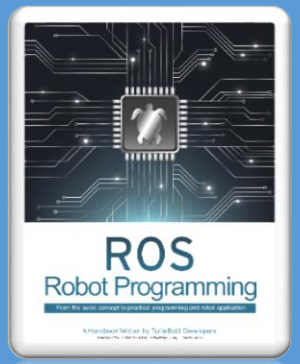
Robot, Sensor, Motor

ROBOTIS

KAIST



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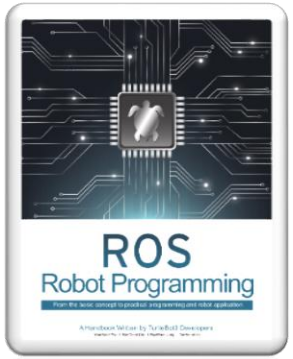

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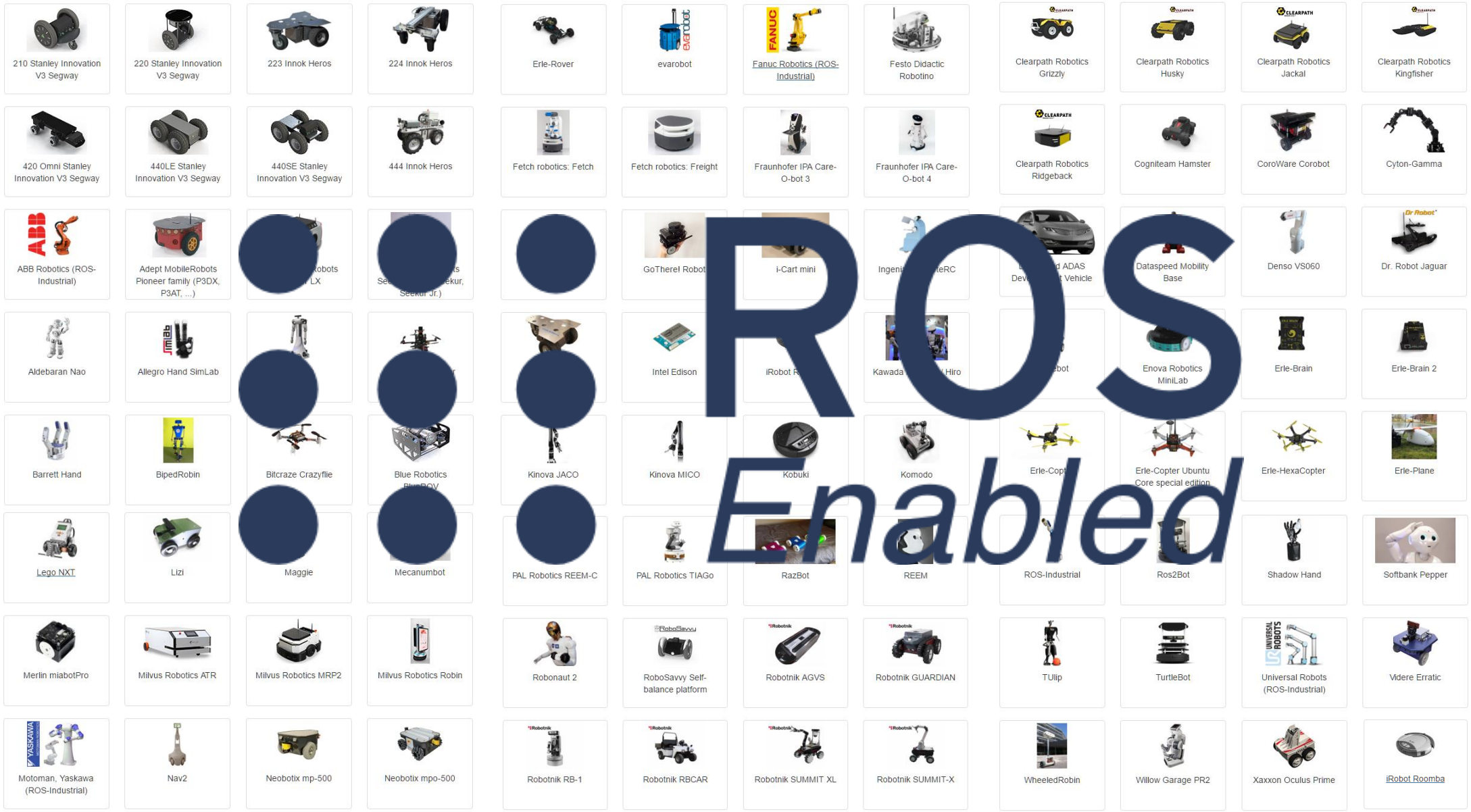
Robot Packages

Robot Package (http://robots.ros.org/)



ROS Enabled

Sensor Packages

Sensor Package (http://wiki.ros.org/Sensors)

Type of sensor package

- **1D Range Finders**
  - Infrared linear distance sensor that can be used to make low-cost robots
- **2D Range Finders**
  - Sensors that can measure the distance on 2D plane, and is mainly used for navigation
- **3D Sensors**
  - Sensors used in 3D distance measurement such as Intel's RealSense, Microsoft's Kinect, ASUS's Xtion
- **Audio/Speech Recognition**
  - Currently, there are few voice recognition related parts, but it seems to be added continuously
- **Cameras**
  - Camera driver used for object recognition, face recognition, character recognition, etc. and various application packages
- **Sensor Interfaces**
  - Very few sensors support USB and web protocols
  - There are still many sensors that can acquire data from a microprocessor
  - These sensors can be used with UART in MCU, or ROS in mini PC.

Practice Time

'LRF, IMU, USB camera,
Depth camera, Robot Model
Let's check through Rviz'

use the Rviz of your Pc to observe the data
from the sensors that you have received

Today's Practice Material

Sensor Package Practice #1 (USB Camera)

```
$ sudo apt-get install ros-kinetic-uvc-camera

$ rosrun uvc_camera uvc_camera_node
$ rosrun uvc_camera uvc_camera_node _device:=/dev/video?

$ rosrun image_view image_view image:=/image_raw
$ rqt_image_view image:=/image_raw
$ rviz
```

If there are more than two cameras,
Enter the device number you want to use
instead of the question mark
(Especially, for notebooks)

Three ways to view image messages

* Change the display options of RViz

1) Change fixed frame

   Global Options > Fixed Frame = camera

2) Add image display

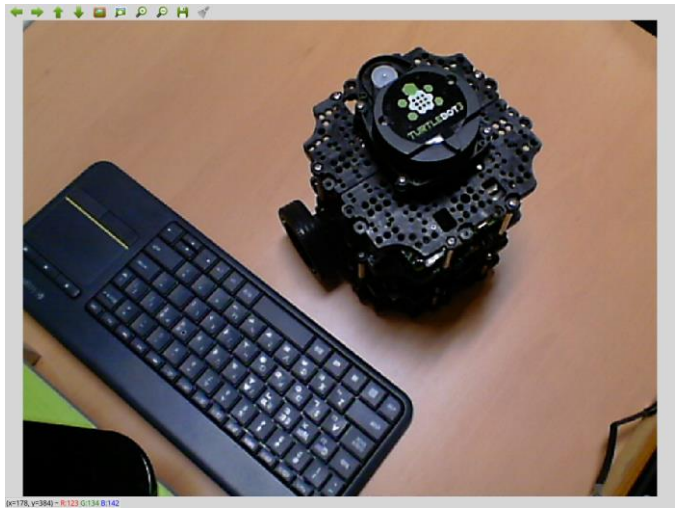
   Click 'Add' in the bottom left corner of Rviz, then select Image

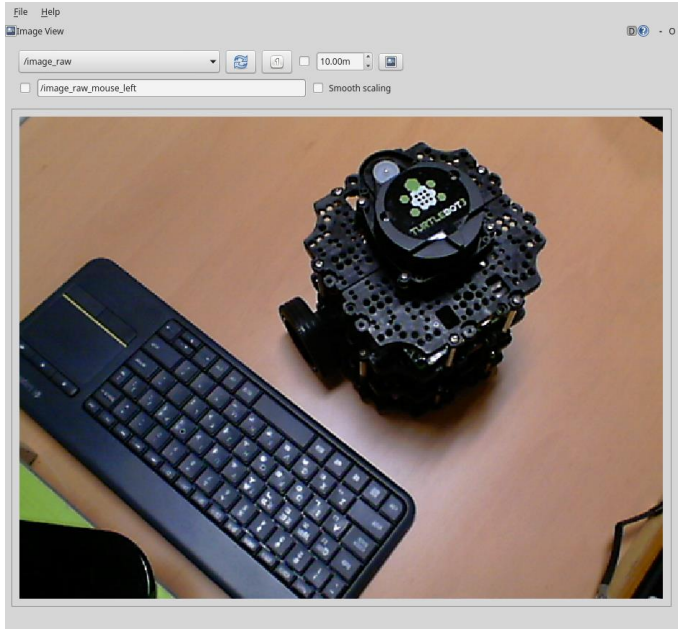
   (Add > by display > Rviz > Image)

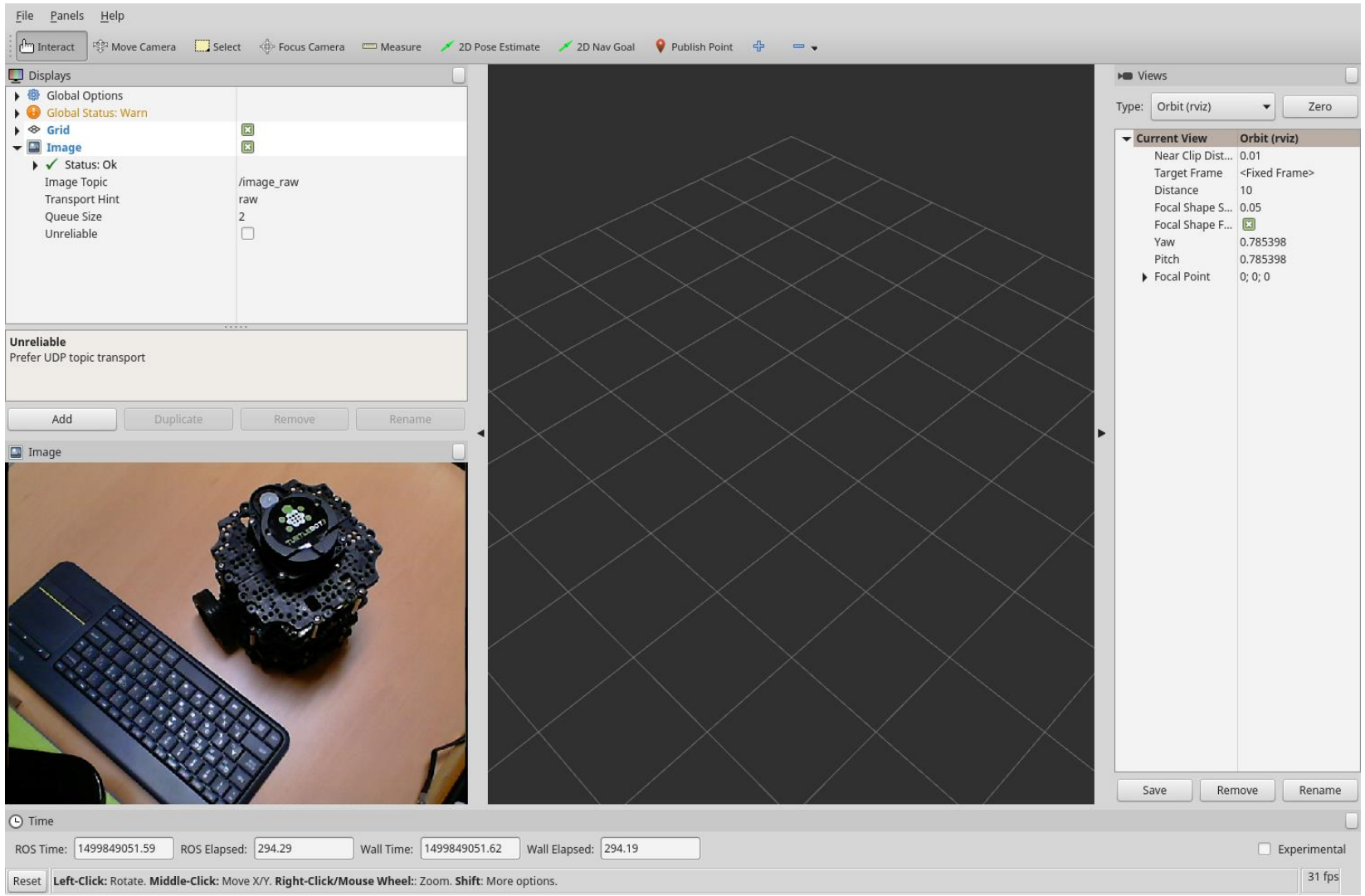
3) Change topic value

   Change the value of 'Image > Image Topic' to "/image_raw"

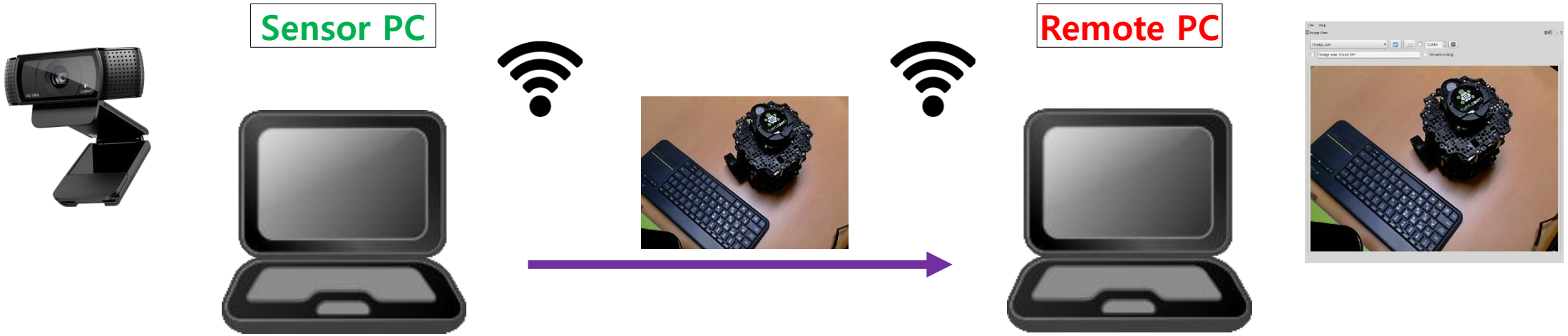
Sensor Package Practice #1 (USB Camera)







Sensor Package Practice #2 (Transfer images remotely)



ROS_MASTER_URI = **http://IP_OF_REMOTE_PC:11311**
ROS_HOSTNAME = **IP_OF_SENSOR_PC**

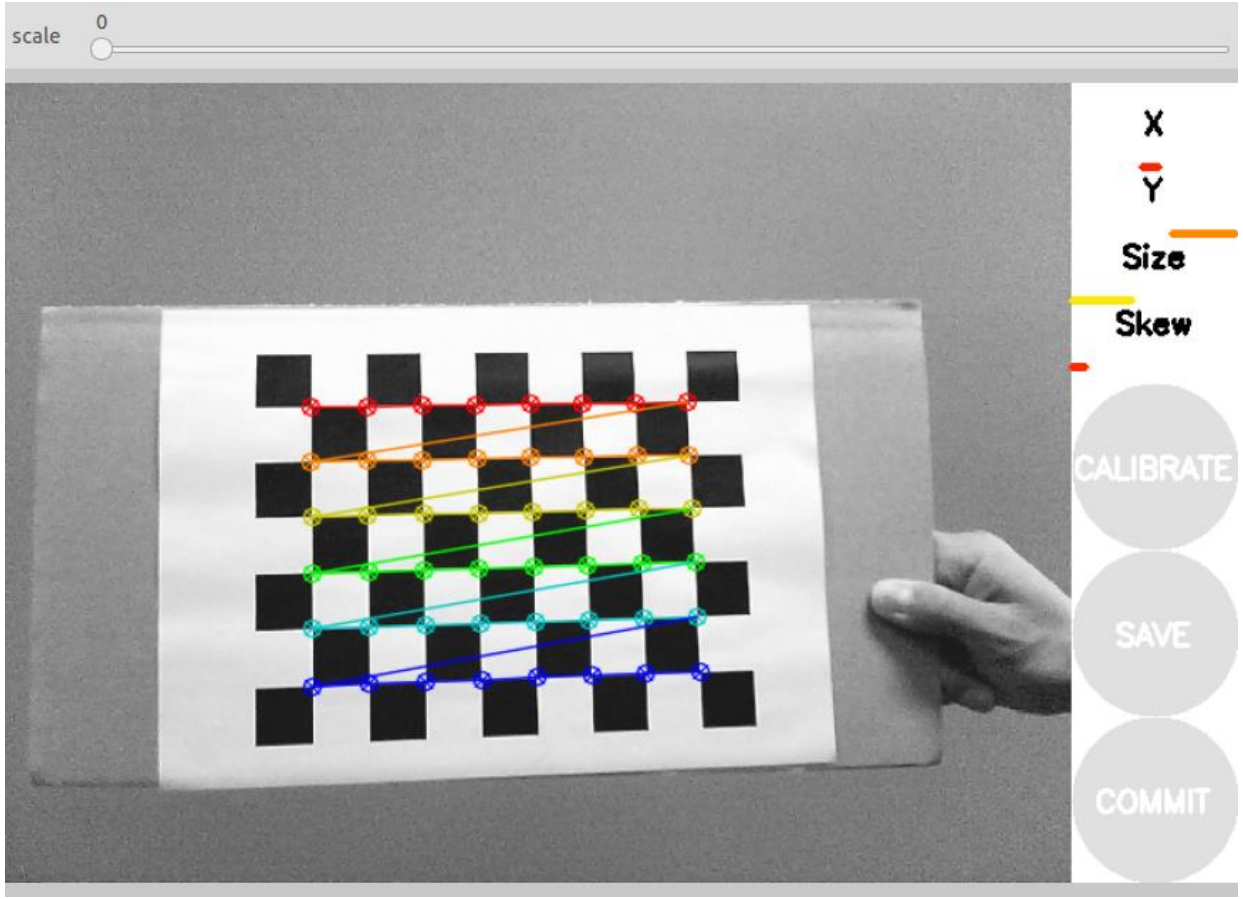
ROS_MASTER_URI = **http://IP_OF_REMOTE_PC:11311**
ROS_HOSTNAME = **IP_OF_REMOTE_PC**

* Example of running ROS Master on a remote PC

- Modify '~/.bashrc' for each PC (ROS_MASTER_URI and ROS_HOSTNAME)
- Run '**roscore**' & '**rqt_image_view image:=/image_raw**' on the remote PC
- Run '**rosrun uvc_camera**', '**uvc_camera_node**' on the sensor PC

Sensor Package Practice #3 (Camera Calibration)

```
$ sudo apt-get install ros-kinetic-camera-calibration
$ rosrun uvc_camera uvc_camera_node
$ rosrun camera_calibration cameracalibrator.py --size 8x6 --square 0.024 image:=/image_raw camera:=/camera
```



Sensor Package Practice #4 (Depth Camera)

```
$ sudo apt-get install ros-kinetic-openni2-camera ros-kinetic-openni2-launch
$ tar -xvf Sensor-Bin-Linux-x64-v5.1.0.41.tar.bz2
$ cd Sensor-Bin-Linux-x64-v5.1.0.41/
$ sudo sh install.sh
$ roslaunch openni2_launch openni2.launch
```

(In case of ASUS's Xtion)

```
$ sudo apt-get install ros-kinetic-astra-camera ros-kinetic-astra-launch
$ wget https://raw.githubusercontent.com/tfoote/ros_astra_camera/master/orbbec-usb.rules
$ wget https://raw.githubusercontent.com/tfoote/ros_astra_camera/master/install.sh
$ sudo ./install.sh
$ roslaunch astra_launch astra.launch
```

(In case of ASTRA)

* Change the display options of RViz

1) Change fixed frame
   Change 'Global Options > Fixed Frame' to "camera_depth_frame"

2) Add & configure PointCloud2
   Click 'Add' at the bottom left of rviz, then select PointCloud2

3) Change topic name & detail settings

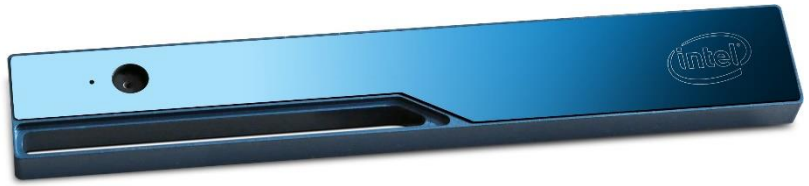
Sensor Package Practice #4 (Depth Camera)

(In case of RealSense)

```
$ sudo apt-get install ros-kinetic-librealsense ros-kinetic-realsense-camera
$ roslaunch realsense_camera r200_nodelet_default.launch
$ rosrun rviz rviz -d rviz/realsenseRvizConfiguration1.rviz
```

* Change the display options of RViz

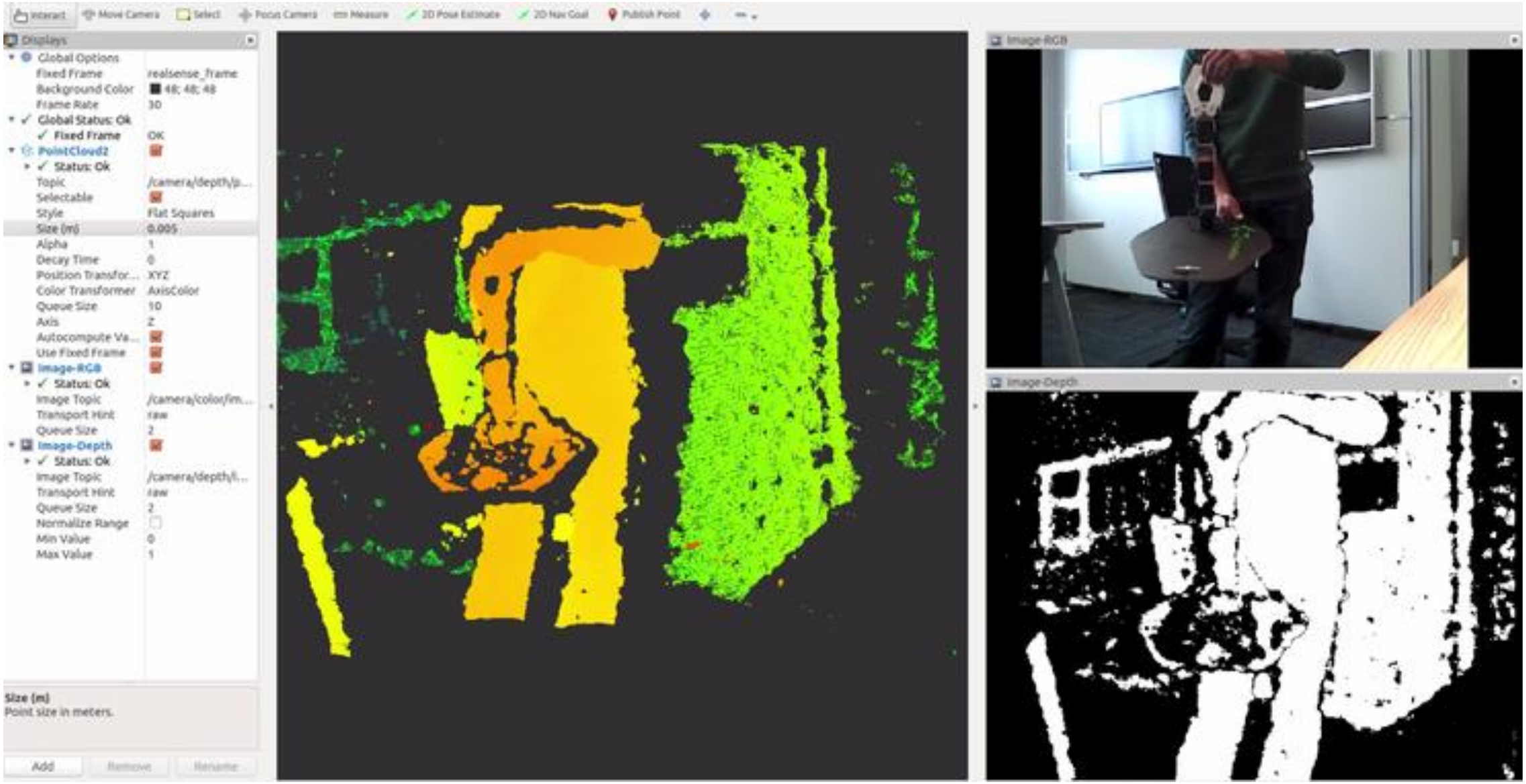
1) Change fixed frame
   Change ‘Global Options > Fixed Frame’ to "camera_depth_frame"



2) Add & configure PointCloud2
   Click ‘Add’ at the bottom left of rviz, then select PointCloud2

3) Change topic name & detail settings

Sensor Package Practice #4 (Depth Camera)



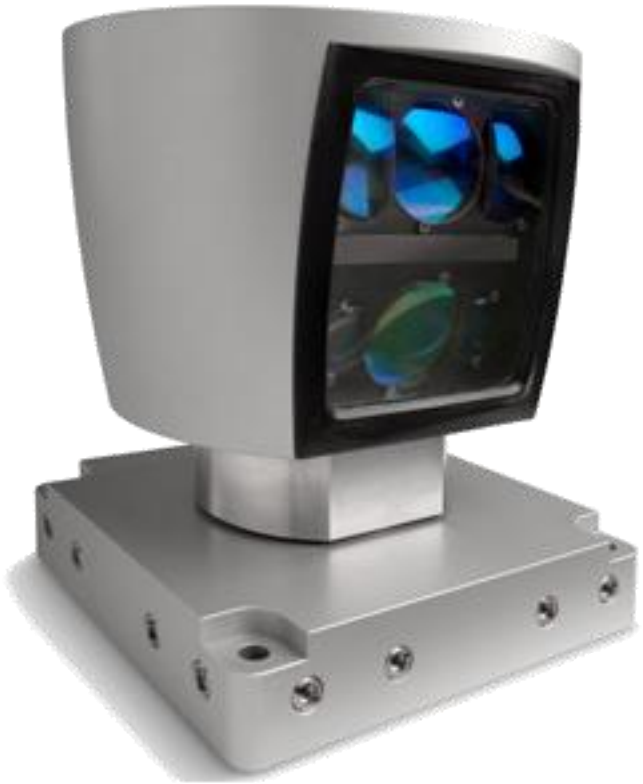
Sensor Package Practice #5 (Stereo Camera)

```
$ sudo apt-get install libv4l-dev libudev-dev ros-kinetic-rtabmap*
$ cd ~/catkin_ws/src/
$ svn export https://github.com/withrobot/oCam/trunk/Software/oCamS_ROS_Package/ocams
$ cd ~/catkin_ws/ && catkin_make
$ sudo gedit /etc/udev/rules.d/99-ttyacms.rules
ATTRS{idVendor}=="04b4" ATTRS{idProduct}=="00f9", MODE="0666", ENV{ID_MM_DEVICE_IGNORE}="1"
ATTRS{idVendor}=="04b4" ATTRS{idProduct}=="00f8", MODE="0666", ENV{ID_MM_DEVICE_IGNORE}="1"
$ sudo udevadm control --reload-rules
$ roslaunch ocams pointcloud.launch
```

(In case of oCam-Stereo)

https://github.com/withrobot/oCam/tree/master/Products/oCamS-1CGN-U

Sensor Package Practice #6 (LDS)



Sensor Package Practice #6 (LDS)

(In case of LDS)

```
$ cs
$ git clone https://github.com/ROBOTIS-GIT/hls_lfcd_lds_driver.git
$ cm
$ sudo chmod a+rw /dev/ttyUSB0
$ roslaunch hls_lfcd_lds_driver view_hlds_laser.launch
```

(In case of RPLiDAR)

```
$ cs
$ git clone https://github.com/robopeak/rplidar_ros.git
$ cm
$ sudo chmod a+rw /dev/ttyUSB0
$ roslaunch rplidar_ros rplidar.launch
```

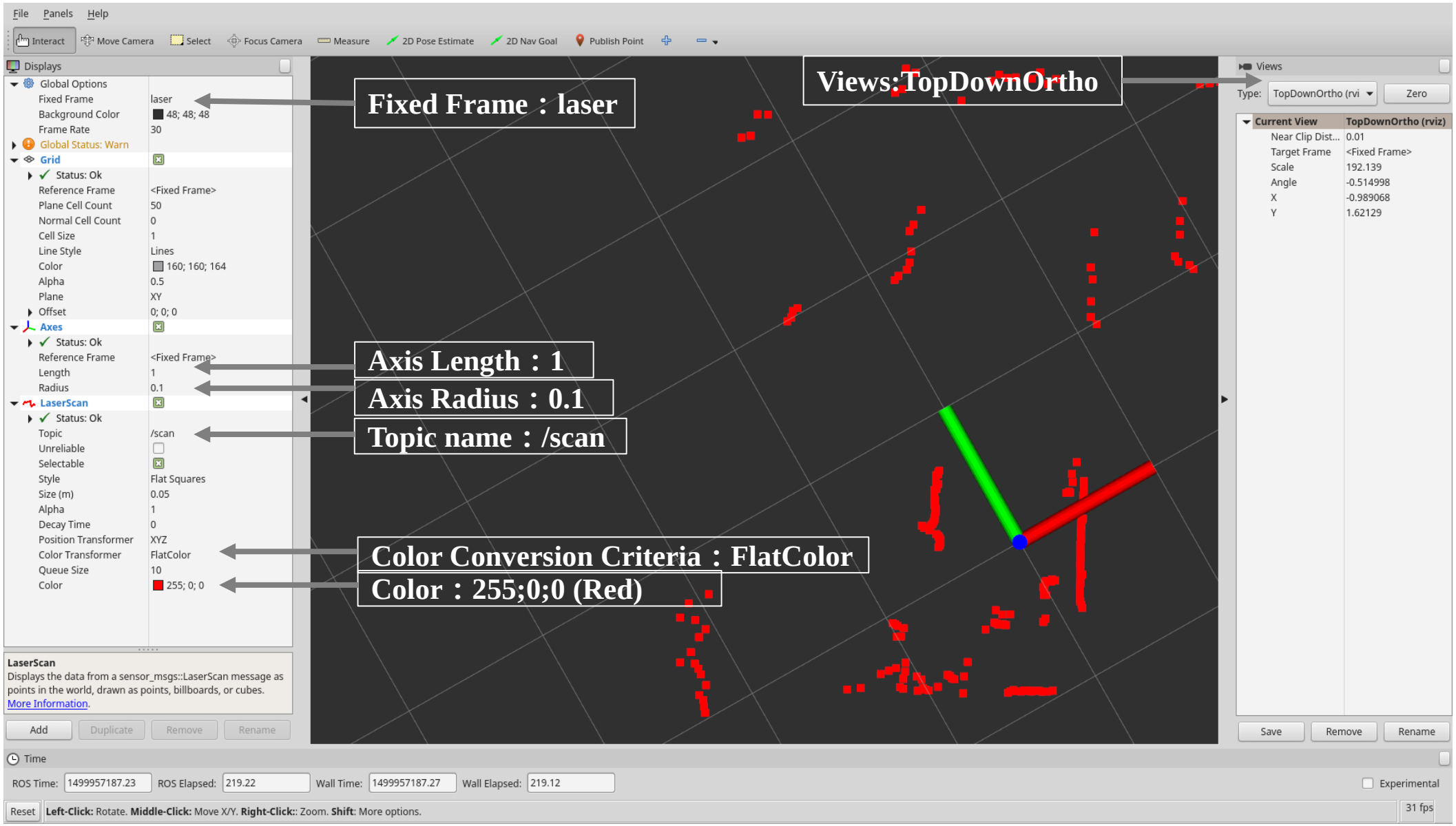
(In case of HOKUYO)

```
$ sudo apt-get install ros-kinetic-urg-node
$ sudo chmod a+rw /dev/ttyACM0
$ rosrun urg_node urg_node
```

* Change the display options of RViz

1) Change fixed frame: Global Options > Fixed Frame = laser
2) Add & configure Axes: Click 'Add' at the bottom left of rviz, then add Axes (Change 'Length' & 'Radius' is option)
3) Add & configure LaserScan: Click 'Add' at the bottom left of rviz, then add LaserScan
(Topic designation is required, 'Color Transformer', 'Color', etc. are options)

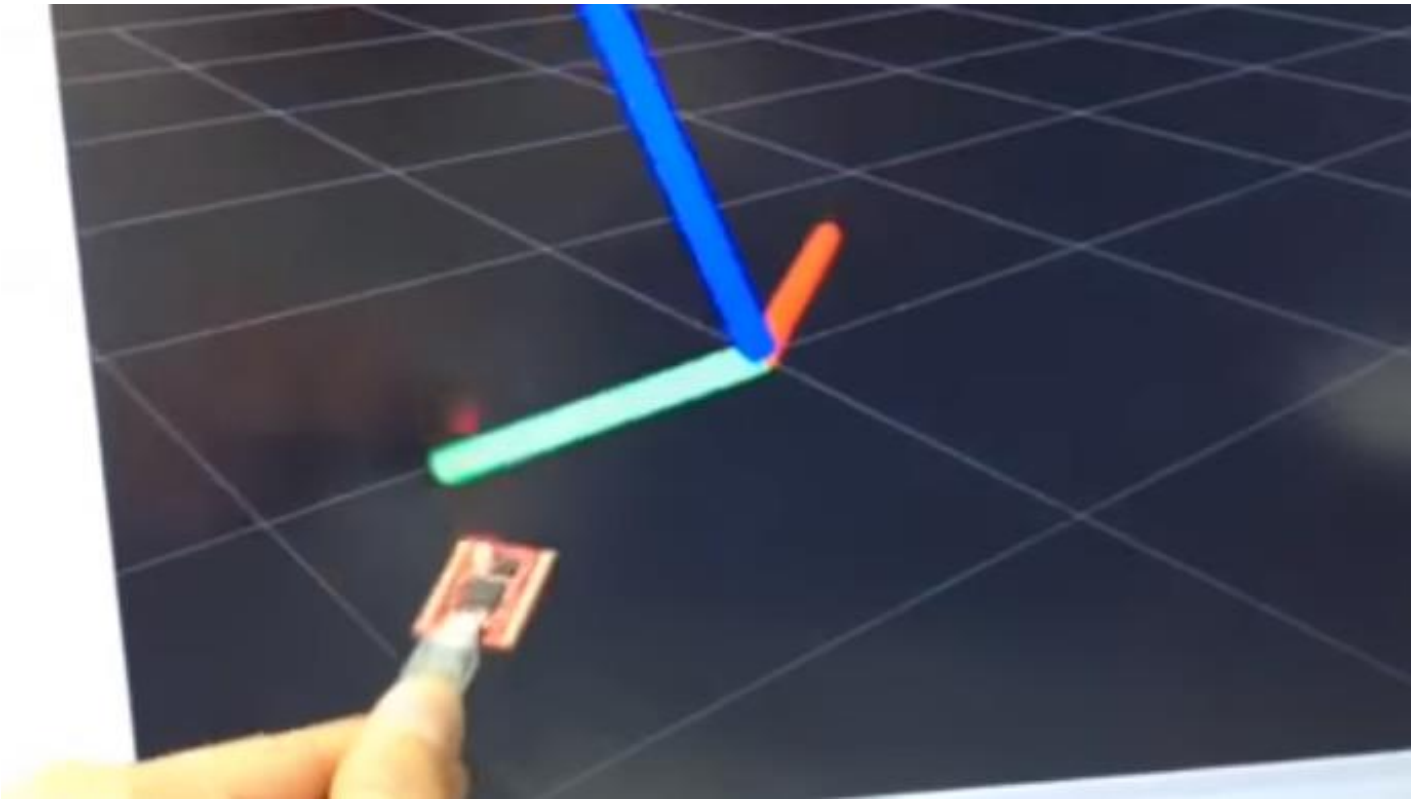
Sensor Package Practice #6 (LDS)



Sensor Package Practice #7 (IMU)

(In case of withrobot's myAHRS+)

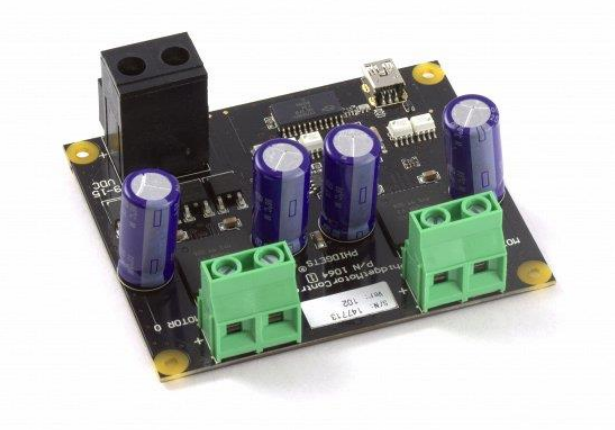
```
$ cs
$ git clone https://github.com/robotpilot/myahrs_driver.git
$ cm
$ sudo chmod a+rw /dev/ttyACM0
$ roslaunch myahrs_driver myahrs_driver.launch
```



Motor Packages

Motor Package (http://wiki.ros.org/Motor%20Controller%20Drivers)

- PhidgetMotorControl HC
- Roboteq AX2550 Motor Controller
- ROBOTIS Dynamixel



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Contorolling Dynamixel with ROS Package

- **DynamixelSDK** (http://wiki.ros.org/dynamixel_sdk)
  - Support 3 representative OS (Linux, Windows, MacOS)
  - Support programming language such as C, C++, C#, Python, Java, MATLAB, LabVIEW, etc.
  - Support ROS

DYNAMIXEL SDK

- **dynamixel_workbench** (http://wiki.ros.org/dynamixel_workbench)
  - Provide a variety of examples for ease of use in ROS
  - Provide GUI tool for ROS

U2D2

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Dynamixel

Question Time!

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“ROS Robot Programming”

A Handbook is written by TurtleBot3 Developers

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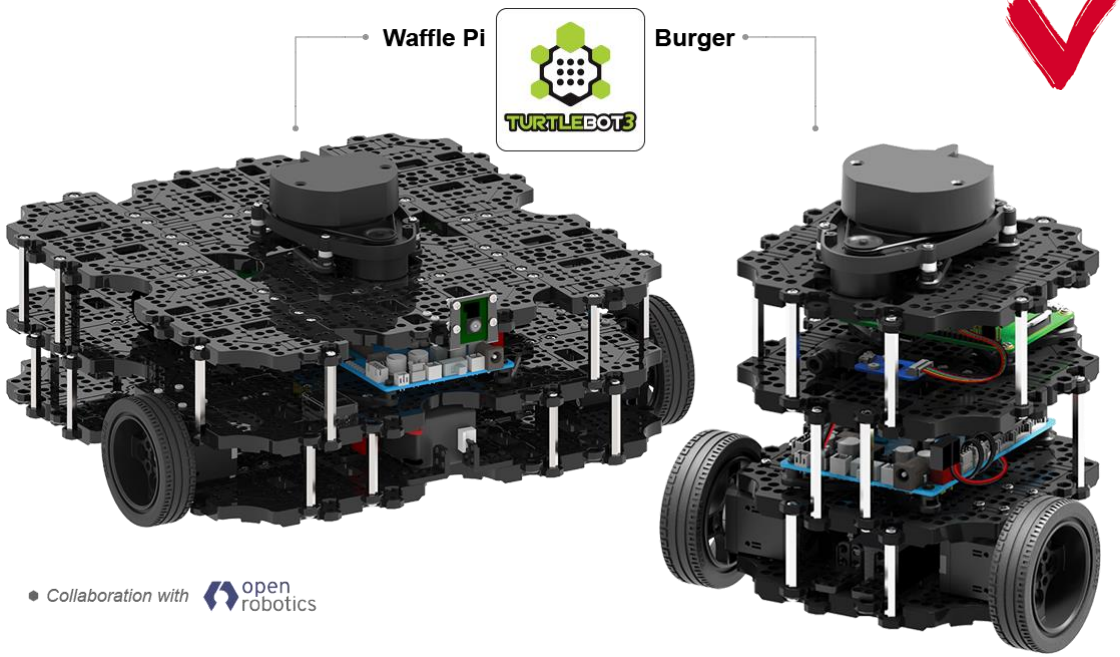
Direct Link



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We hope to be a community where we can share knowledge about robots, share robot development information and experiences, help each other and collaborate together. Through this community, we want to realize open robotics without disti nguishing between students, universities, research institutes and companies.

Join us in the Robot community ~

END.