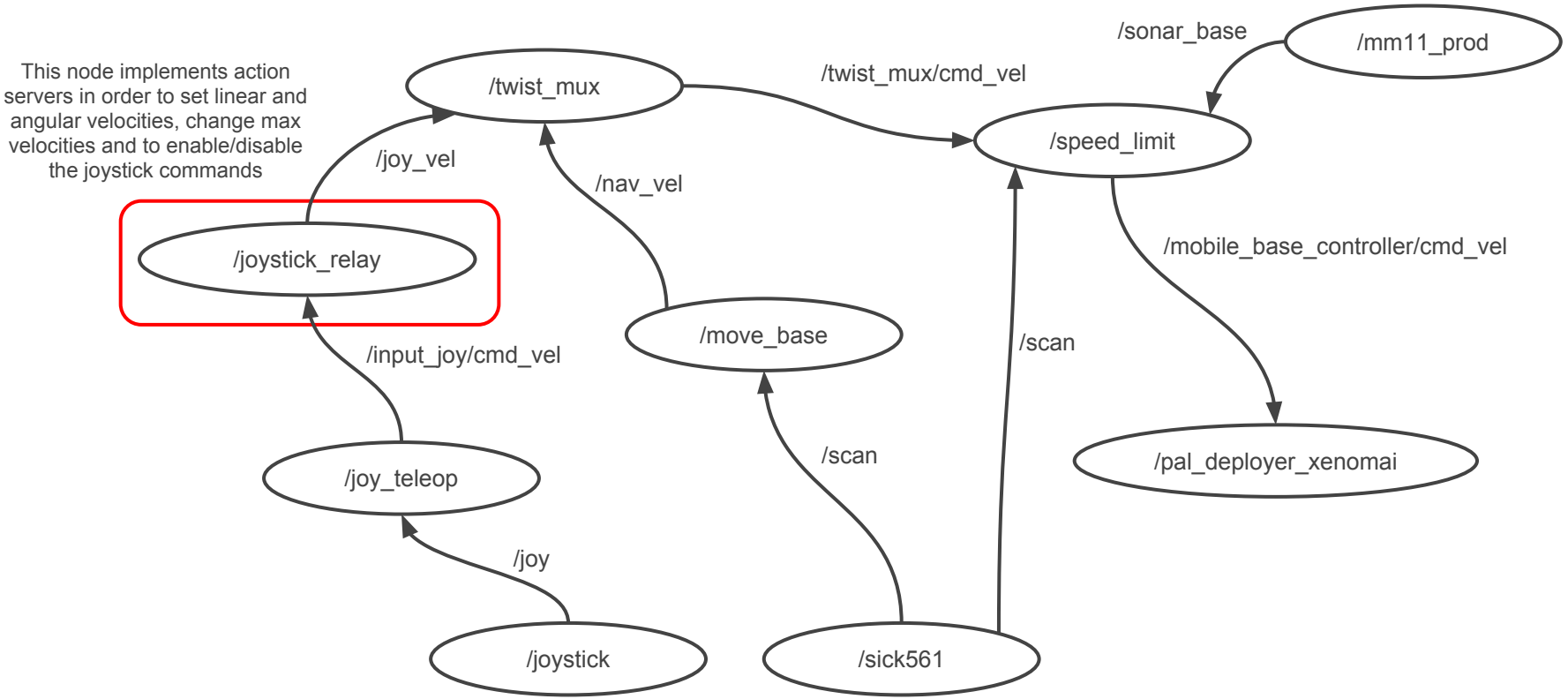
Wheels command diagram (IV)



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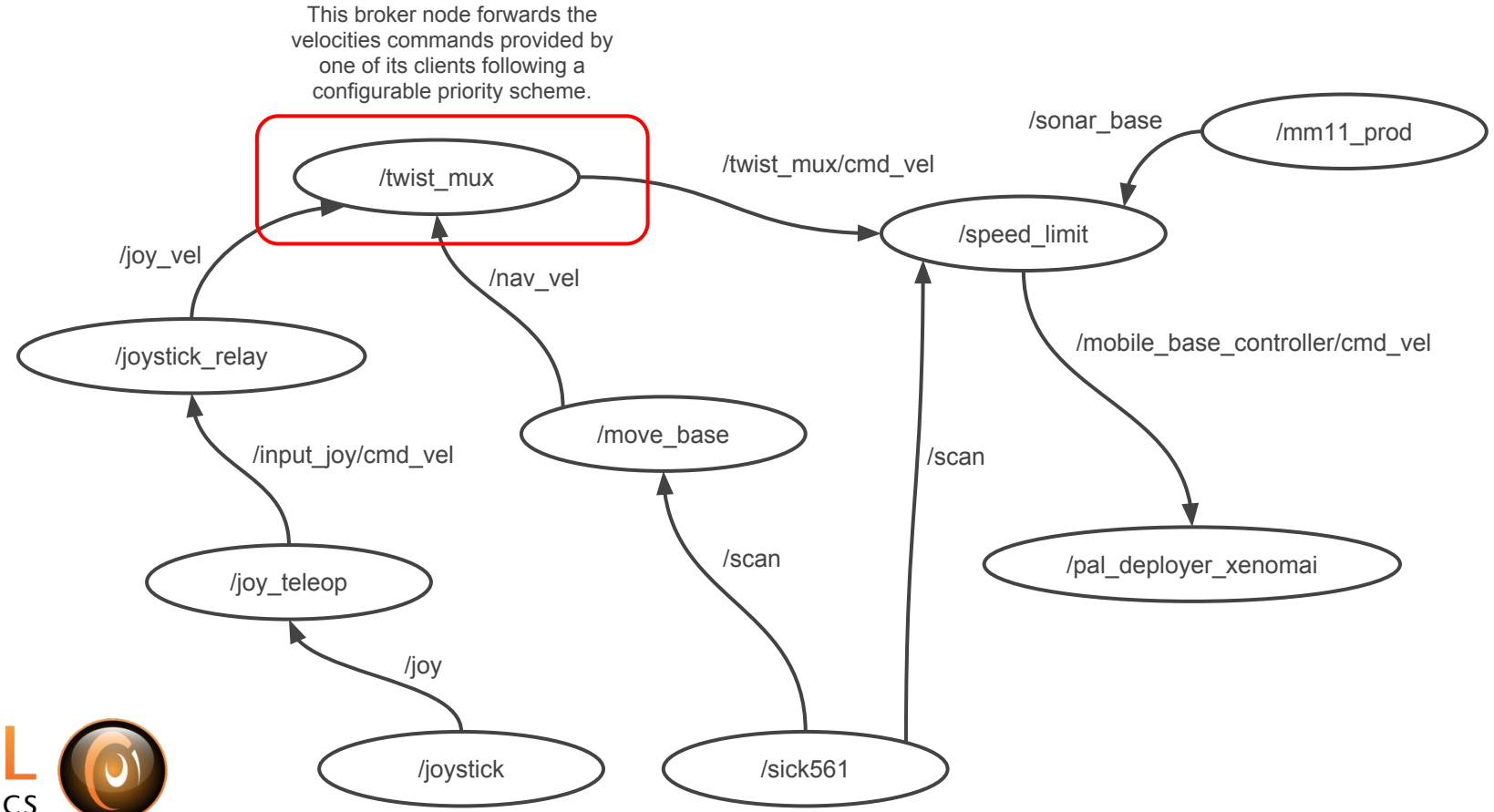
Wheels command diagram (V)



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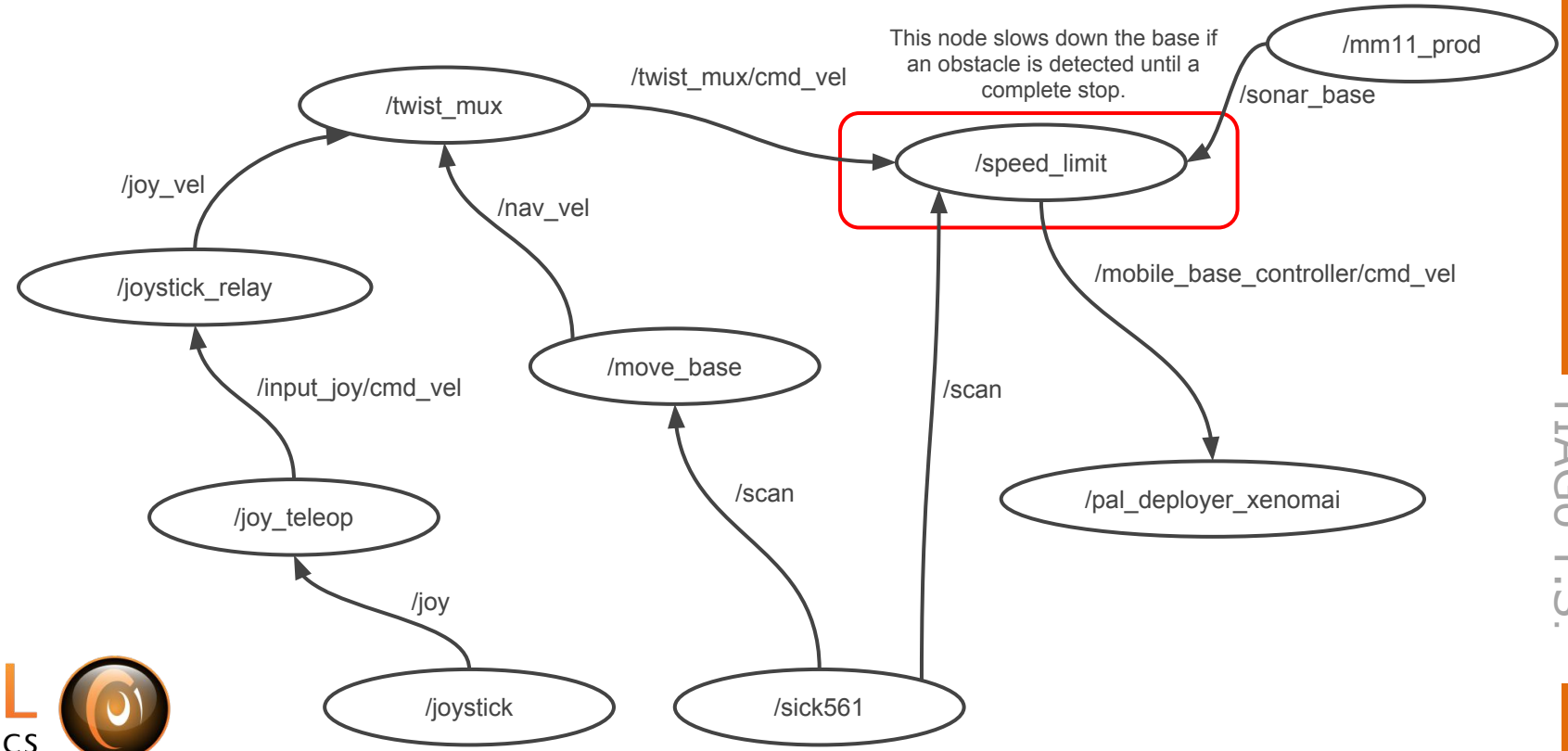
Wheels command diagram (VI)



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Joystick base motion triggers

- Motion trigger example:

rosparam get /teleop/move -p

```
axis_mappings: - {axis: 1, scale: 1.0,
target: linear.x}
- {axis: 2, scale: 1.0, target: angular.z}
message_type: geometry_msgs/Twist
topic_name: cmd_vel
type: topic
```

Default joystick triggers location:
tiago_bringup/config/joy_teleop.yaml

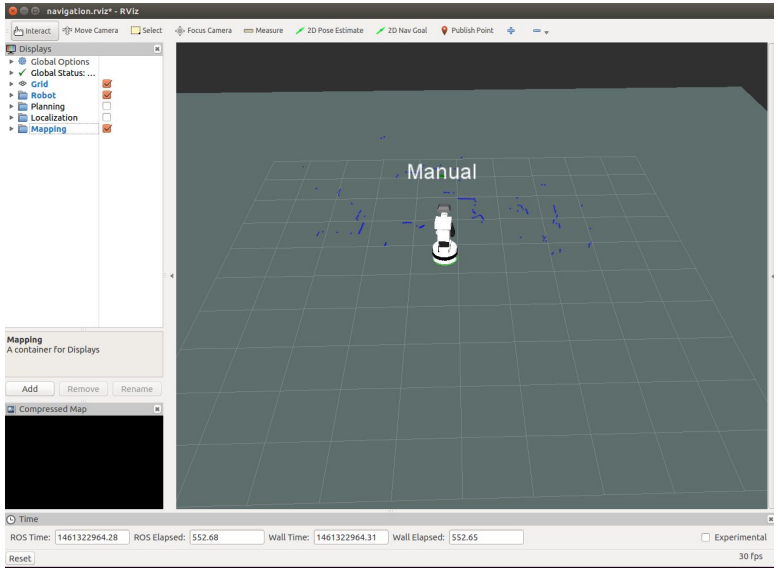
Mapping

Mapping (I)

- Change to **mapping mode**:
  export ROS_MASTER_URI=http://tiago-0c:11311
  rosservice call /pal_navigation_sm “input: 'MAP'”

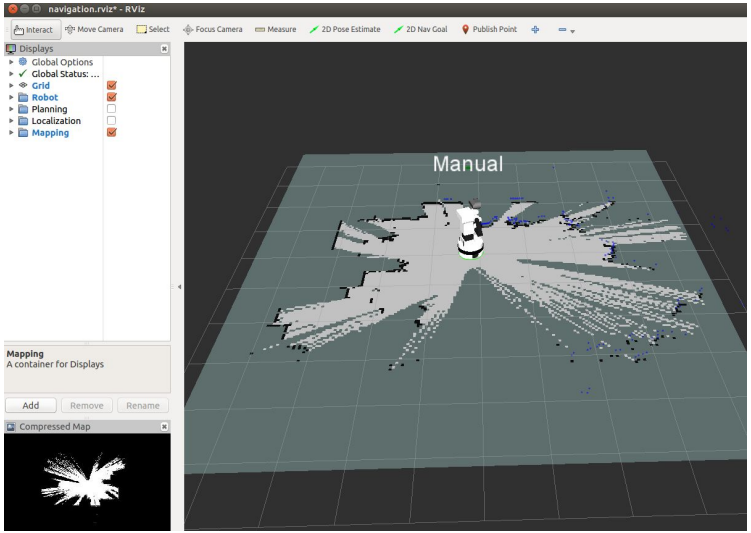
- In the development computer start rviz for navigation:
  export ROS_MASTER_URI=http://tiago-0c:11311
  ROS_IP=10.68.0.128 rosrun rviz rviz -d `rospack find tiago_2dnav`/config/rviz/navigation.rviz

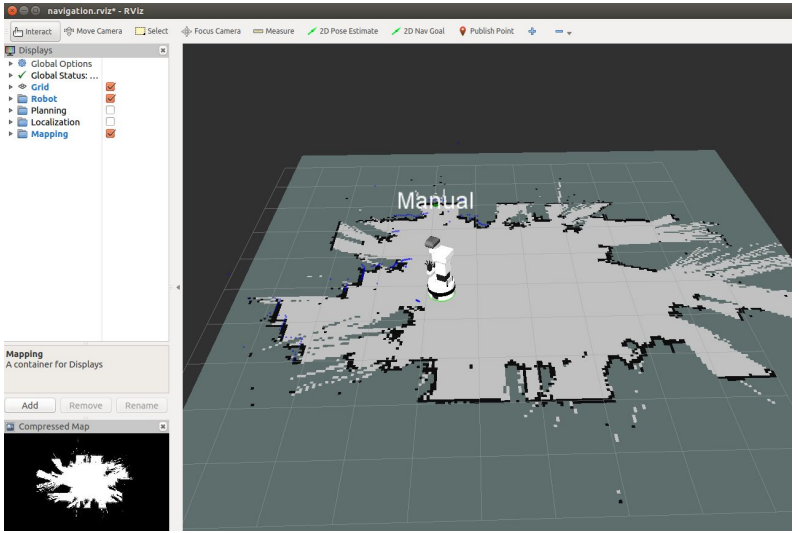
Get your IP with ifconfig



Mapping (II)

- Move the base with the joystick in order to take a tour of the area you want to map





Map management

- Save the map as follows:
  export ROS_MASTER_URI=http://tiago-0c:11311
  rosservice call /pal_map_manager/save_map “directory: 'pal_room'”

  This map will be named after the provided name and saved in the configuration folder:
  /home/pal/.pal/tiago_maps/configurations

  The map in use is the one pointed by the symbolic link:
  /home/pal/.pal/tiago_maps/config -> /home/pal/.pal/tiago_maps/configurations/pal_room

  In order to change the active map we first need to switch to localization mode:
  rosservice call /pal_navigation_sm “input: 'LOC'”

  Then we can select the new map as follows:
  rosservice call /pal_map_manager/change_map "input: 'pal_room'"

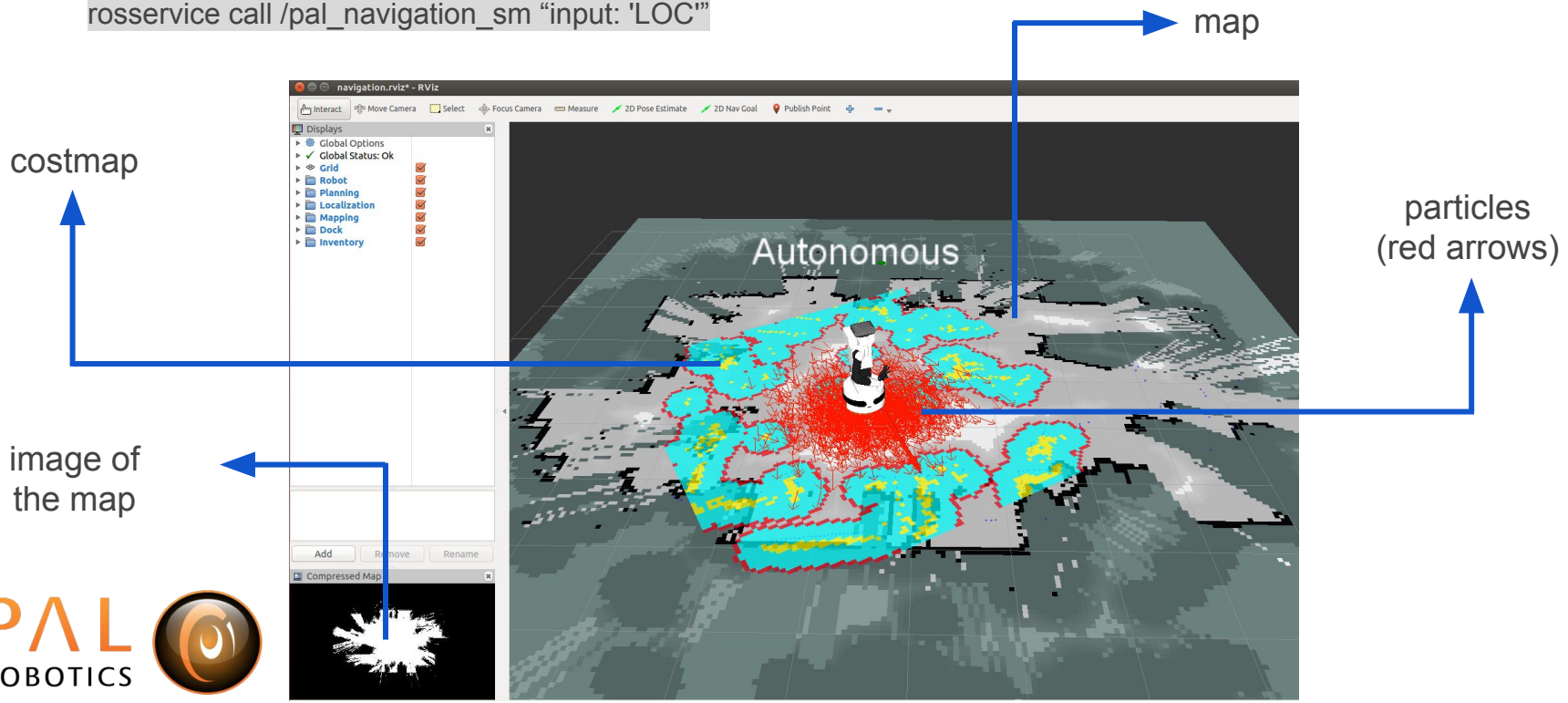
  If no name is specified during the rosservice call, the map will be named after the current date and time.

Localization

Start localization

- Localization is provided by the ROS package [amcl](), which implements a particle filter to track the pose of a robot against the current map. After mapping, the localization mode is enabled as follows:

```
rosservice call /pal_navigation_sm “input: 'LOC'”
```



Global localization

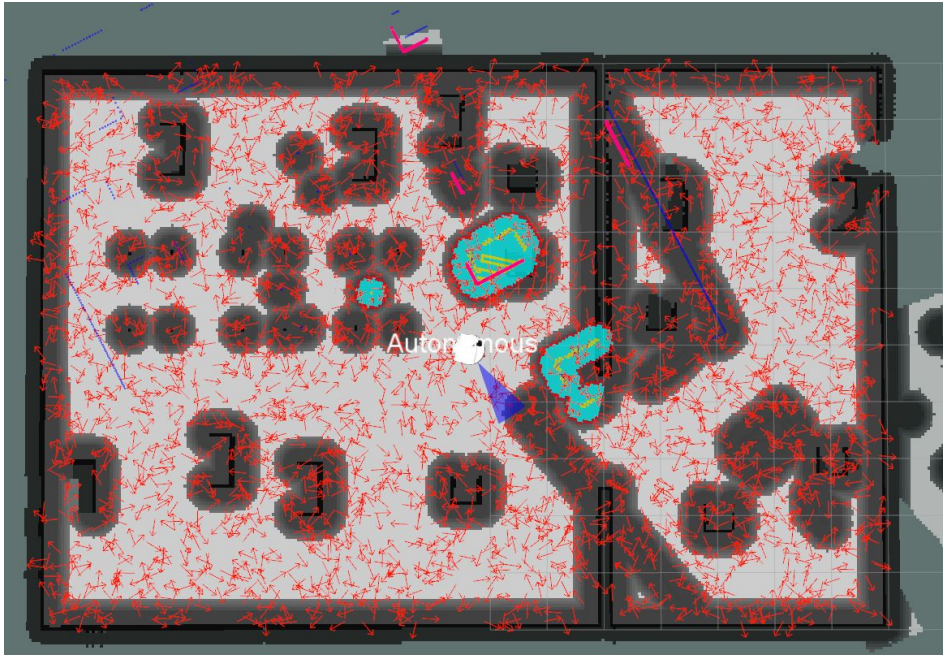
- In order to let the robot self-localize when it wakes up first run the following command:

  `rosservice call /global_localization "{}"`

  This will spread particles over the entire map.

  Then clear the costmaps:

  `rosservice call /move_base/clear_costmaps "{}"`



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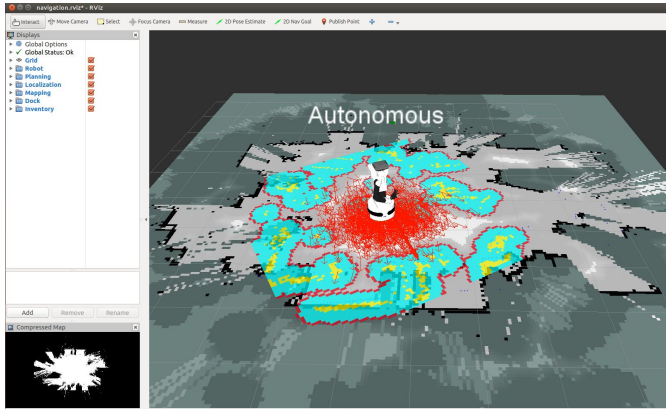
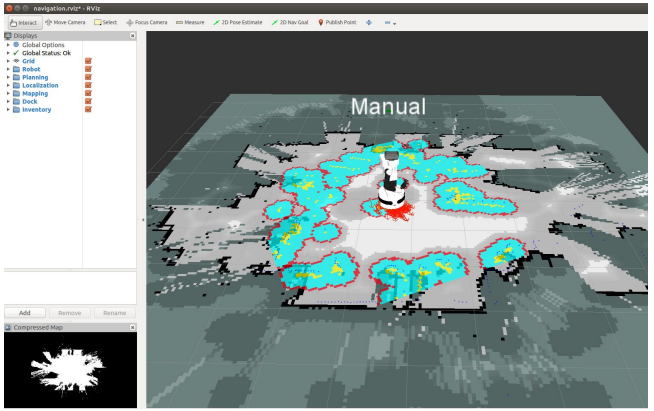
Reduce localization uncertainty

- In some cases the particles are spread in a large area → the localization is uncertain (for example when turning on the robot)
- The uncertainty reduces when the robot moves



rotate and translate robot



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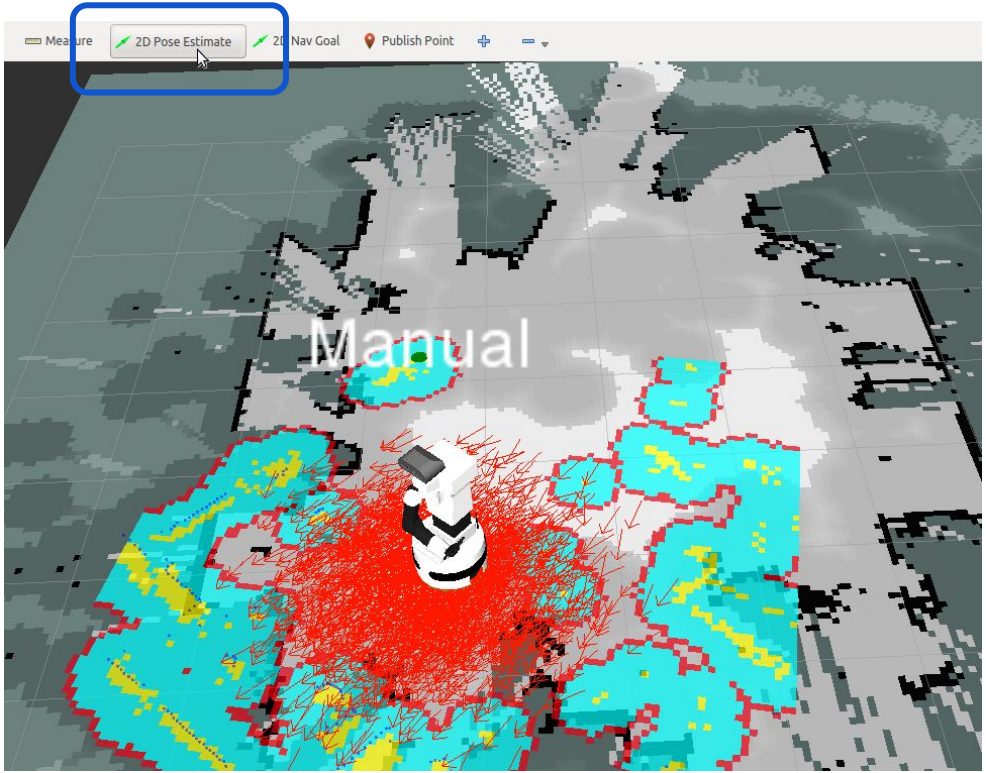
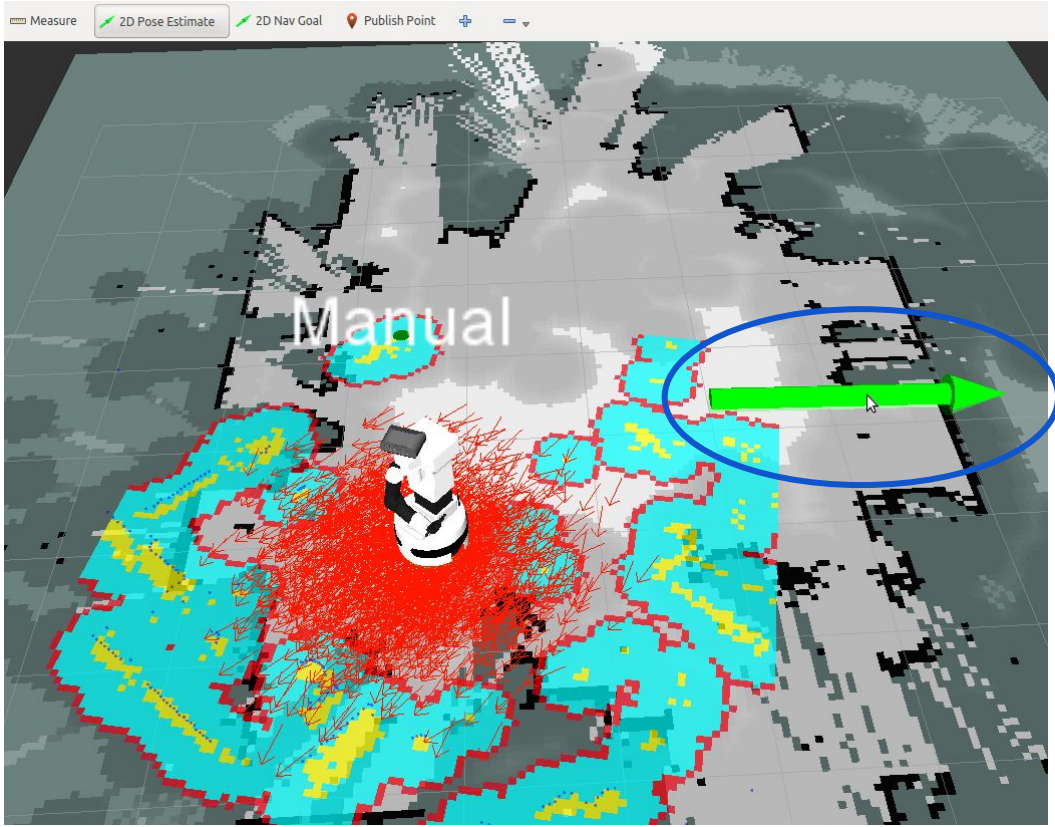
Force localization initial guess (I)

- If for any reason (e.g. turning the robot on after moving it) the robot is mislocalized the user may force spreading the filter particles around a given pose in the map.



Force localization initial guess (II)

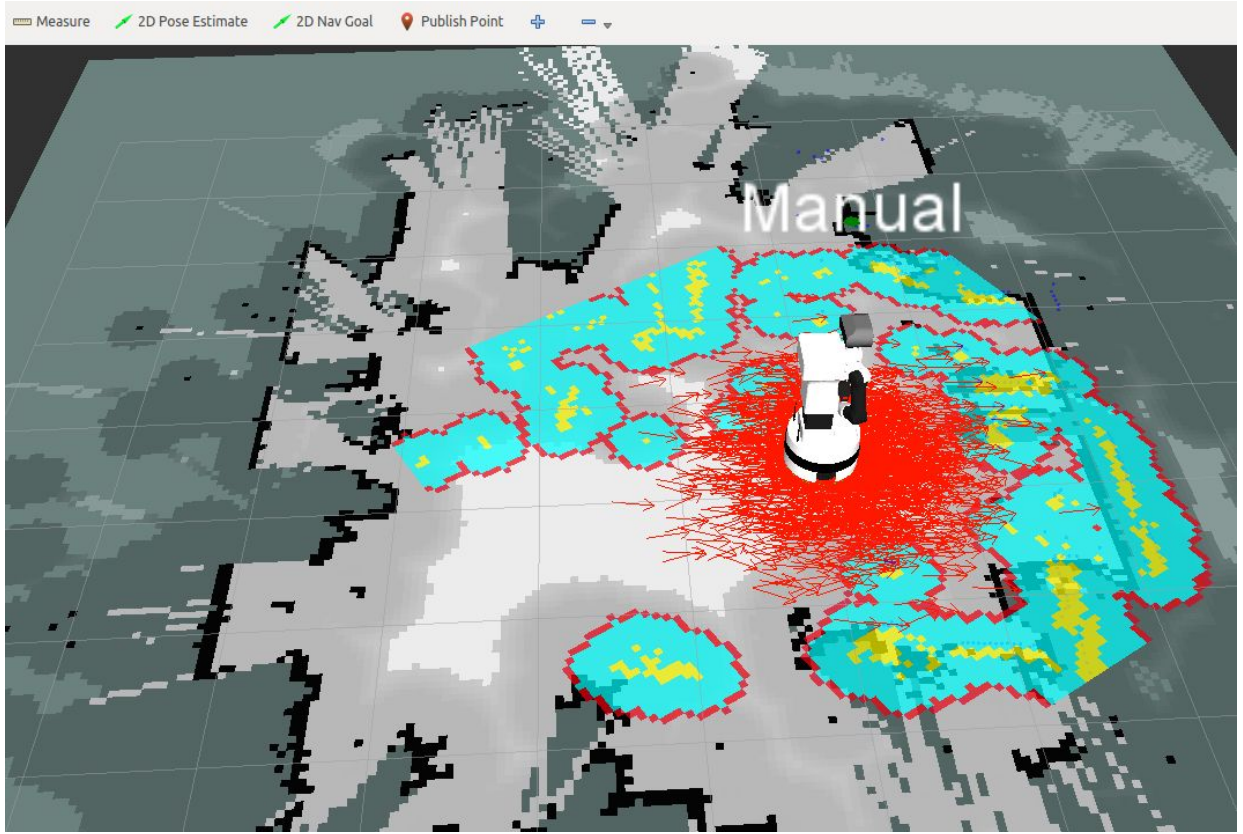
- Select the pose in the map corresponding approximately to the actual robot pose.



The arrow indicates our guess about the robot pose (position and orientation)

Force localization initial guess (III)

- The particles will spread around the selected pose so that the robot looks towards the arrow's head.



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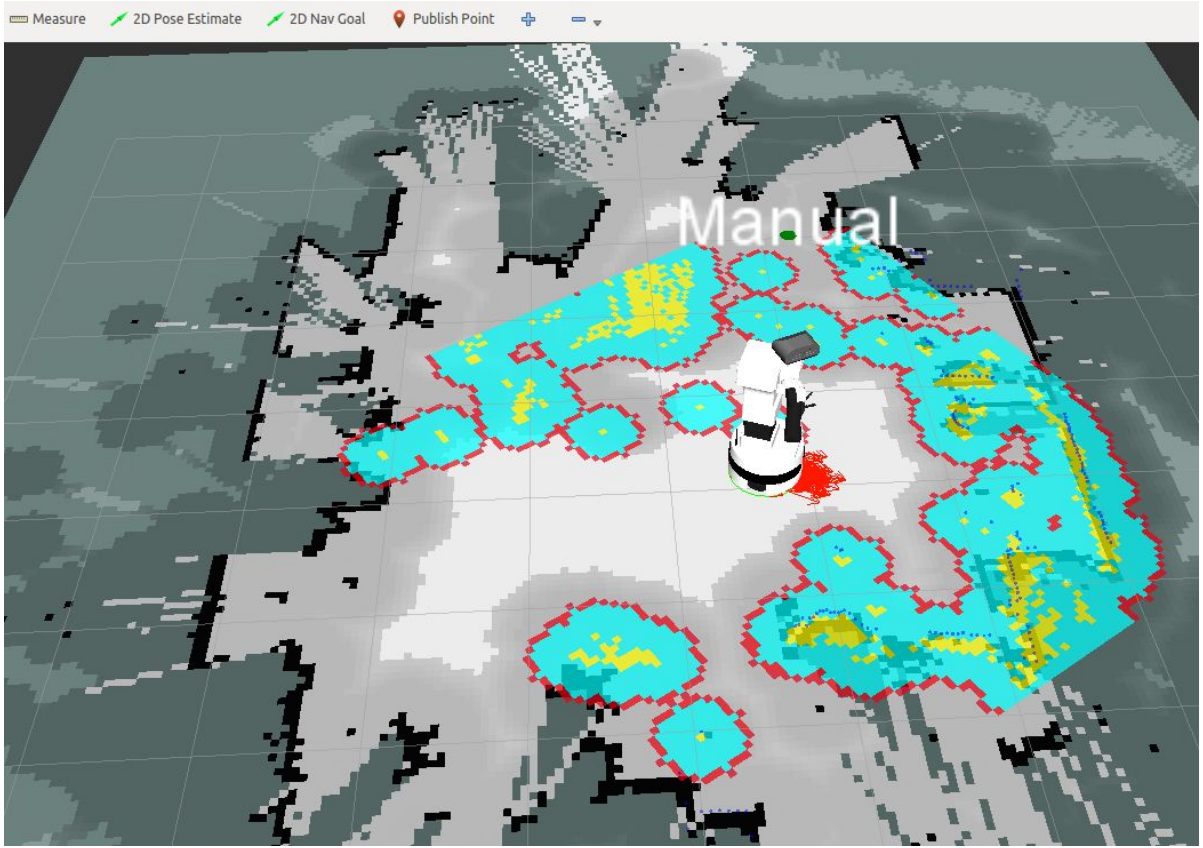
Force localization initial guess (IV)

- Moving the robot with the joystick will cause the particles to focus in the actual pose of the robot



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Autonomous navigation

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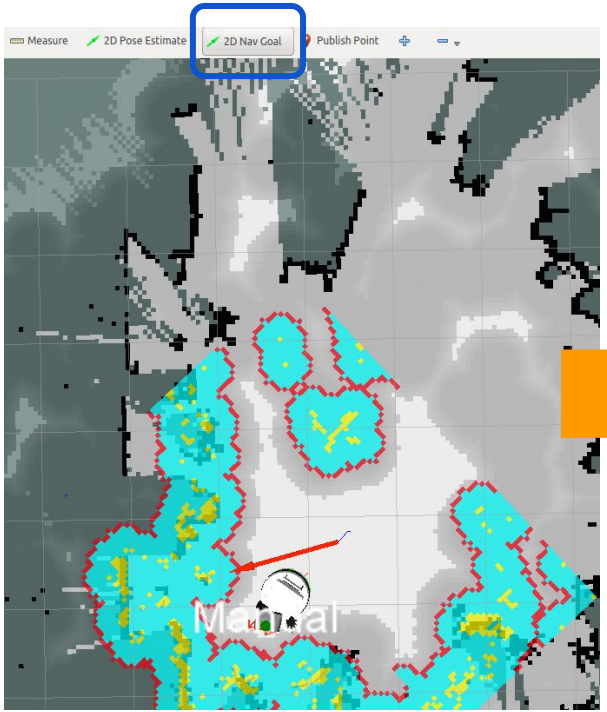
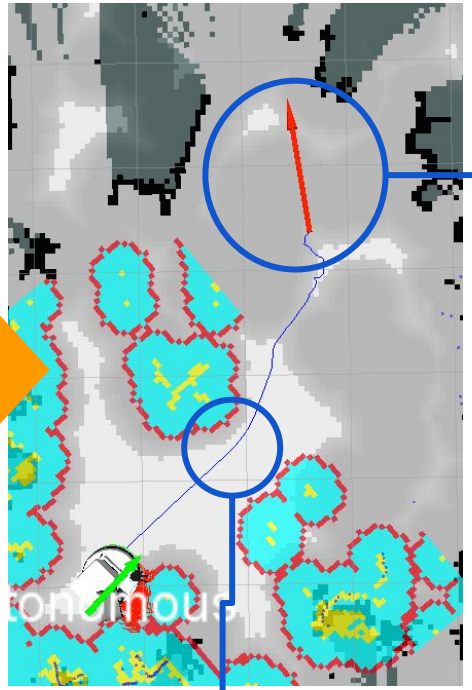
Autonomous navigation

- Sending the robot to a map point using the **2D Nav Goal** button





Clicking on a map point will publish the map coordinates in the following topic:

```
pal@tiago-0c:~$ rostopic echo /move_base_simple/goal
header:
  seq: 5
  stamp:
    secs: 1461336857
    nsecs: 999692300
  frame_id: map
pose:
  position:
    x: 0.284426689148
    y: -0.665684938431
    z: 0.0
  orientation:
    x: 0.0
    y: 0.0
    z: -0.609778695113
    w: 0.792571727344
---
```

publish goal to action server **/move_base**

a **path** to the destination point is dynamically **planned** avoiding obstacles

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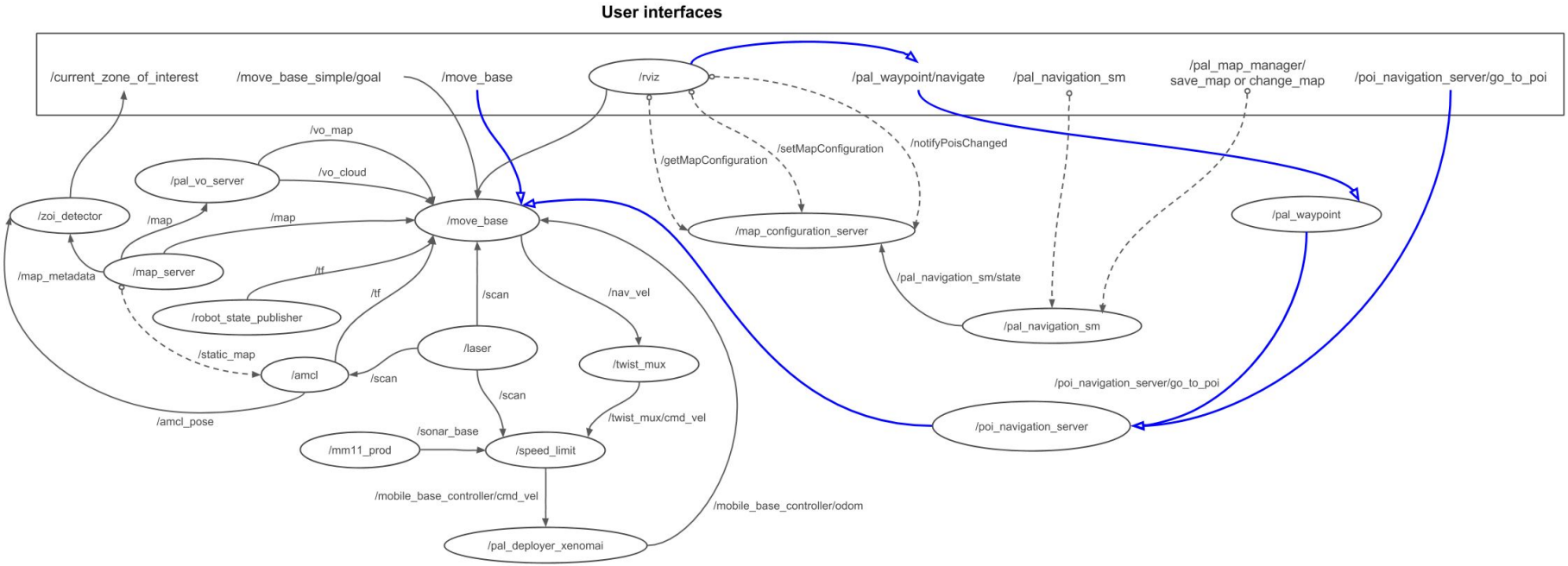
Navigation internals (I)



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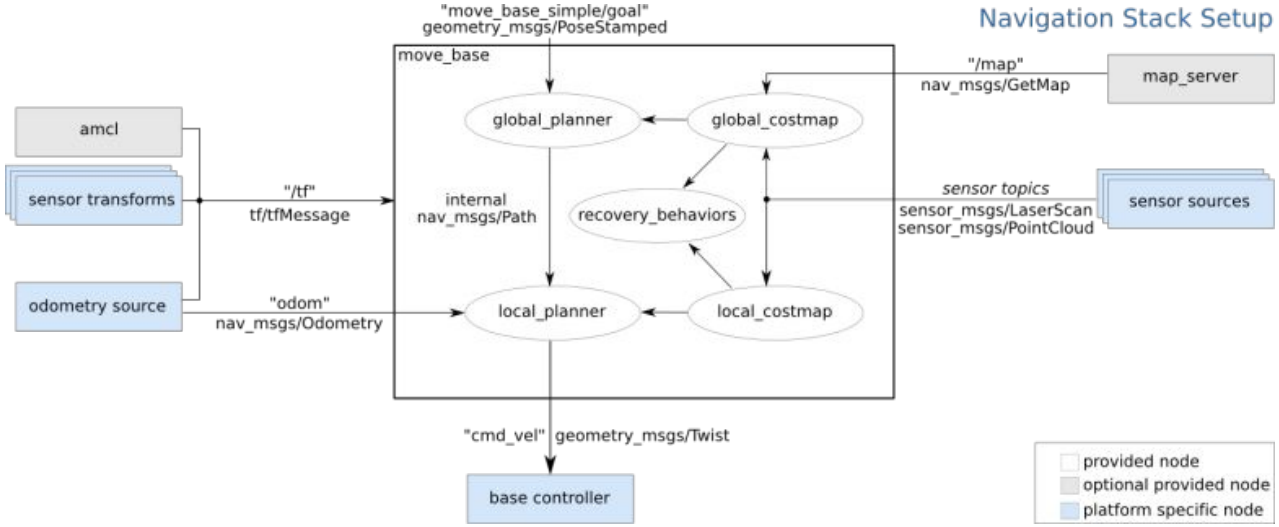
Navigation internals (II)



Extensive documentation about navigation functioning and parameters can be found at:

http://wiki.ros.org/move_base

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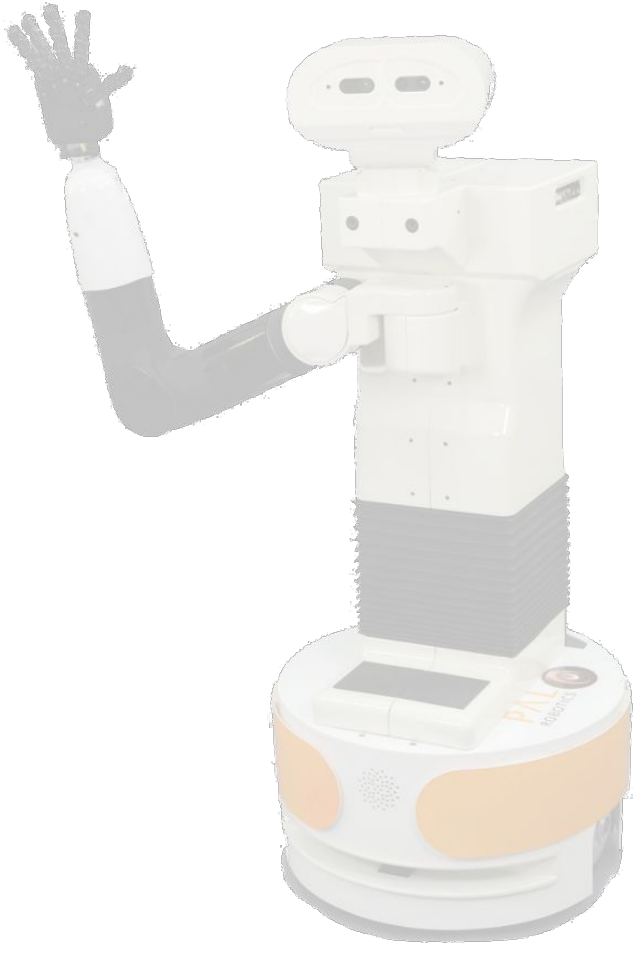
Questions?



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