Introduction to ROS

B팀

김준서
임승현
정종현
최지훤

INDEX

1. More about ROS
2. Navigation
3. Reference

1

More about ROS

1 ROS (Robot Operating System)

● What is ROS?

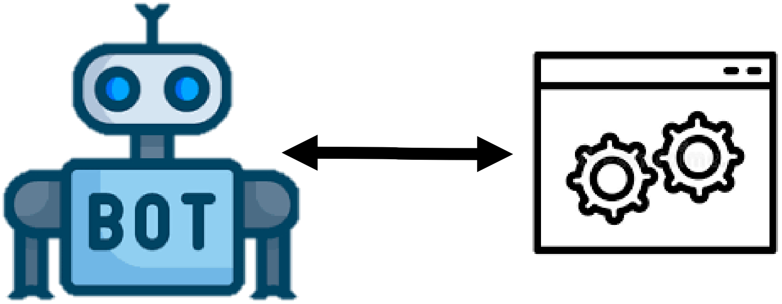
Why do we need special Robot framework?

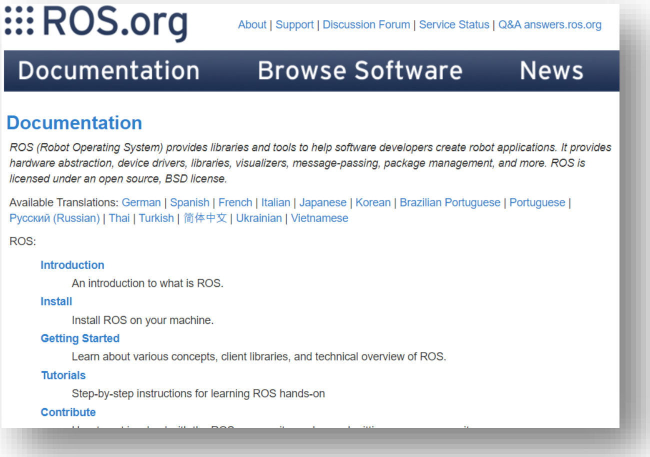
What are the advantages using ROS?

1 ROS (Robot Operating System)

What is ROS? (2)

Integration with ROS





::: ROS.org

About | Support | Discussion Forum | Service Status | Q&A answers.ros.org

Documentation Browse Software News

Documentation

ROS (Robot Operating System) provides libraries and tools to help software developers create robot applications. It provides hardware abstraction, device drivers, libraries, visualizers, message-passing, package management, and more. ROS is licensed under an open source, BSD license.

Available Translations: German | Spanish | French | Italian | Japanese | Korean | Brazilian Portuguese | Portuguese | Русский (Russian) | Thai | Turkish | 简体中文 | Ukrainian | Vietnamese

ROS:

Introduction
An introduction to what is ROS.

Install
Install ROS on your machine.

Getting Started
Learn about various concepts, client libraries, and technical overview of ROS.

Tutorials
Step-by-step instructions for learning ROS hands-on

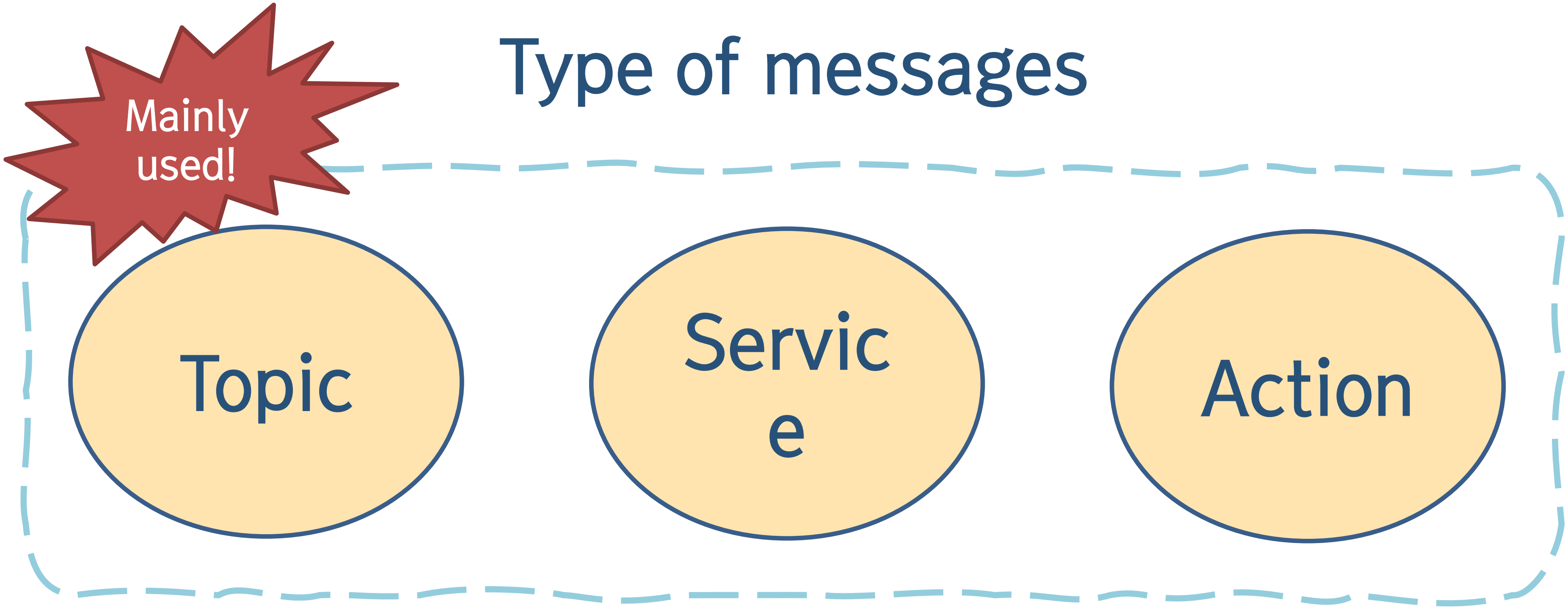
Contribute

Free wiki (with many users)

1 ROS (Robot Operating System)

- Basic Configuration & Communication

Type of messages



TCP based communication

Dividing whole framework into several nodes.

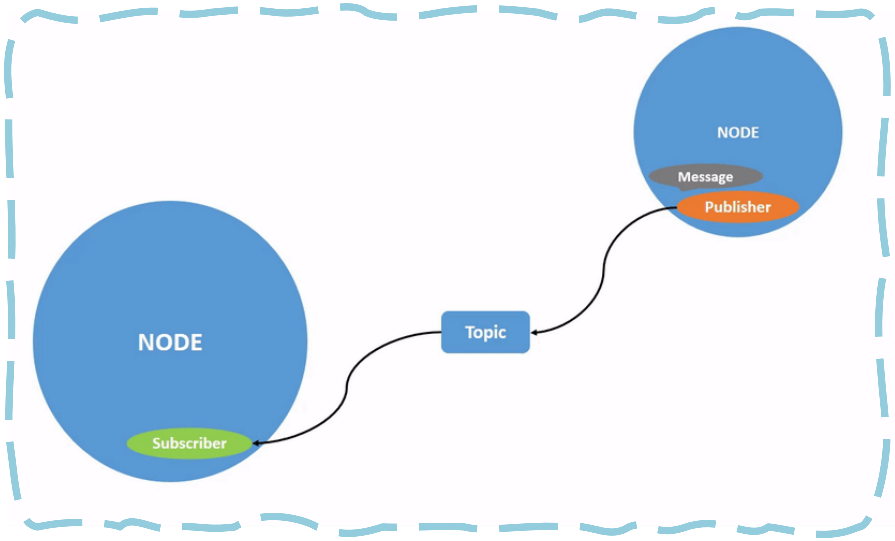
Node communicate each other by sending messages.

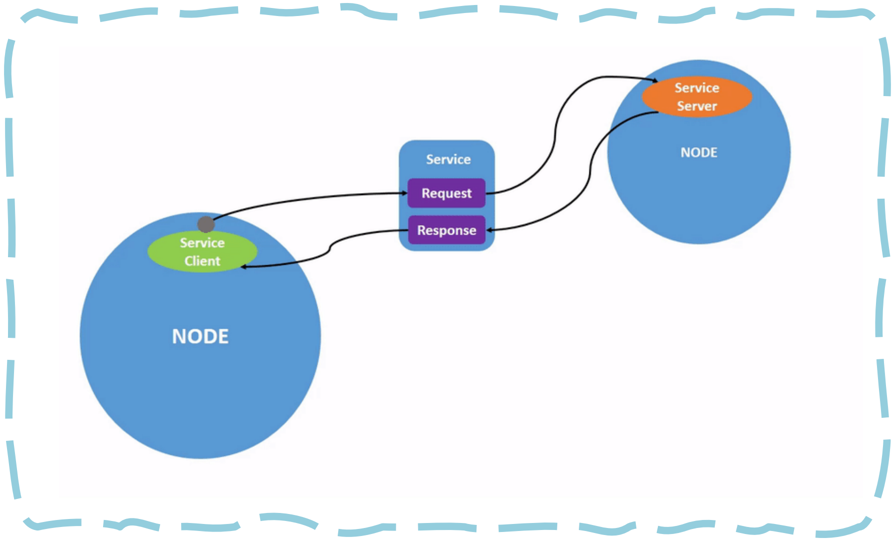
1 ROS (Robot Operating System)

Communication between nodes

Topic (Publisher-Subscriber)

Service (Server-Client)





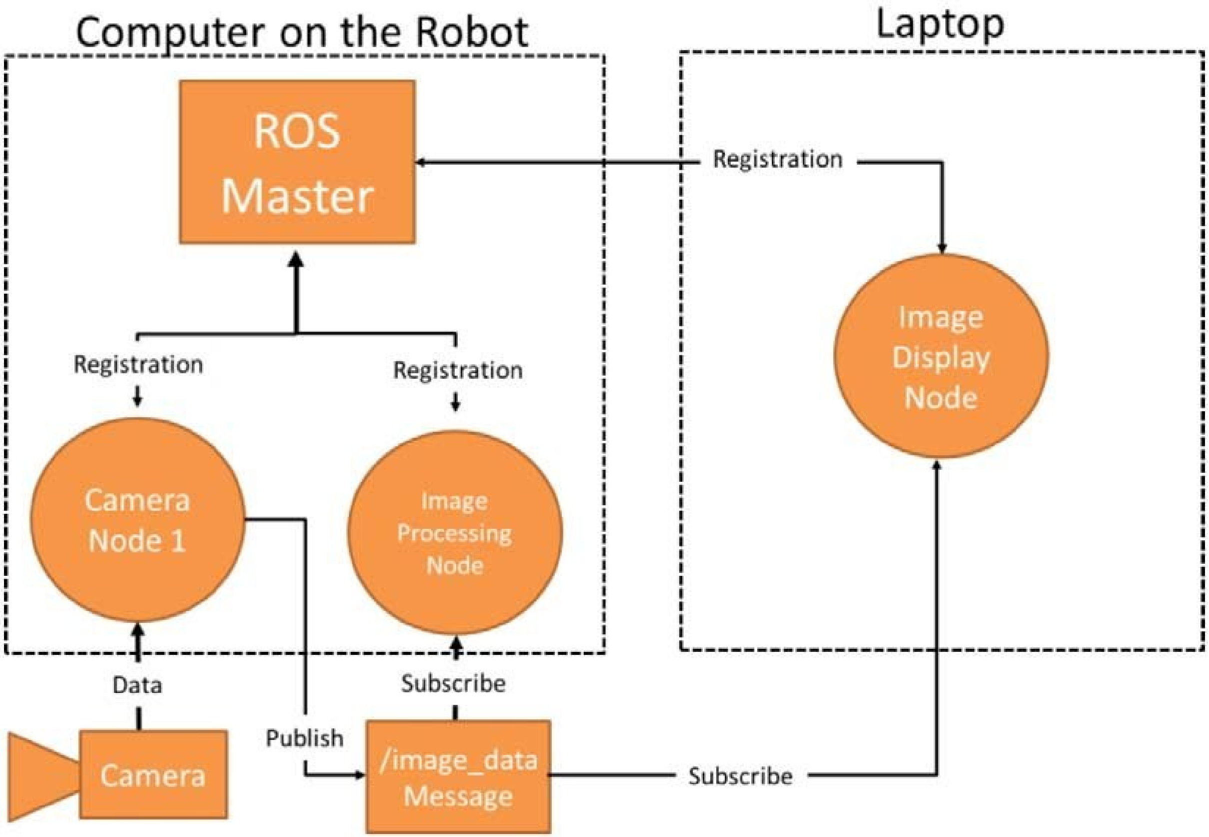
Send message all times

Send Response based on Request

http://docs.ros.org.ros.informatik.uni-freiburg.de/en/eloquent/Tutorials/Services/Understanding-ROS2-Services.html
https://docs.ros.org/en/foxy/Tutorials/Topics/Understanding-ROS2-Topics.html

1 ROS (Robot Operating System)

Node Communication example



All nodes are registered by ROS Master (Master Node)
Each node publish/subscribe data, has its own functions.

https://www.researchgate.net/figure/ROS-comprised-of-camera-node-publishes-to-the-image-data-topic-while-the-image_fig6_331719966

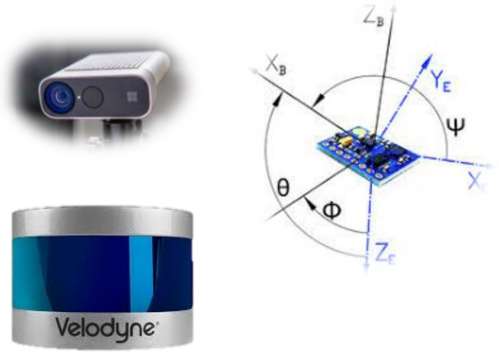
1 ROS (Robot Operating System)

Advantages for providing data types format

ROS

Regulated type of data
Ex) PointCloud,geometry_msgs

Easy for collaboration between multiple sensors, programs, etc.



Others

Cannot cover up all data types

Hard to collaborate between teams

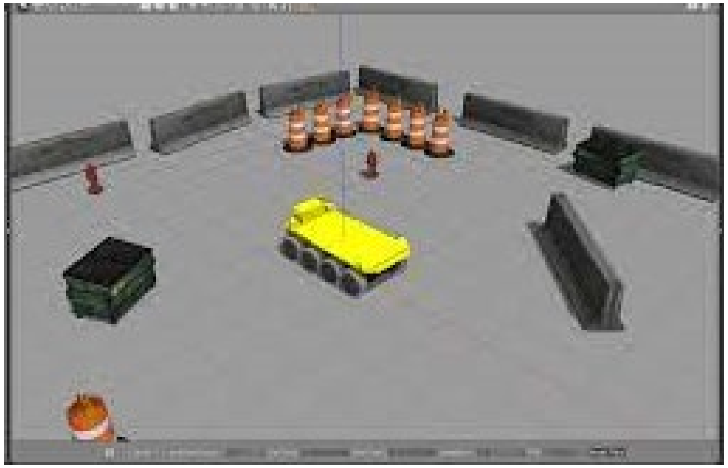
Hard to manage data formats

For ROS, you can manage your own data types by rosmsg files!

1 ROS (Robot Operating System)

Friendly with various tools & Open Source Packages

Gazebo Simulator



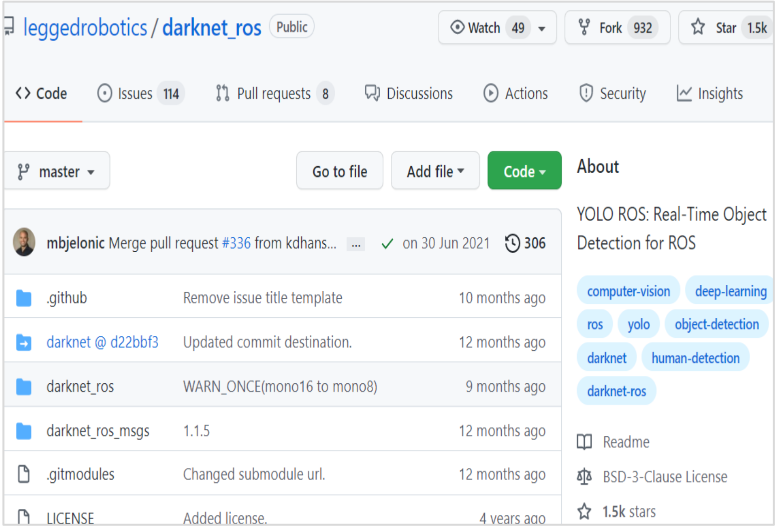
Visualization

1 ROS (Robot Operating System)

- **Friendly with various tools & Open Source Packages**

OpenCV

Image Processing



leggedrobotics / darknet_ros Public

Watch 49 · Fork 932 · Star 1.5k

Code · Issues 114 · Pull requests 8 · Discussions · Actions · Security · Insights

master · Go to file · Add file · Code

mbjelonic Merge pull request #336 from kdhans... … ✓ on 30 Jun 2021 · 306

.github	Remove issue title template	10 months ago
darknet @ d22bbf3	Updated commit destination.	12 months ago
darknet_ros	WARN_ONCE(mono16 to mono8)	9 months ago
darknet_ros_msgs	1.1.5	12 months ago
.gitmodules	Changed submodule url.	12 months ago
LICENSE	Added license.	4 years ago

About

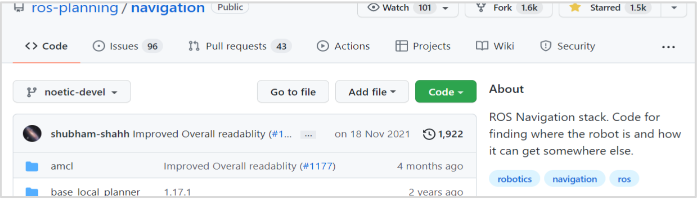
YOLO ROS: Real-Time Object Detection for ROS

computer-vision · deep-learning · ros · yolo · object-detection · darknet · human-detection · darknet-ros

Readme

BSD-3-Clause License

1.5k stars



ros-planning / navigation Public

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Code · Issues 96 · Pull requests 43 · Actions · Projects · Wiki · Security · …

noetic-devel · Go to file · Add file · Code

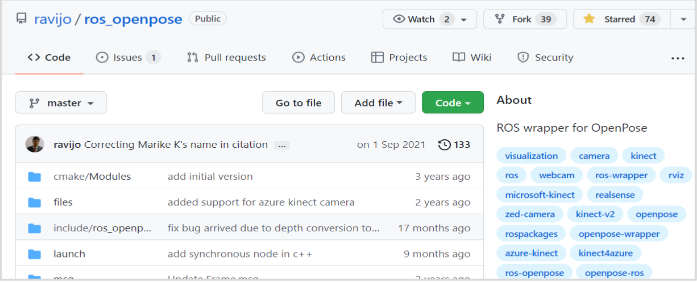
shubham-shahh Improved Overall readablity (#1… … on 18 Nov 2021 · 1,922

amcl	Improved Overall readablity (#1177)	4 months ago
base_local_planner	1.17.1	2 years ago

About

ROS Navigation stack. Code for finding where the robot is and how it can get somewhere else.

robotics · navigation · ros



ravijo / ros_openpose Public

Watch 2 · Fork 39 · Starred 74

Code · Issues 1 · Pull requests · Actions · Projects · Wiki · Security · …

master · Go to file · Add file · Code

ravijo Correcting Marike K's name in citation … on 1 Sep 2021 · 133

cmake/Modules	add initial version	3 years ago
files	added support for azure kinect camera	2 years ago
include/ros_openp...	fix bug arrived due to depth conversion to...	17 months ago
launch	add synchronous node in c++	9 months ago
msg	Update Frame.msg	2 years ago

About

ROS wrapper for OpenPose

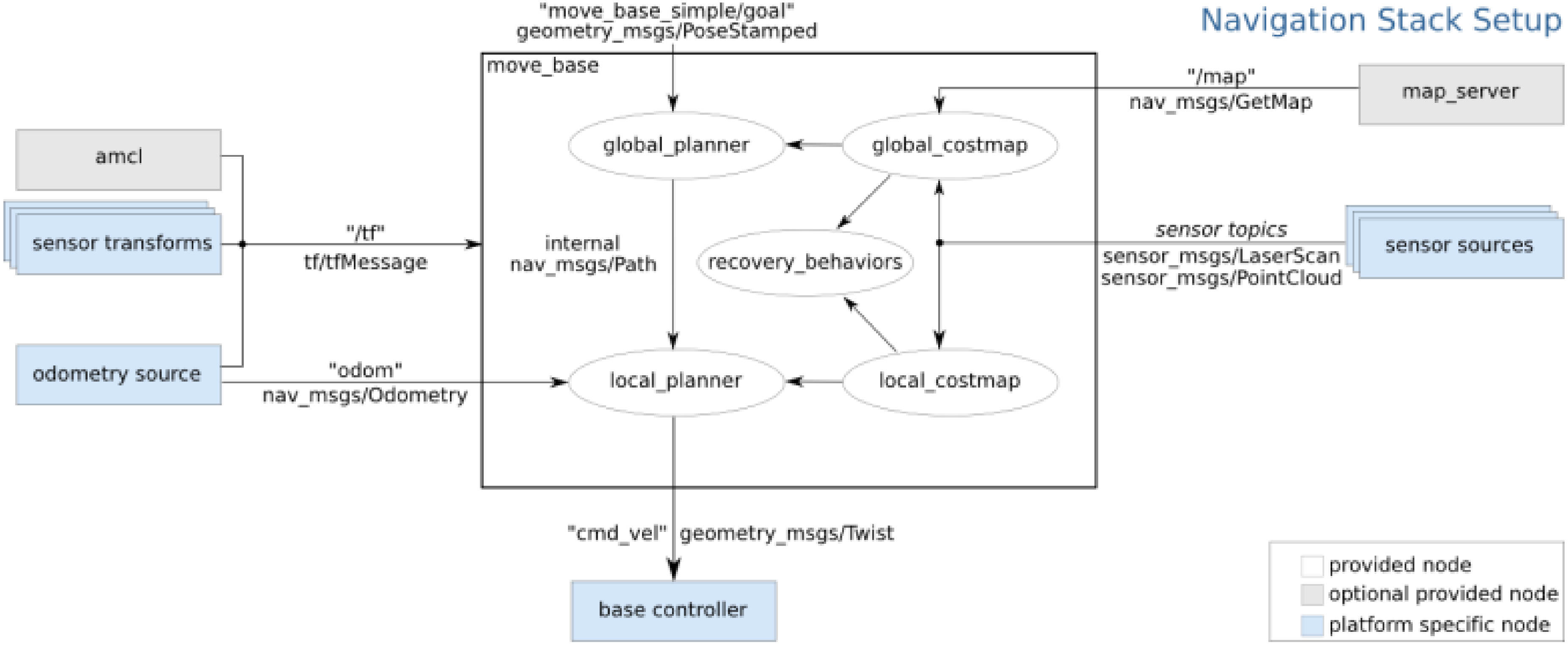
visualization · camera · kinect · ros · webcam · ros-wrapper · rviz · microsoft-kinect · realsense · zed-camera · kinect-v2 · openpose · rospackages · openpose-wrapper · azure-kinect · kinect4azure · ros-openpose · openpose-ros

Bunch of ROS packages available in github!

2

Navigation

Overview



http://wiki.ros.org/navigation/Tutorials/RobotSetup

Odometry

Wheel Odometry

Encoder

https://www.autonics.com/series/3000482

SLAM

RGB-D Camera

LiDAR

https://pinkwink.kr/1277

https://wego-robotics.com/wego-vlp-16/

GPS & IMU

GPS

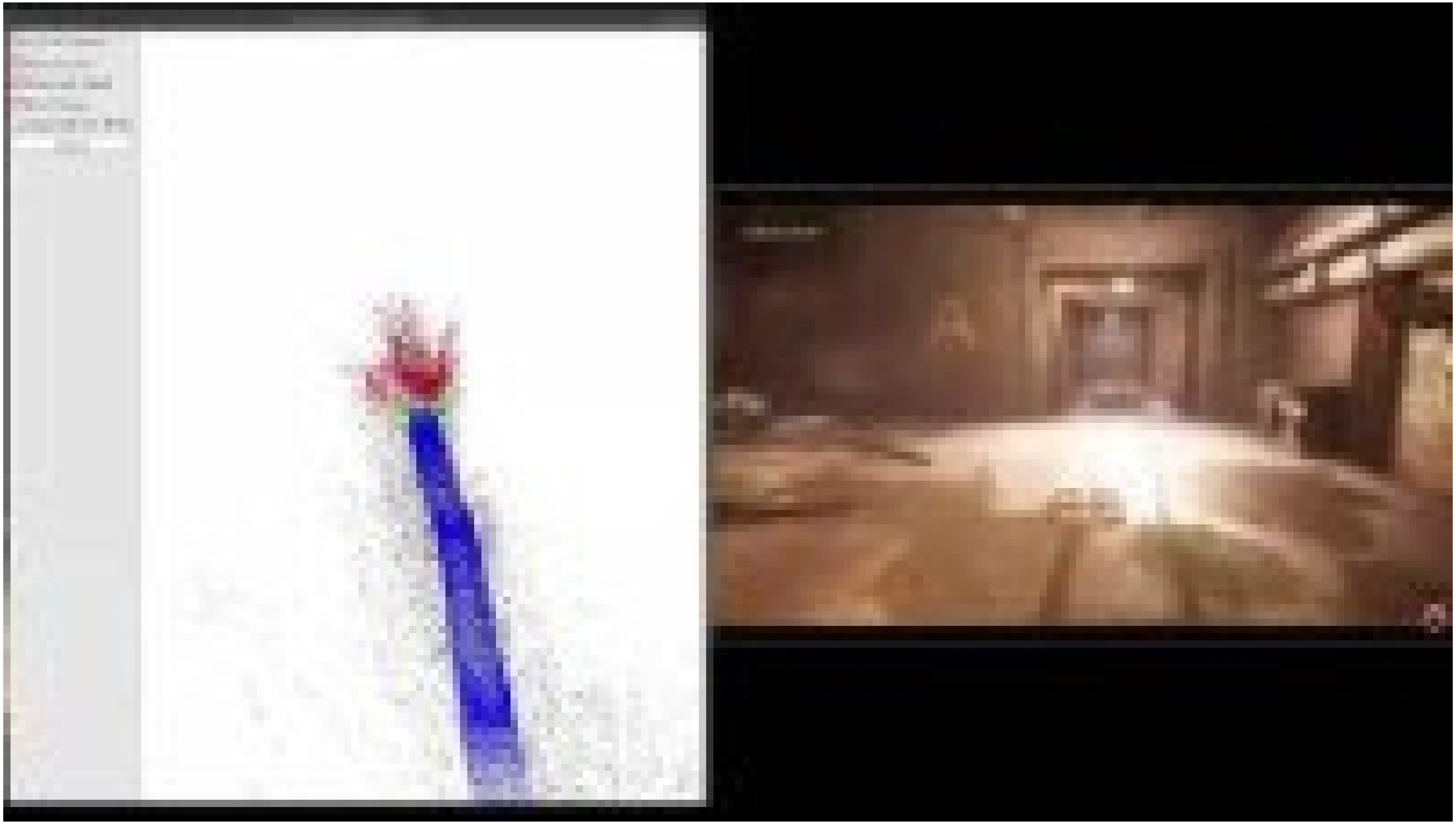
IMU

http://vctec.co.kr

https://www.e2box.co.kr/

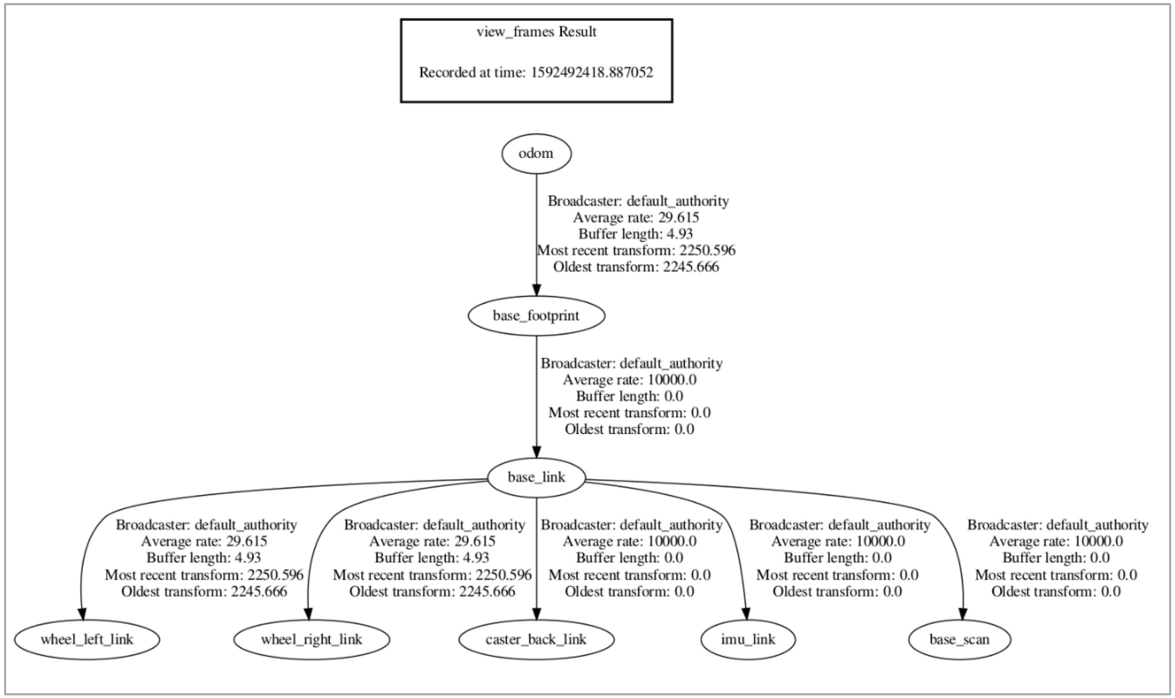
2 Navigation

Visual SLAM



2 Navigation

- TF

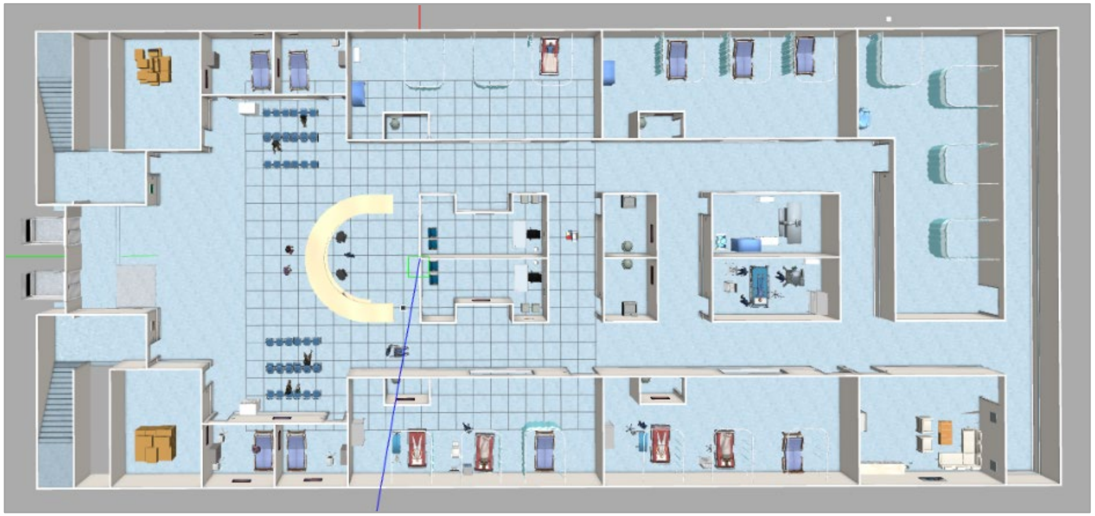

view_frames Result
Recorded at time: 1592492418.887052
odom
Broadcaster: default_authority
Average rate: 29.615
Buffer length: 4.93
Most recent transform: 2250.596
Oldest transform: 2245.666
base_footprint
Broadcaster: default_authority
Average rate: 10000.0
Buffer length: 0.0
Most recent transform: 0.0
Oldest transform: 0.0
base_link
Broadcaster: default_authority
Average rate: 29.615
Buffer length: 4.93
Most recent transform: 2250.596
Oldest transform: 2245.666
Broadcaster: default_authority
Average rate: 29.615
Buffer length: 4.93
Most recent transform: 2250.596
Oldest transform: 2245.666
Broadcaster: default_authority
Average rate: 10000.0
Buffer length: 0.0
Most recent transform: 0.0
Oldest transform: 0.0
Broadcaster: default_authority
Average rate: 10000.0
Buffer length: 0.0
Most recent transform: 0.0
Oldest transform: 0.0
Broadcaster: default_authority
Average rate: 10000.0
Buffer length: 0.0
Most recent transform: 0.0
Oldest transform: 0.0
wheel_left_link
wheel_right_link
caster_back_link
imu_link
base_scan

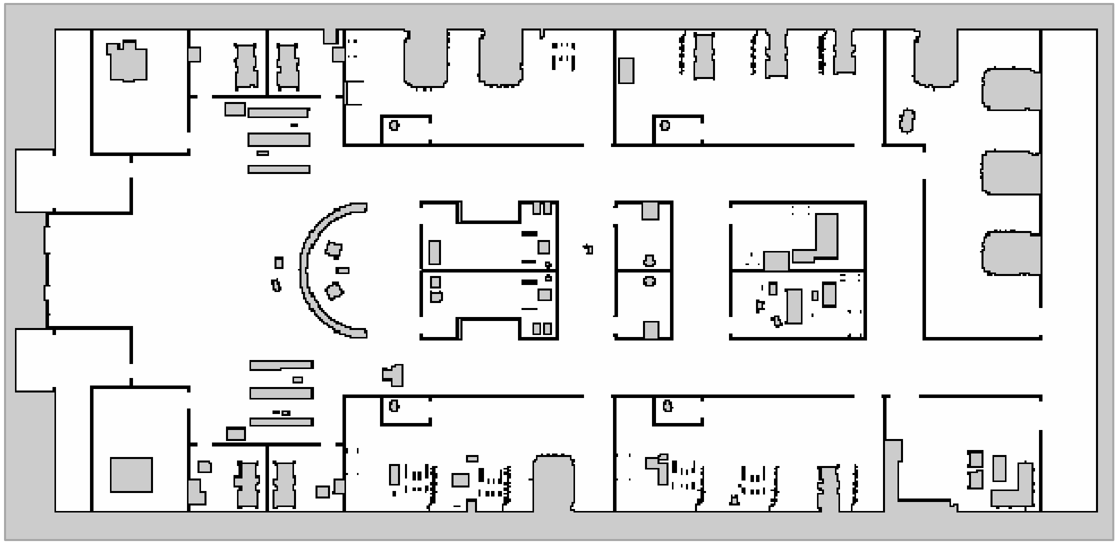
$$\begin{bmatrix} X_2 \\ Y_2 \\ Z_2 \\ 1 \end{bmatrix} = \begin{bmatrix} r_{11} & r_{12} & r_{13} & t_x \\ r_{21} & r_{22} & r_{23} & t_y \\ r_{31} & r_{32} & r_{33} & t_z \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} X_1 \\ X_1 \\ X_1 \\ 1 \end{bmatrix}$$

https://answers.ros.org/question/355242/robot_localization-with-turtlebot3/

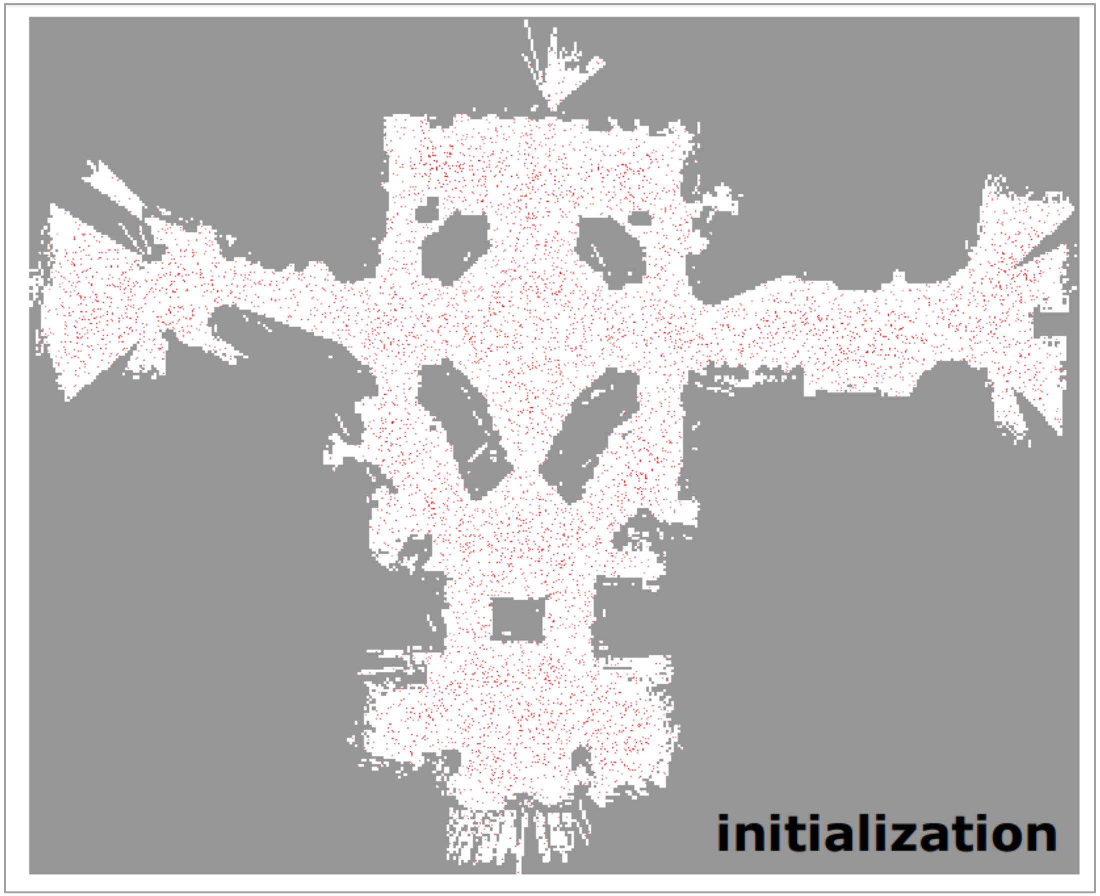
2 Navigation

Map Server





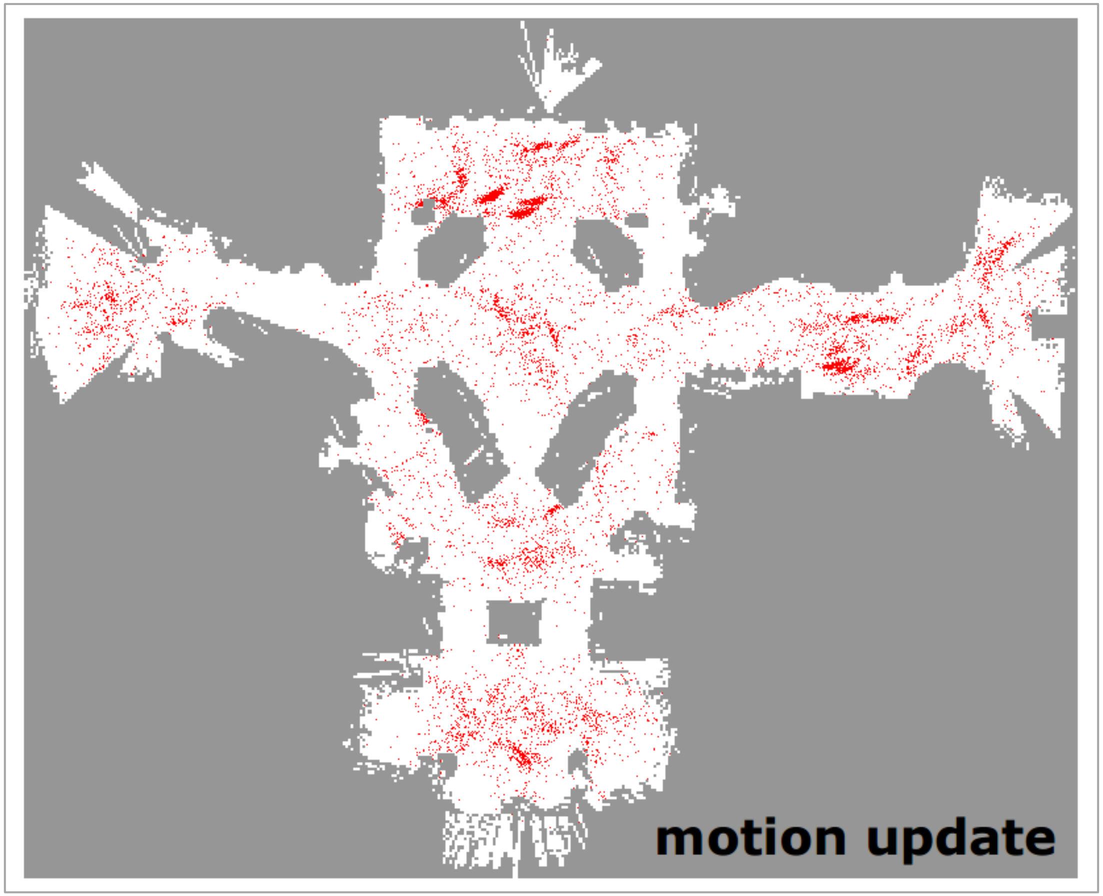
AMCL



0. Initialization: Spread particle on the map

http://jinyongjeong.github.io/2017/02/22/lec11_Particle_filter/

AMCL

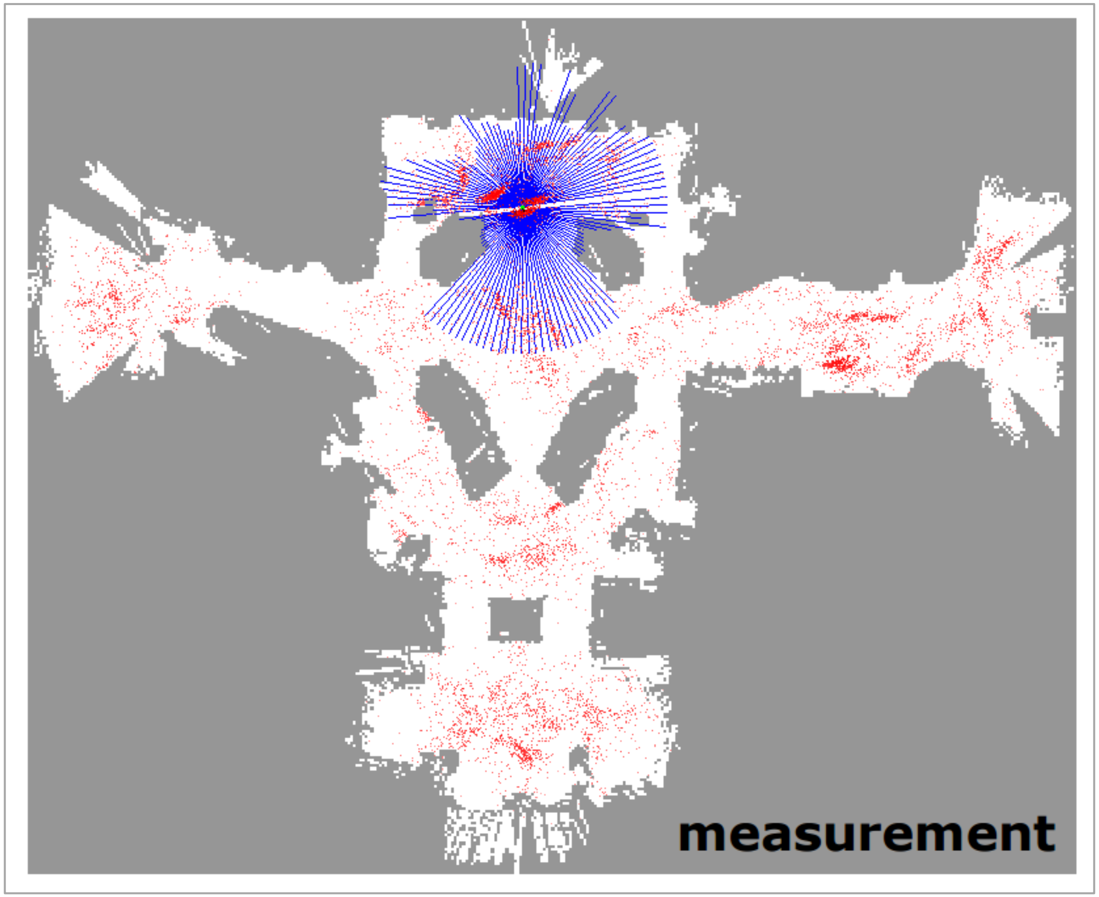


1. Motion Update: Update motion of particle by control input

http://jinyongjeong.github.io/2017/02/22/lec11_Particle_filter/

2 Navigation

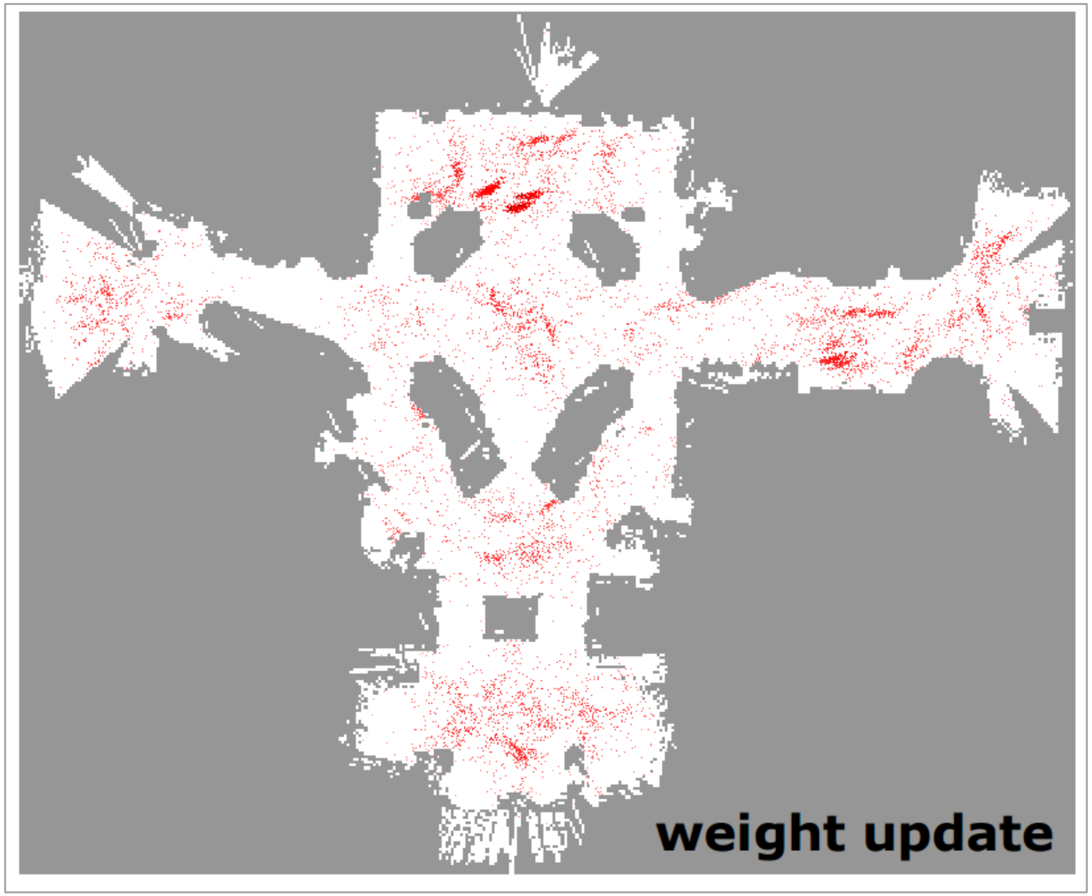
AMCL



2. Measurement: Obtain data of environment from robot sensor

http://jinyongjeong.github.io/2017/02/22/lec11_Particle_filter/

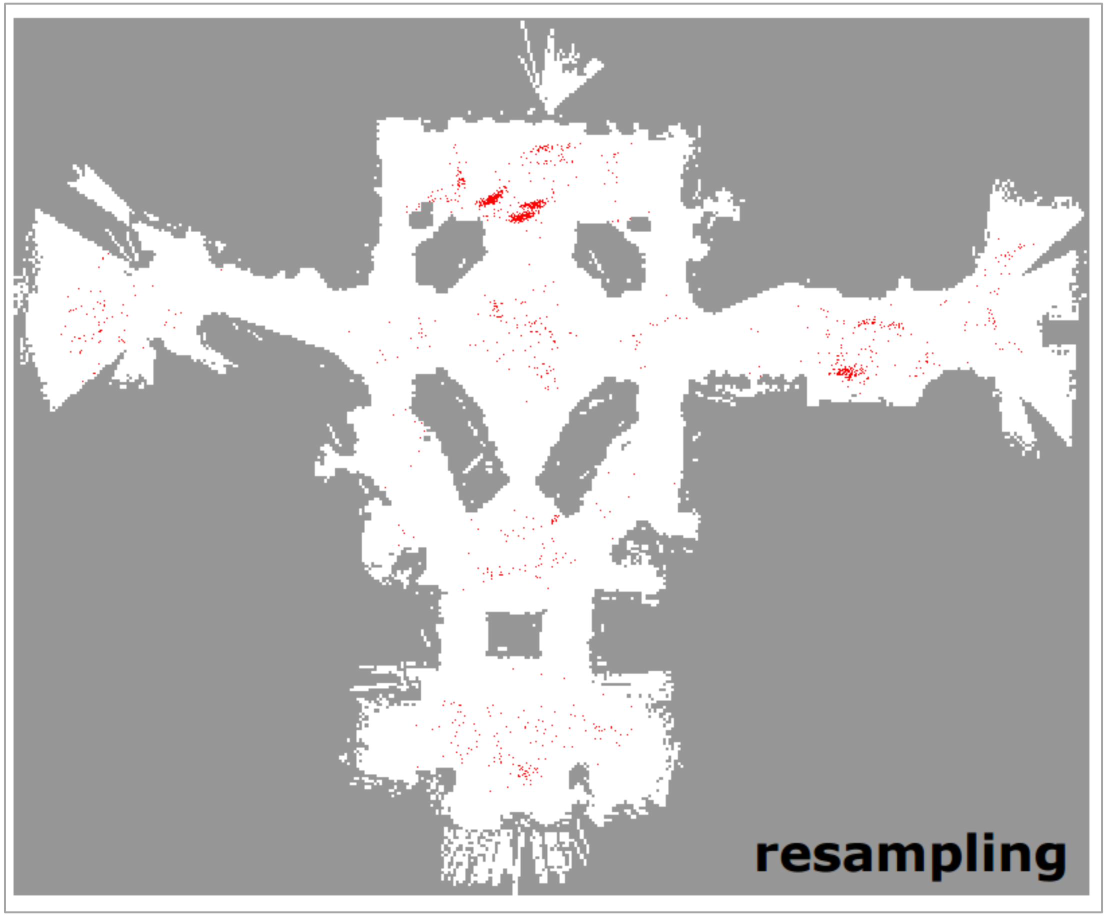
AMCL



3. Weight Update: Update weight of particle from sensor data

http://jinyongjeong.github.io/2017/02/22/lec11_Particle_filter/

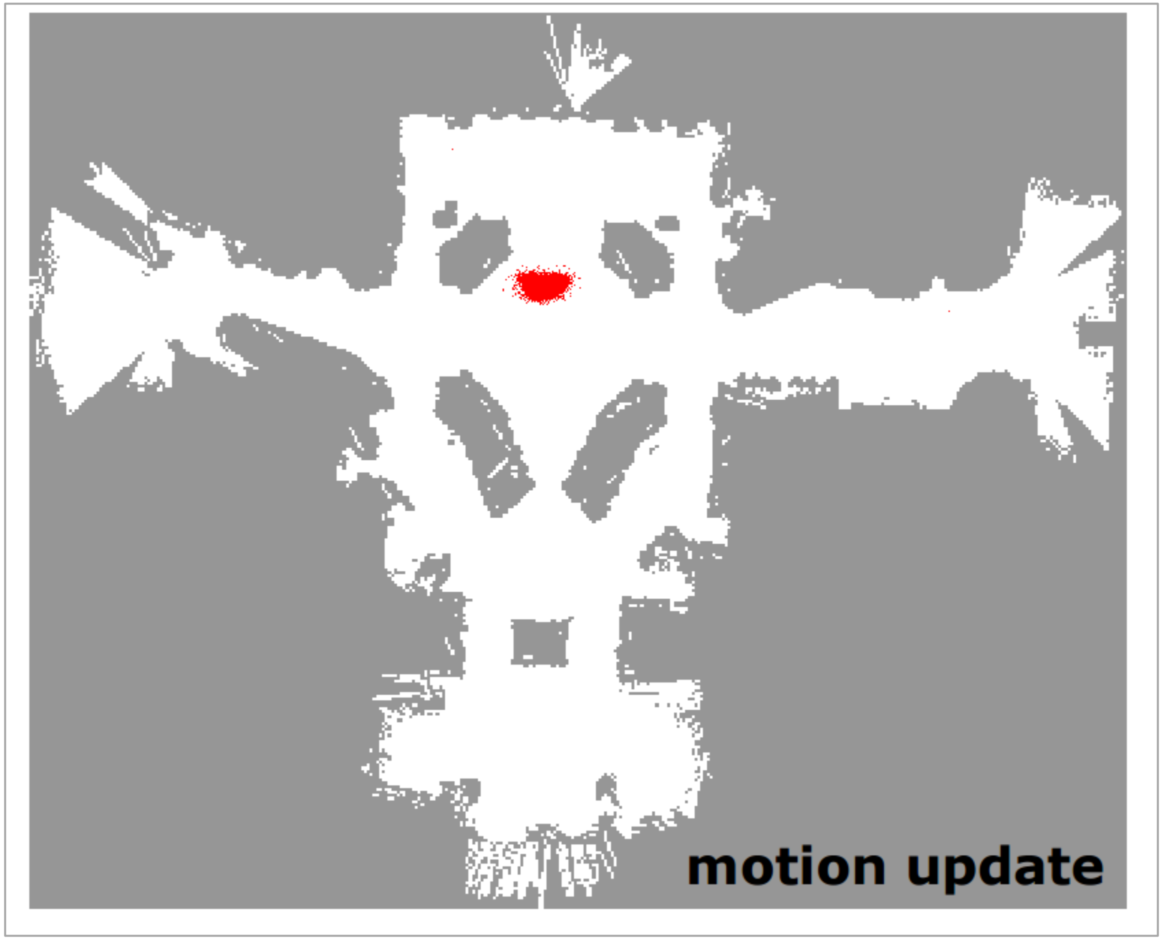
AMCL



4. Resampling: Resampling particle by weight.

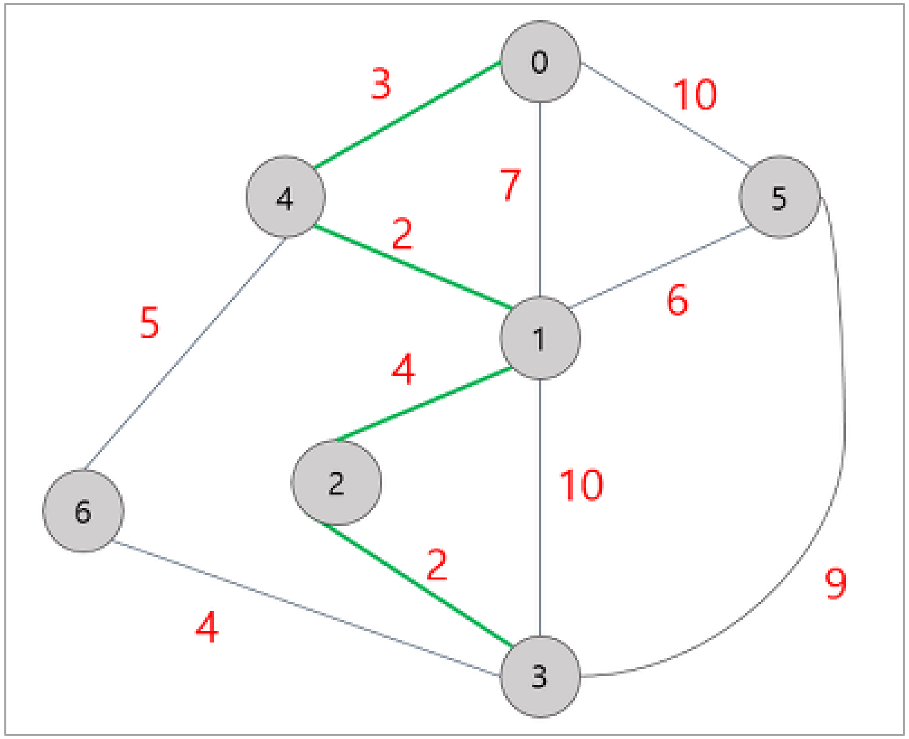
http://jinyongjeong.github.io/2017/02/22/lec11_Particle_filter/

AMCL



http://jinyongjeong.github.io/2017/02/22/lec11_Particle_filter/

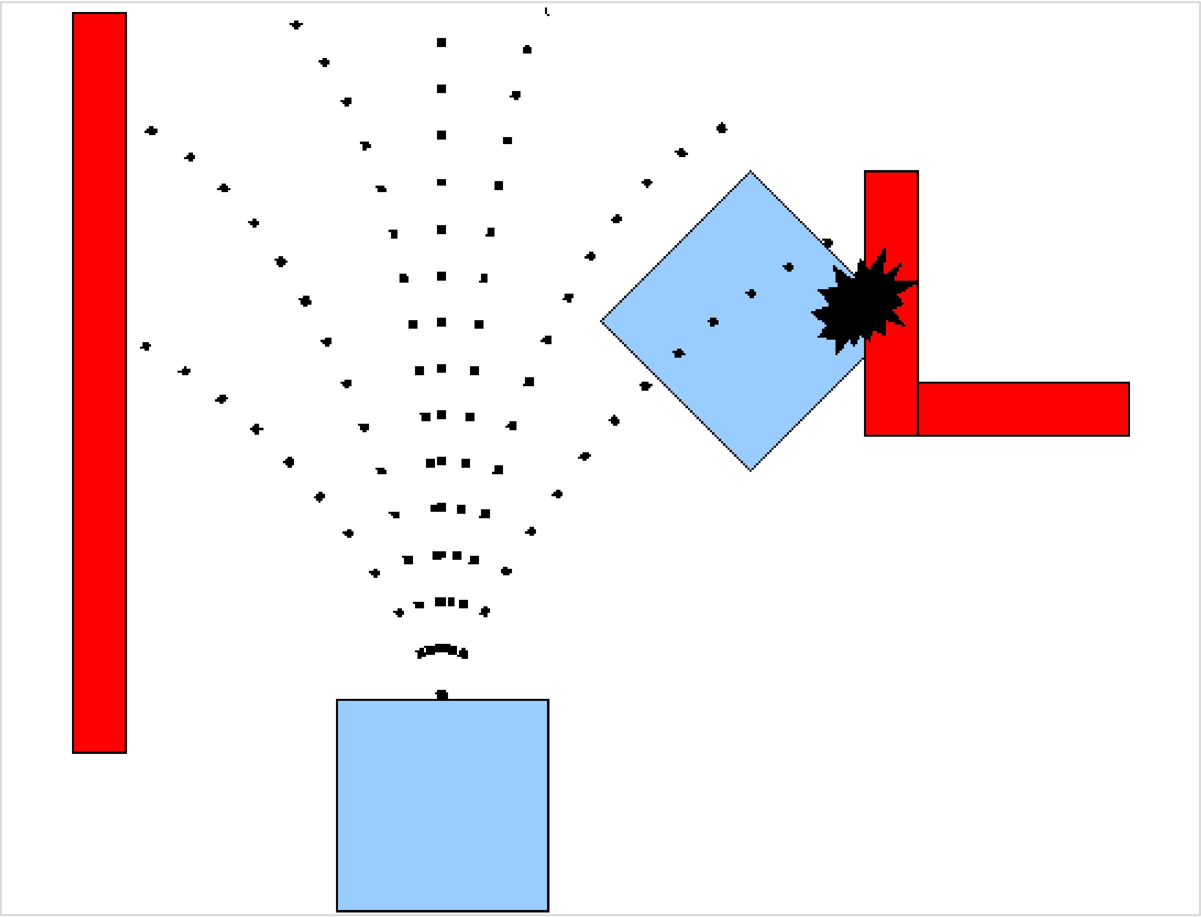
Global Planner: Dijkstra’s Algorithm



https://mattlee.tistory.com/50

1. Make cost of start node 0 and the others to inf
2. Compare start node cost + edge cost and target node cost
3. If former is smaller, update node cost and mother node
4. Repeat

Local Planner: DWA Local Planner



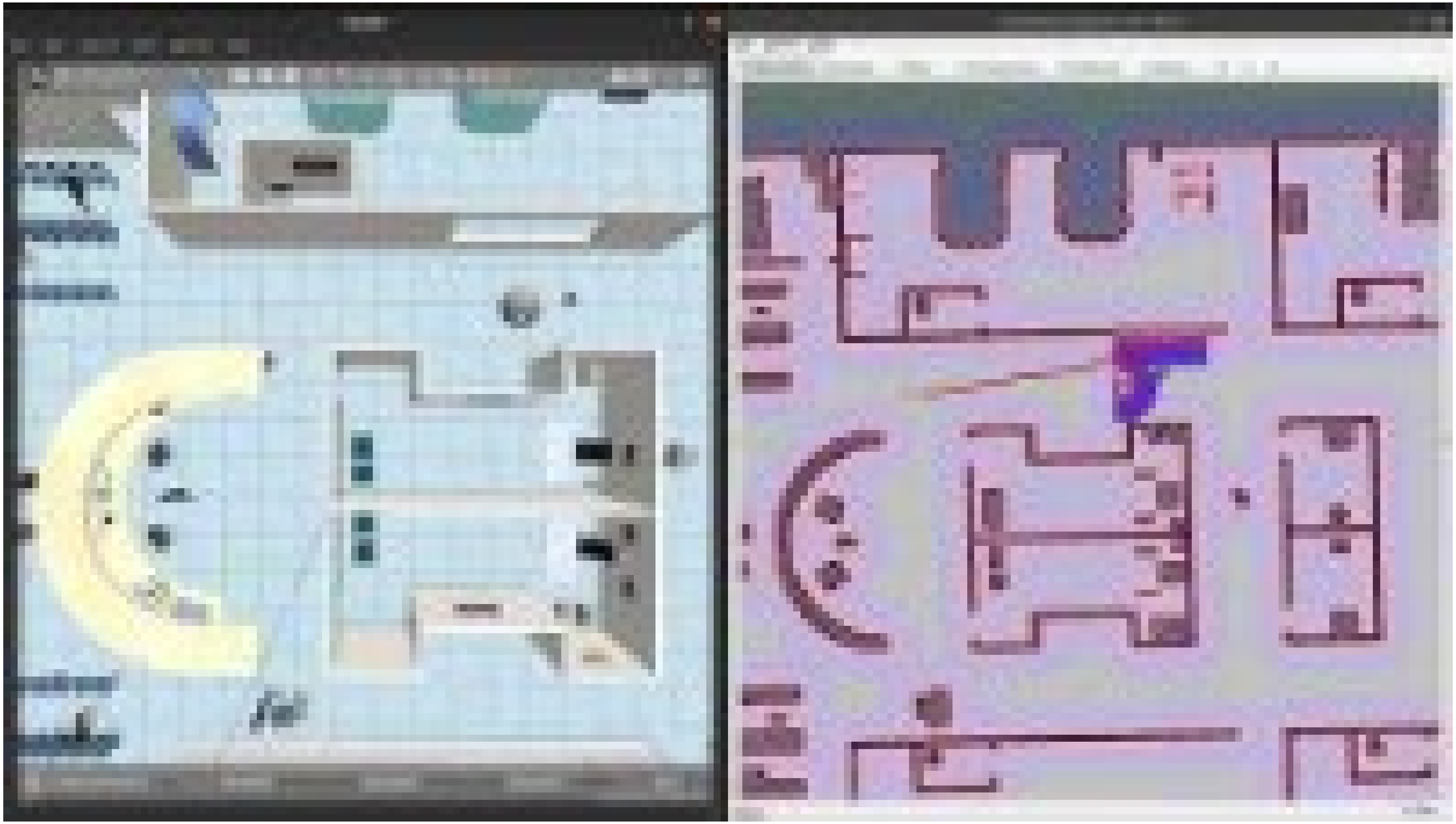
1. Discretization

2. Simulation

3. Evaluation

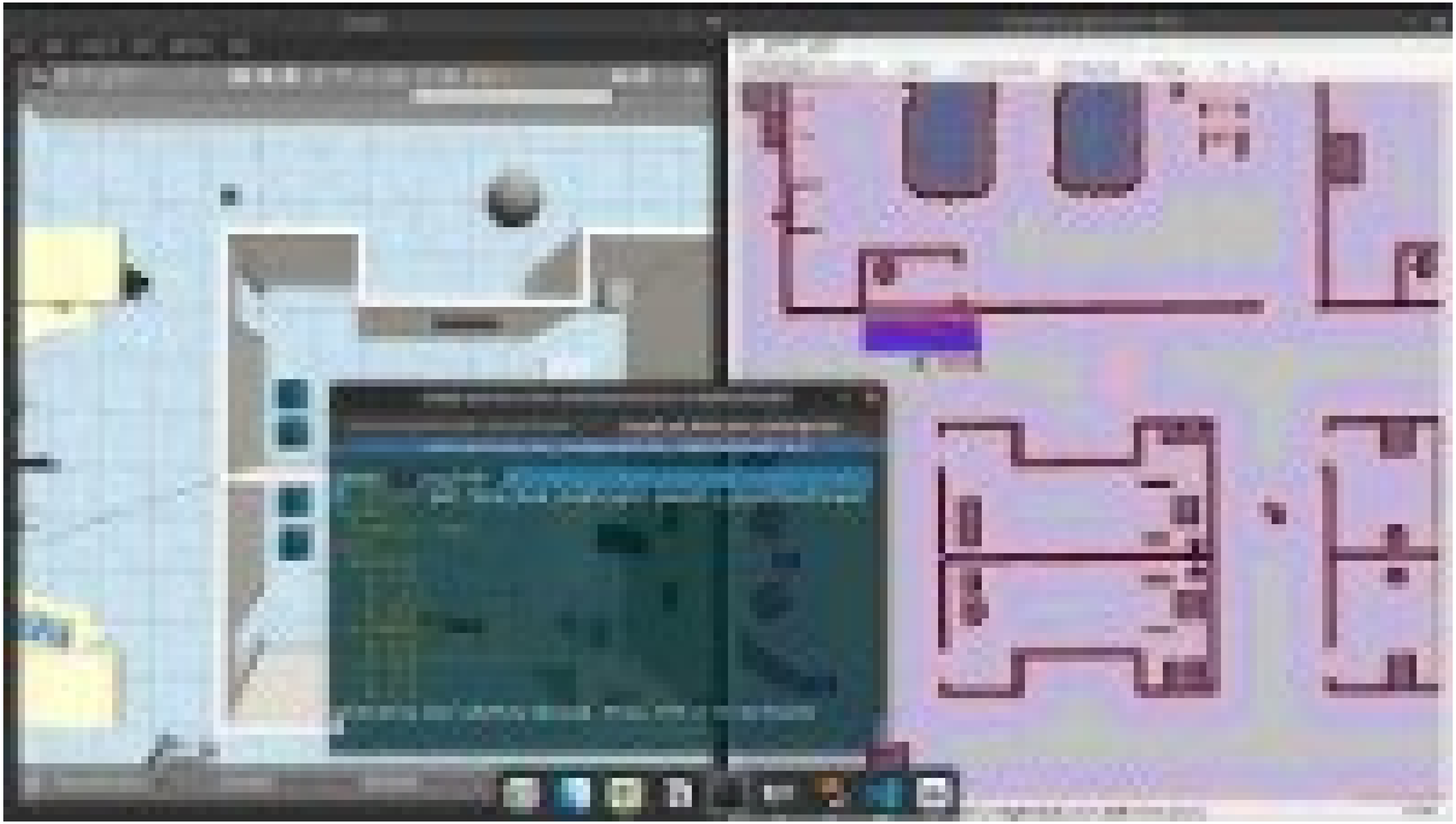
4. Selection

- Example

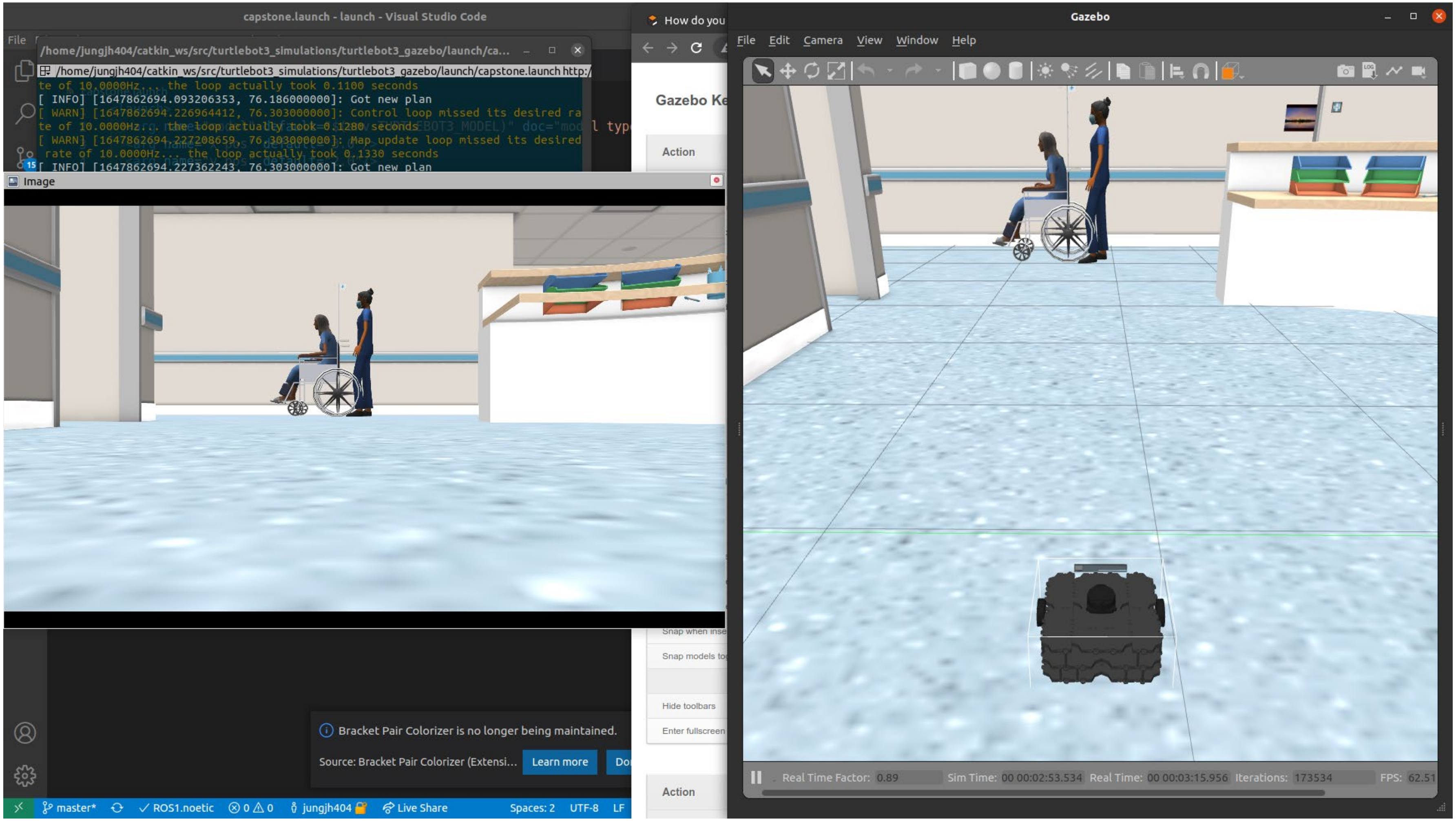


2 Navigation

- Example



Example



```
te of 10.0000Hz... the loop actually took 0.1100 seconds
[ INFO] [1647862694.093206353, 76.186000000]: Got new plan
[ WARN] [1647862694.226964412, 76.303000000]: Control loop missed its desired ra
te of 10.0000Hz... the loop actually took 0.1280 seconds
[ WARN] [1647862694.227208659, 76.303000000]: Map update loop missed its desired
 rate of 10.0000Hz... the loop actually took 0.1330 seconds
[ INFO] [1647862694.227362243, 76.303000000]: Got new plan
```

Bracket Pair Colorizer is no longer being maintained.

Source: Bracket Pair Colorizer (Extensi...

Real Time Factor: 0.89 Sim Time: 00 00:02:53.534 Real Time: 00 00:03:15.956 Iterations: 173534 FPS: 62.51

capstone.launch - launch - Visual Studio Code
File
/home/jungjh404/catkin_ws/src/turtlebot3_simulations/turtlebot3_gazebo/launch/ca...
/home/jungjh404/catkin_ws/src/turtlebot3_simulations/turtlebot3_gazebo/launch/capstone.launch http:/
Image
How do you
Gazebo Ke
Action
Snap when inse
Snap models to
Hide toolbars
Enter fullscreen
Action
Learn more
Do
master*
ROS1.noetic
⊗ 0 ⚠ 0
jungjh404
Live Share
Spaces: 2
UTF-8
LF
Gazebo
File
Edit
Camera
View
Window
Help

2 Navigation

Example