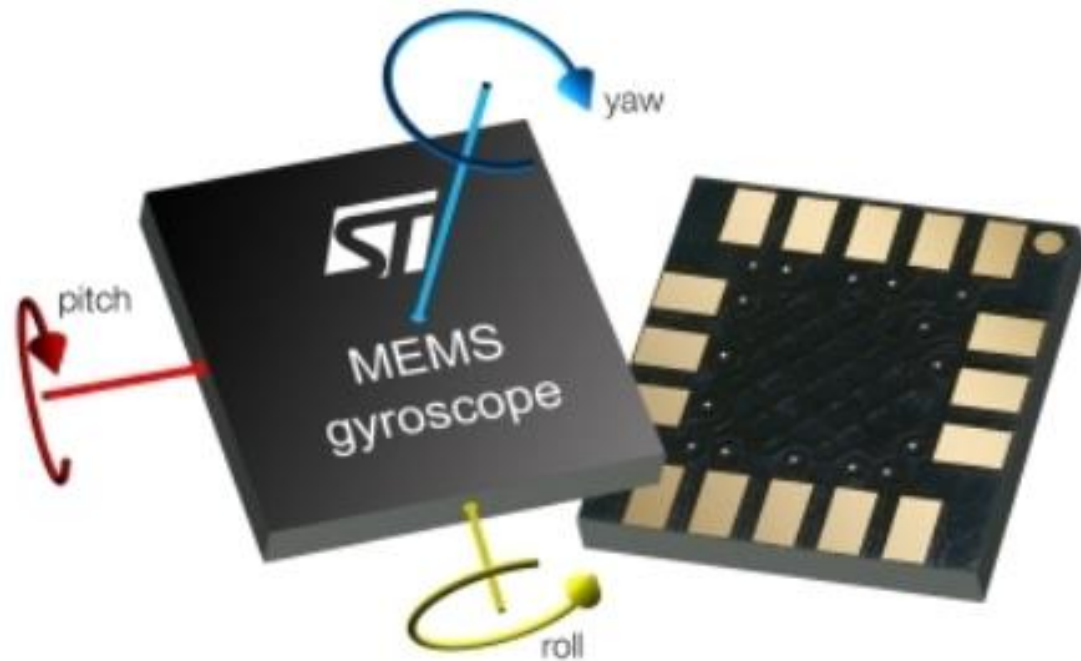


IMU Sensor

(Intertial Mesurment, 관성 측정)

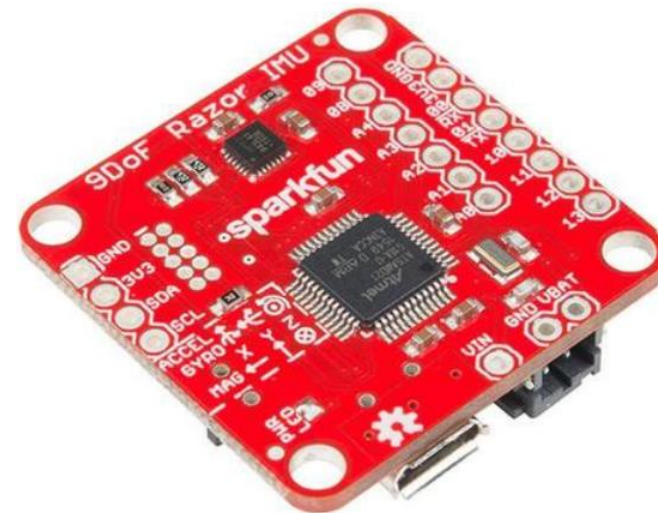
- 무인비행체, 인공위성 등
- 가속도계, 자이로스코프, 지자계 사용
- 3차원 공간에서의 움직임을 측정



IMU Sensor

장점

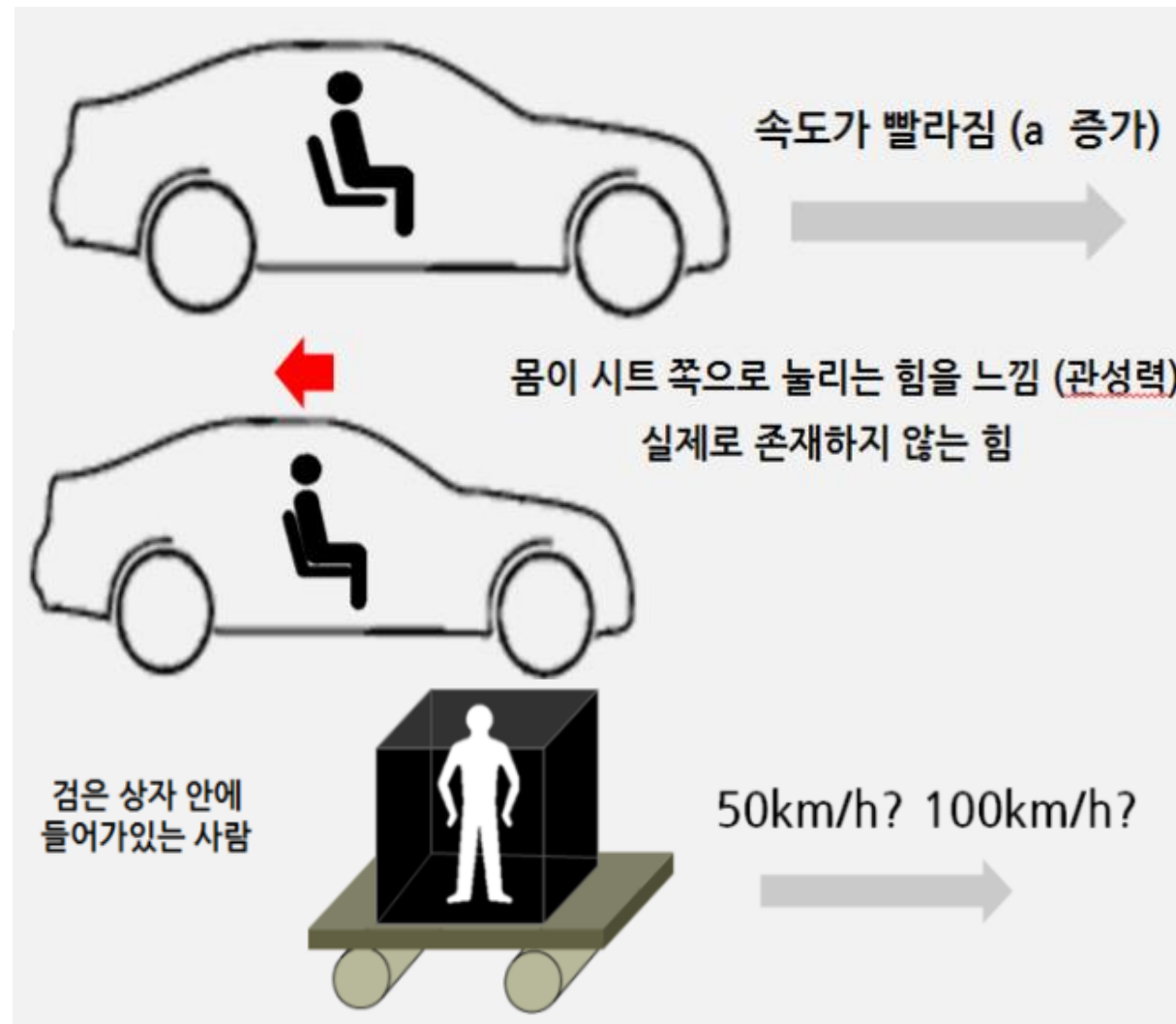
- GPS 신호의 수신기 문제
- 실내 주행 문제
- 전자기 간섭이 있는 공간



IMU Sensor

(Intertial Mesurment, 관성 측정)

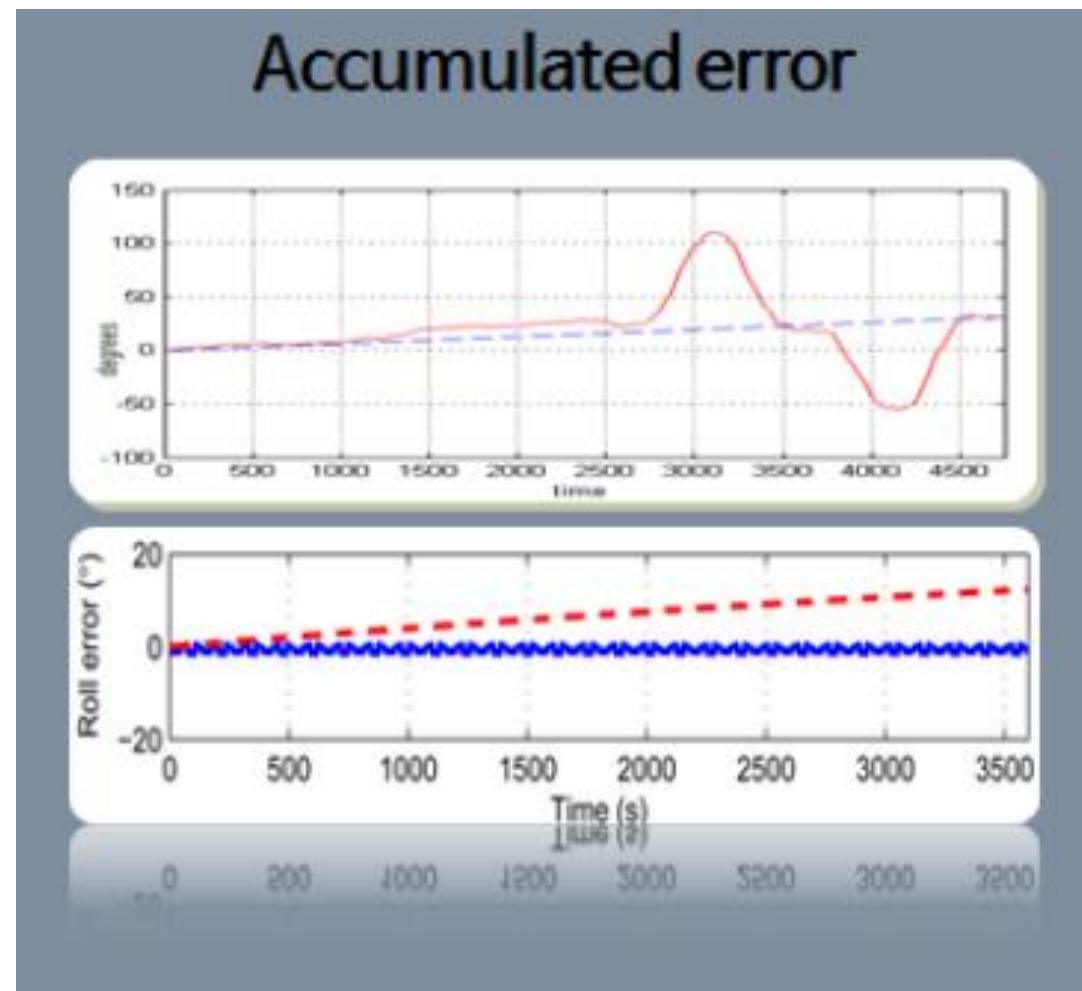
- 무인비행체, 인공위성 등
- 가속도계, 자이로스코프, 지자기 사용
- 3차원 공간에서의 움직임을 측정



IMU Sensor

(Intertial Mesurment, 관성 측정)

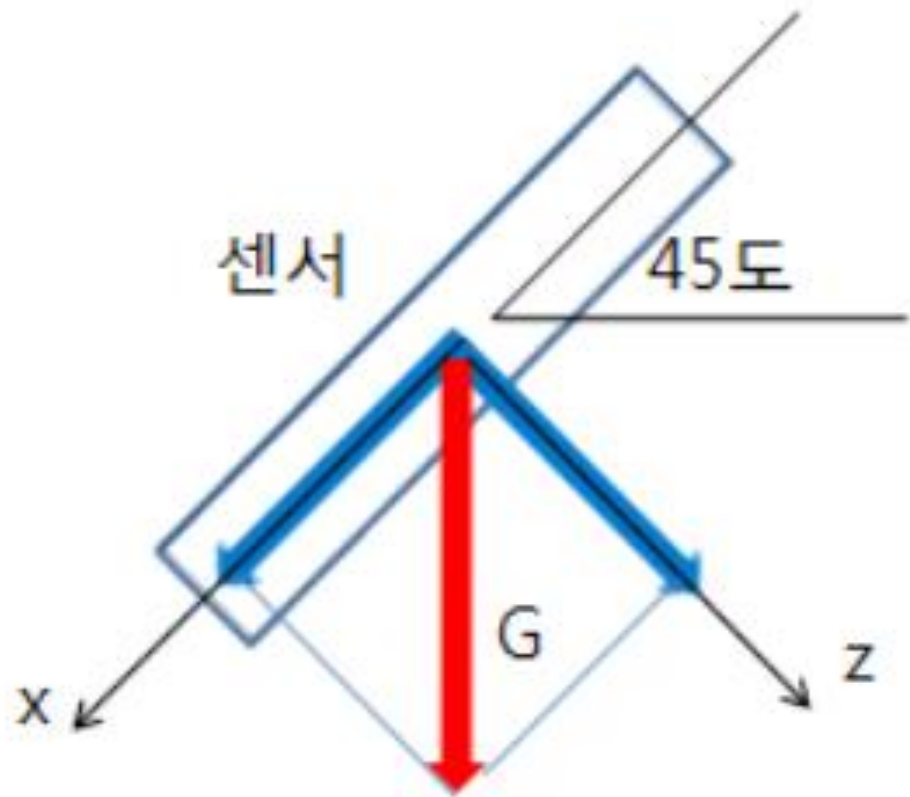
- 가속도센서와 지자계센서를 사용해
- Absolute reference of Orientation를 측정
- 보다 정확한 위치를 계산



IMU Sensor

가속도 센서 (Accelerometer)

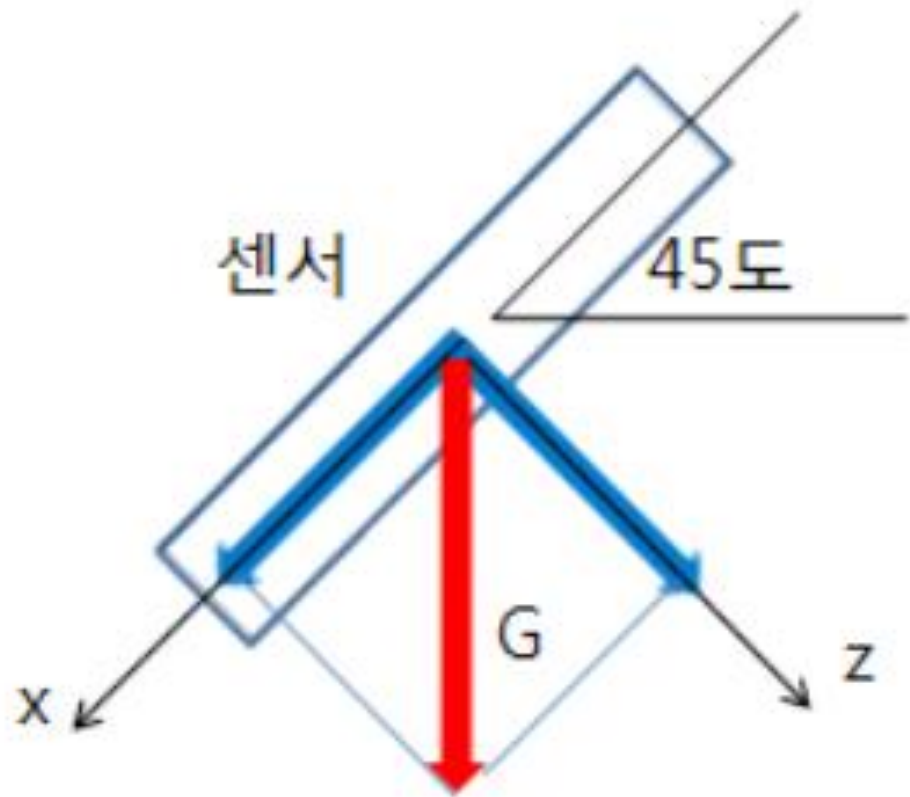
- x축, y축, z축 (가속도 방향 측정)
- 단위 [g] : 0.707g
- 정지상태의 중력 가속도 감지
- 시간에 따라 속도 변화



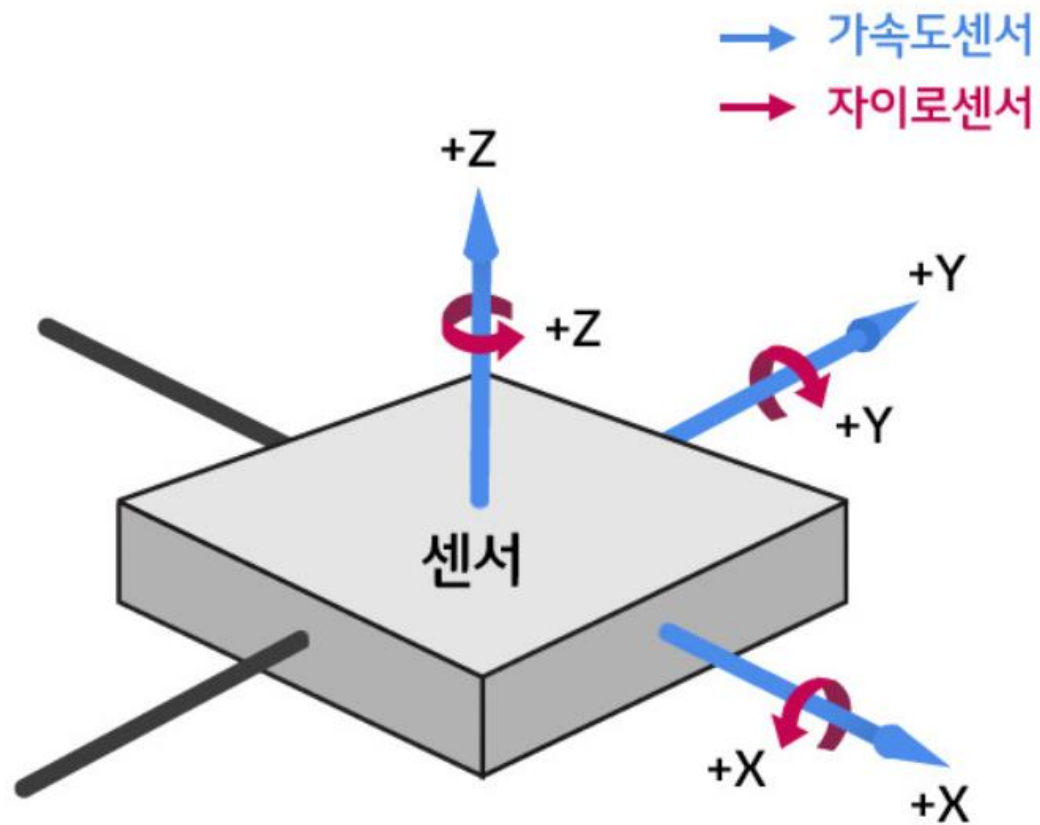
IMU Sensor

각속도 센서 (Gyroscope)

- 노이즈 多
- 시간이 지날수록 오차 발생
- 각각의 단점을 보상
- 짧은 시간에 정확한 계산된 각도



IMU Sensor



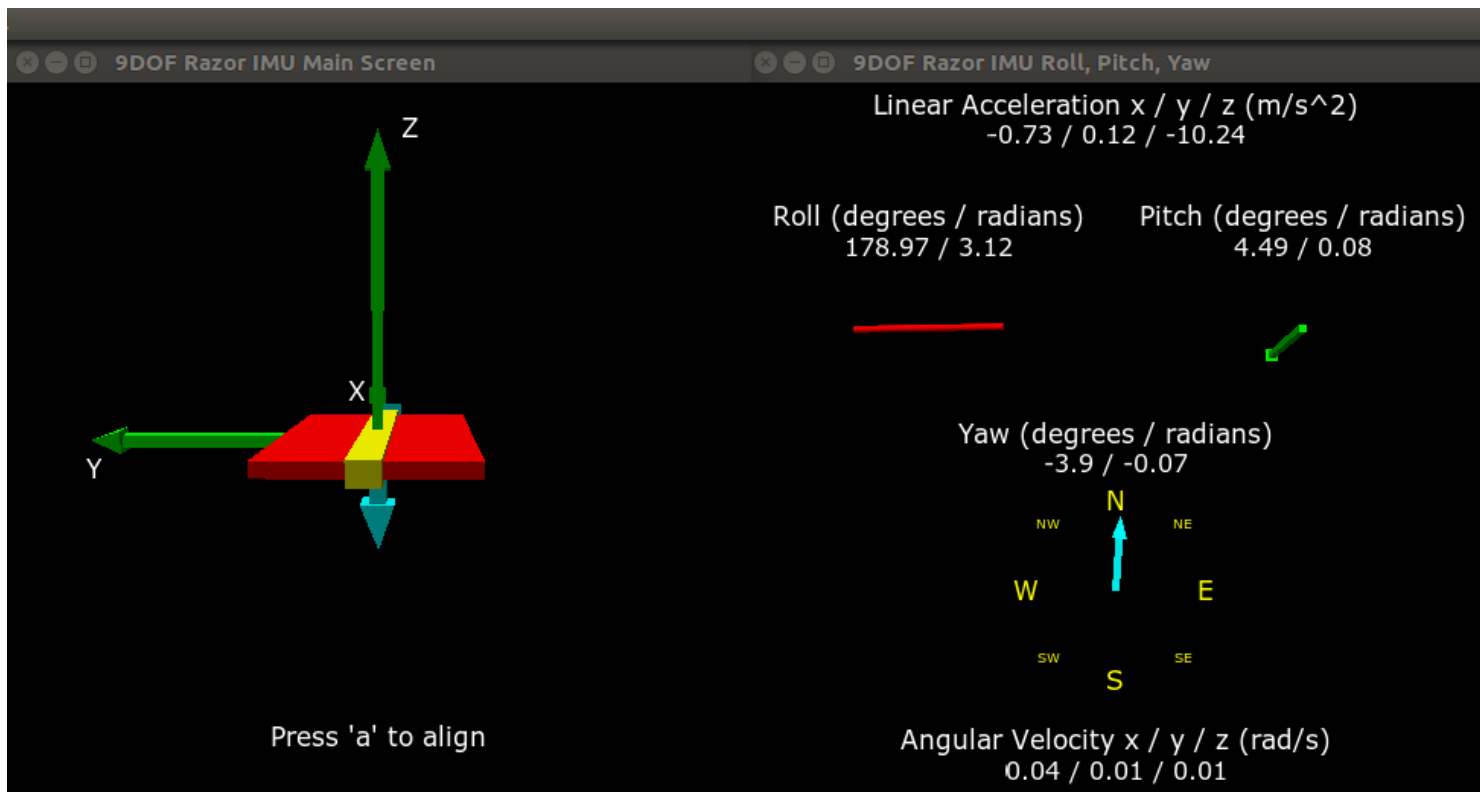
05. WeCar Sensor Demos

- IMU Sensor

```
cd wecar-ws
```

```
source devel/setup.bash
```

```
roslaunch razor_imu_9dof razor_pub_and_display.launch
```



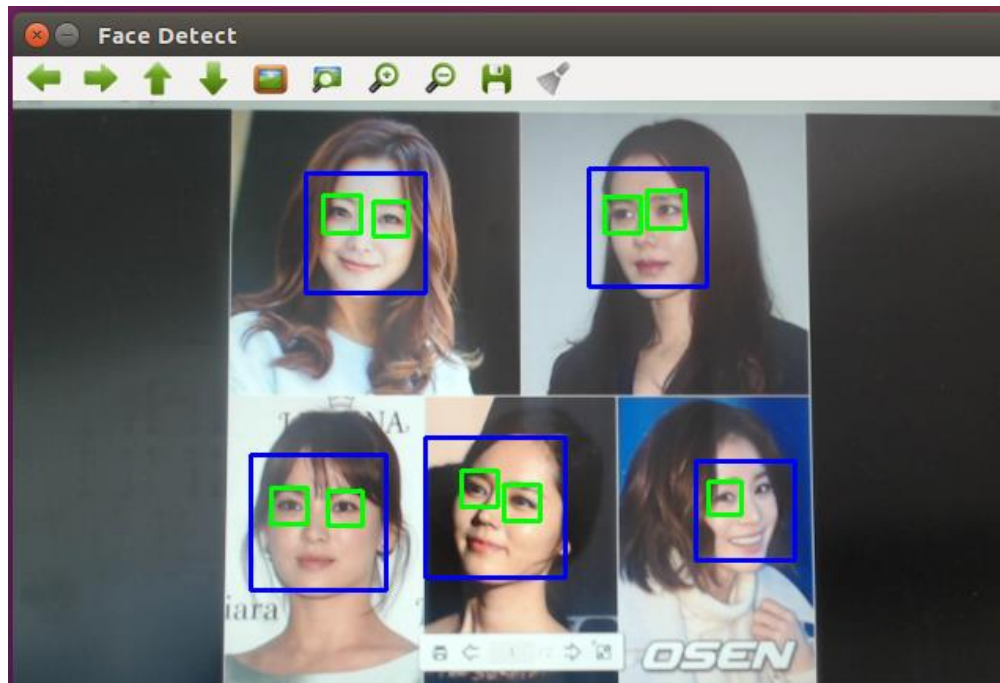
1. 피치(pitch)
2. 롤 (roll)
3. 요(yaw)

기수가 아래로 내려 하강
및 상승(P)
좌우 방향(Y)
왼쪽으로 젖히면 회전

05. WeCar Sensor Demos

- USB Camera
 - ✓ Face Detector

cd USB_Camera
python face_detect.py



```
*face_detect.py (-/USB_Camera) - gedit
Open  [icon]

# https://docs.opencv.org/3.3.1/d7/d0b/tutorial_py_face_detection.html
# On the Jetson Nano, OpenCV comes preinstalled
# Data files are in /usr/share/OpenCV
import numpy as np
import cv2
import argparse
import sys

def open_camera_device(device_number):
    return cv2.VideoCapture(device_number)

def face_detect():
    face_cascade = cv2.CascadeClassifier(
        "/usr/share/OpenCV/haarcascades/haarcascade_frontalface_default.xml"
    )
    eye_cascade = cv2.CascadeClassifier(
        "/usr/share/OpenCV/haarcascades/haarcascade_eye.xml"
    )

    cap = open_camera_device(video_device)

    #cap = cv2.VideoCapture(gstreamer_pipeline(), cv2.CAP_GSTREAMER)
    if cap.isOpened():
        cv2.namedWindow("Face Detect", cv2.WINDOW_AUTOSIZE)
        while cv2.getWindowProperty("Face Detect", 0) >= 0:
            ret, img = cap.read()
            gray = cv2.cvtColor(img, cv2.COLOR_BGR2GRAY)
            faces = face_cascade.detectMultiScale(gray, 1.3, 5)

            for (x, y, w, h) in faces:
                cv2.rectangle(img, (x, y), (x + w, y + h), (255, 0, 0), 2)
                roi_gray = gray[y:y + h, x:x + w]
                roi_color = img[y:y + h, x:x + w]
                eyes = eye_cascade.detectMultiScale(roi_gray)
                for (ex, ey, ew, eh) in eyes:
                    cv2.rectangle(
                        roi_color, (ex, ey), (ex + ew, ey + eh), (0, 255, 0), 2
                    )

            cv2.imshow("Face Detect", img)
            keyCode = cv2.waitKey(30) & 0xFF
            # Stop the program on the ESC key
            if keyCode == 27:
                break

        cap.release()
        cv2.destroyAllWindows()
    else:
        print("Unable to open camera")

if __name__ == "__main__":
    video_device=1
    face_detect()
```

05. WeCar Sensor Demos

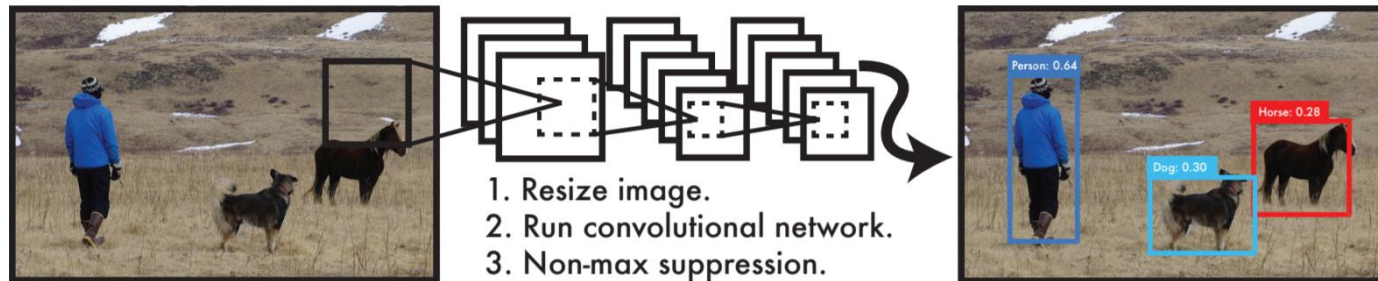
- USB Camera
 - ✓ Yolov3 Object Detector

YOLO 란?

- YOLO: You Only Look Once
- 실시간 이미지 객체 탐지 및 인식에 강력하다.

The YOLO Detection System:

- (1) input image를 448 x 448의 이미지로 resize하고
- (2) image에서 작동하는 single convolution network를 실행시킵니다.
- (3) 해당 모델을 통해서 나온 확률값을 threshold로 잘라서 결과값을 보여줍니다.

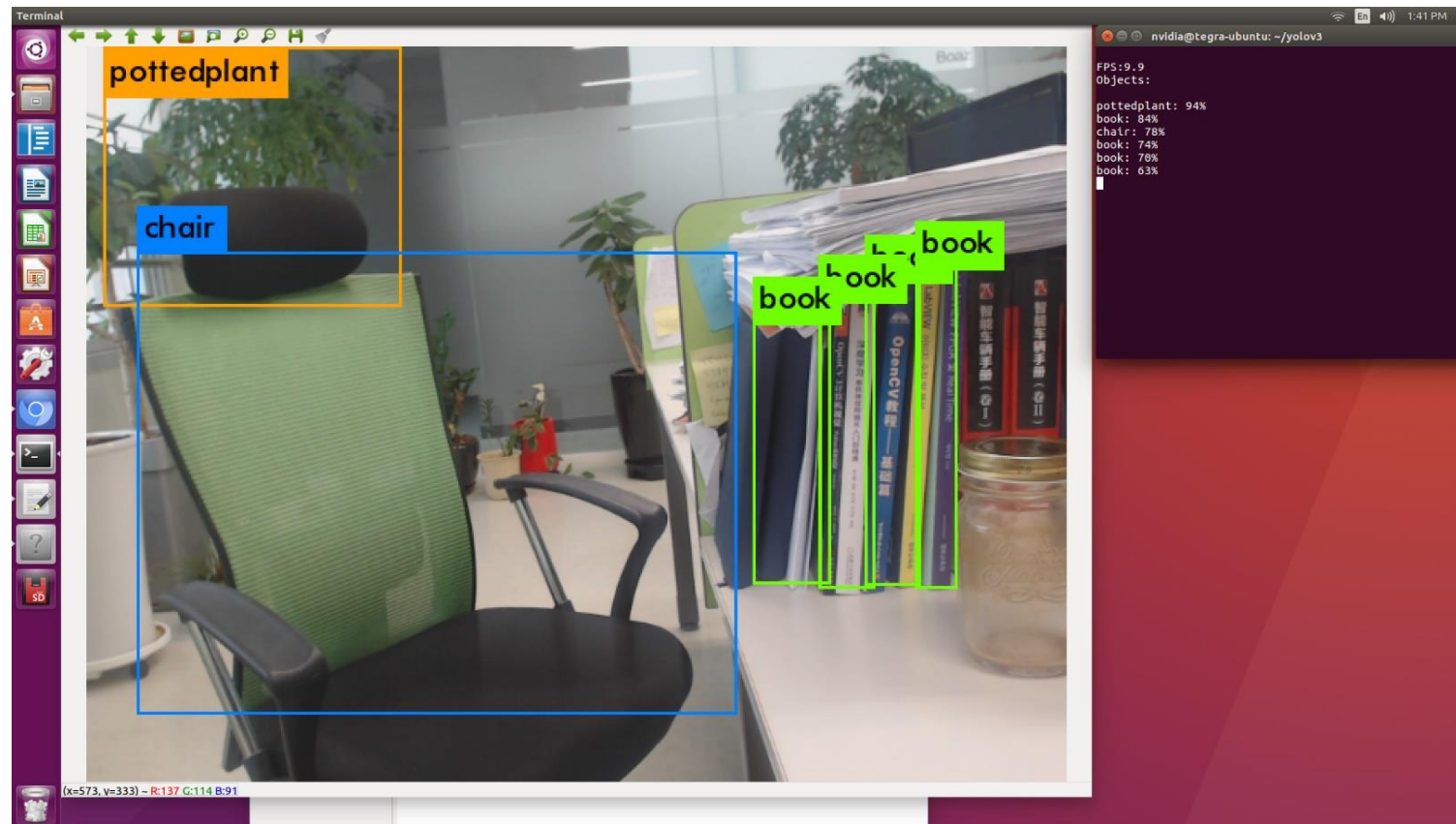


05. WeCar Sensor Demos

- USB Camera
 - ✓ Yolov3 Object Detector

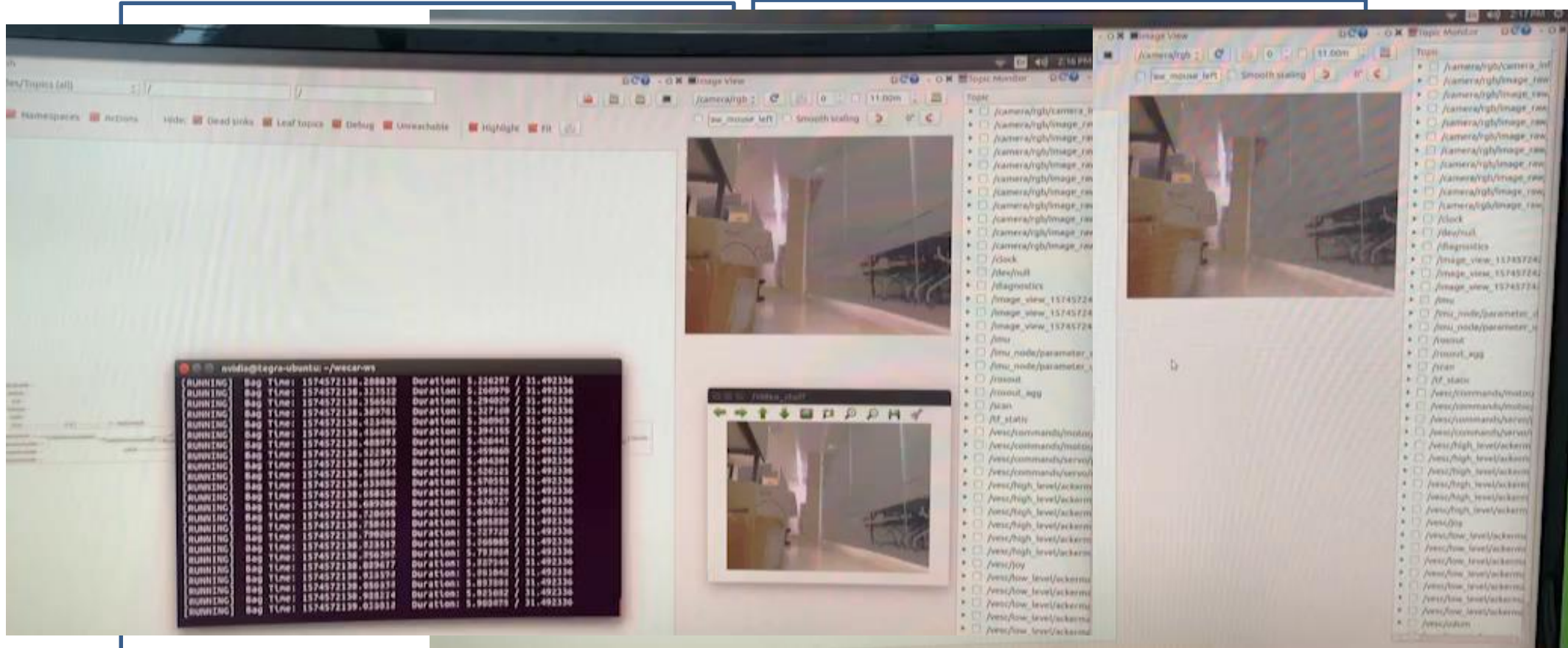
`cd yolov3`

`./darknet detector demo cfg/coco.data cfg/yolov3.cfg yolov3.weights -c 1`



05. WeCar Sensor Demos

- USB Camera
 - ✓ Recording and playing back a robots actions is easy using rosbags



RP Lidar Sensor

A2

측정거리: 18M

샘플링 속도: 8000 point

회전 : 360도

PWM 제어를 이용한 스캔 속도 조절 가능



RPLidar Sensor

[내장형 드라이버]

신호를 통해 모터의 시작, 정지 및
회전 속도를 조절 가능

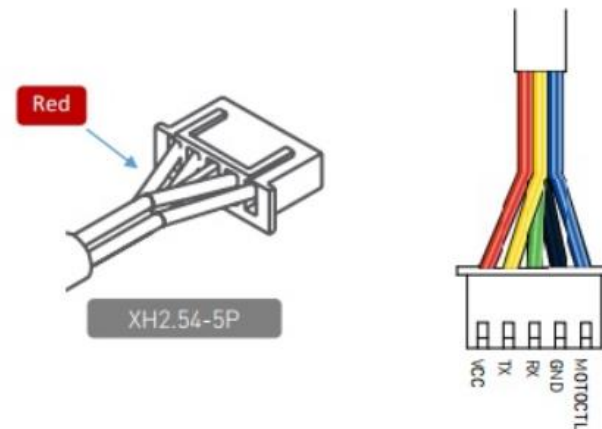
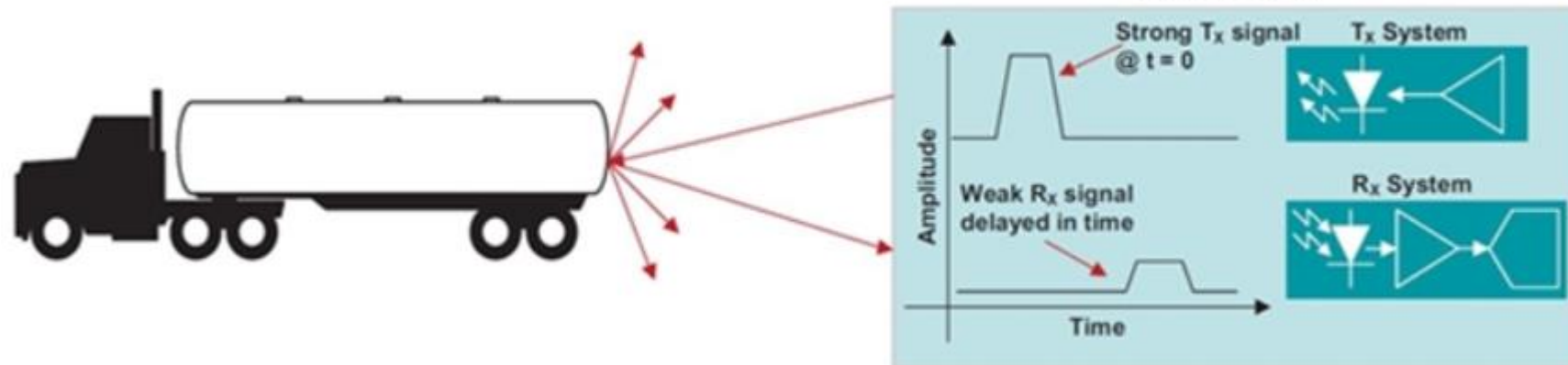


Figure 3-1 RPLIDAR A2 Pins

| Color | Signal name | Type | Description | Minimum | Typical | Maximum |
|--------|-------------|-------------------|--|---------|---------|---------|
| Red | VCC | Power | Power supply for the whole RPLIDAR | 4.9V | 5V | 5.5V |
| Yellow | TX | Output | Serial output for RPLIDAR scan core | 0V | 3.3V | 3.5V |
| Green | RX | Input | Serial input for RPLIDAR scan core | 0V | 3.3V | 3.5V |
| Black | GND | Power | GND | 0V | 0V | 0V |
| Blue | MOTOCTL | Input (pull down) | Enable pin for RPLIDAR scan motor/PWM control signal (active high) | 0V | 3.3V | 5V |

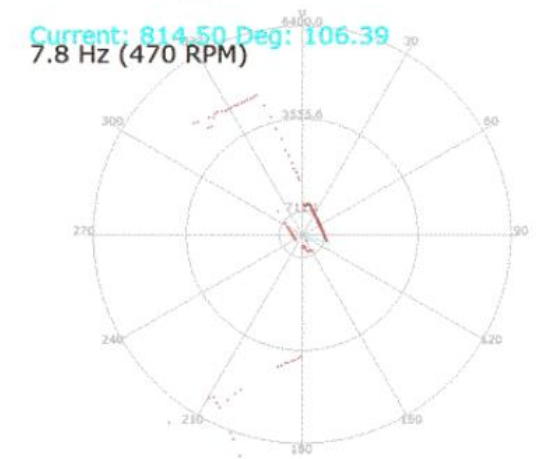
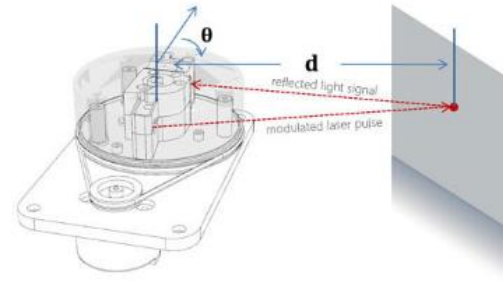
RP Lidar Sensor

- 목표물로부터 반사된 전자파의 시차 및 에너지
- 사물까지의 거리, 방향, 속도, 온도
- 펄스의 신호를 생성



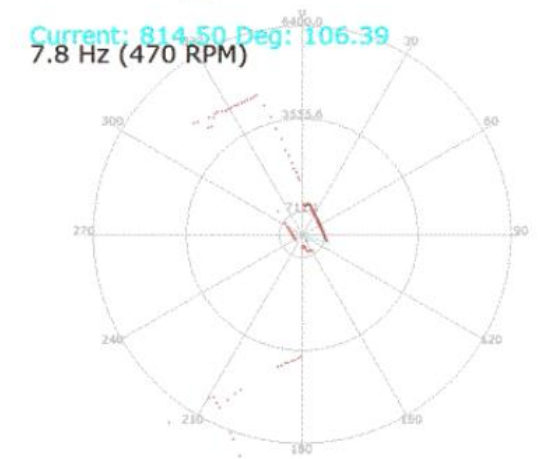
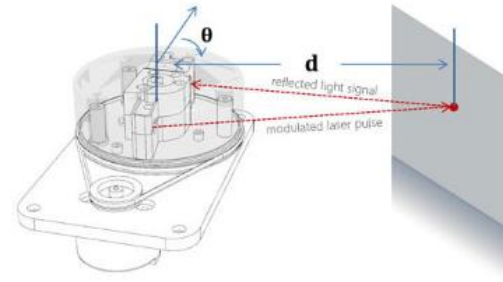
RP Lidar Sensor

- RP Lidar – SLAM 구현
- 레이저 센서를 회전
- 각에 대한 거리 스캔 (2차원 데이터 생성)



RP Lidar Sensor

- RP Lidar – SLAM 구현
- 레이저 센서를 회전
- 각에 대한 거리 스캔 (2차원 데이터 생성)



RP Lidar Sensor

```
ls -l /dev/ttyUSB*
```

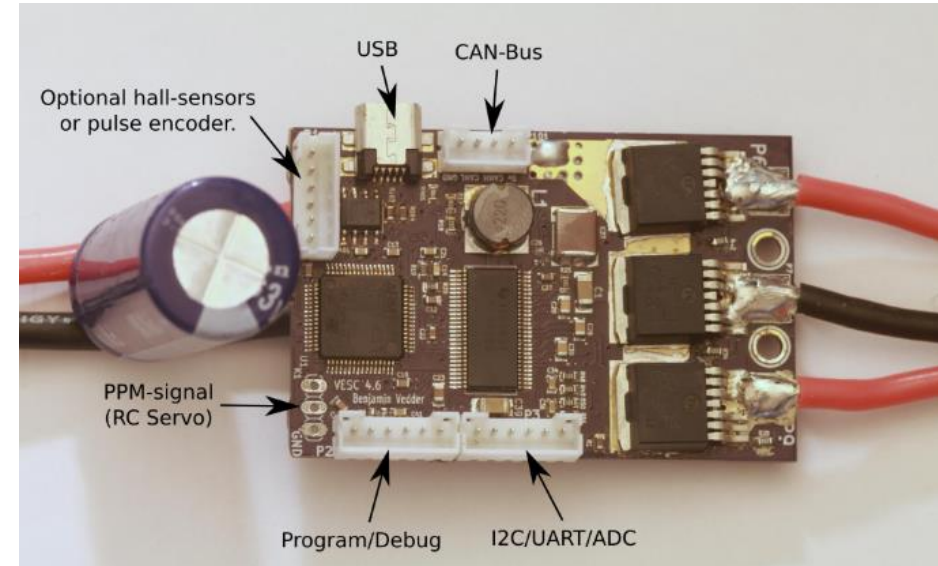
```
sudo chmod a+rw /dev/ttyUSB0
```

```
roslaunch <package_name> <launch_name>.launch
```



VESC

- 배터리의 전력을 사용하여 모터 에너지를
- 조절하는 방식
-



01

Startup WeCar

04. Startup WeCar

Step 1: On host PC, remote access WeCar TX2 target

```
ssh nvidia@192.168.x.xx
```

Step 2: Launch wecar teleoperation

```
cd wecar-ws  
source devel/setup.bash  
roslaunch racecar teleop.launch
```

Step 3: Turn on joystick to control wecar

```
mode LDE: off
```

02

WeCar Sensor Demos

05. WeCar Sensor Demos

- IMU Sensor
- USB Camera
 - ✓ Face Detector
 - ✓ Yolov3 Object Detector
 - ✓ Recording and playing back a robots actions is easy using r osbags
- RPLiDAR
 - ✓ Simple RPLiDAR View Demo
 - ✓ ROS AMCL Known map example
 - ✓ RPLiDAR gmapping Demo

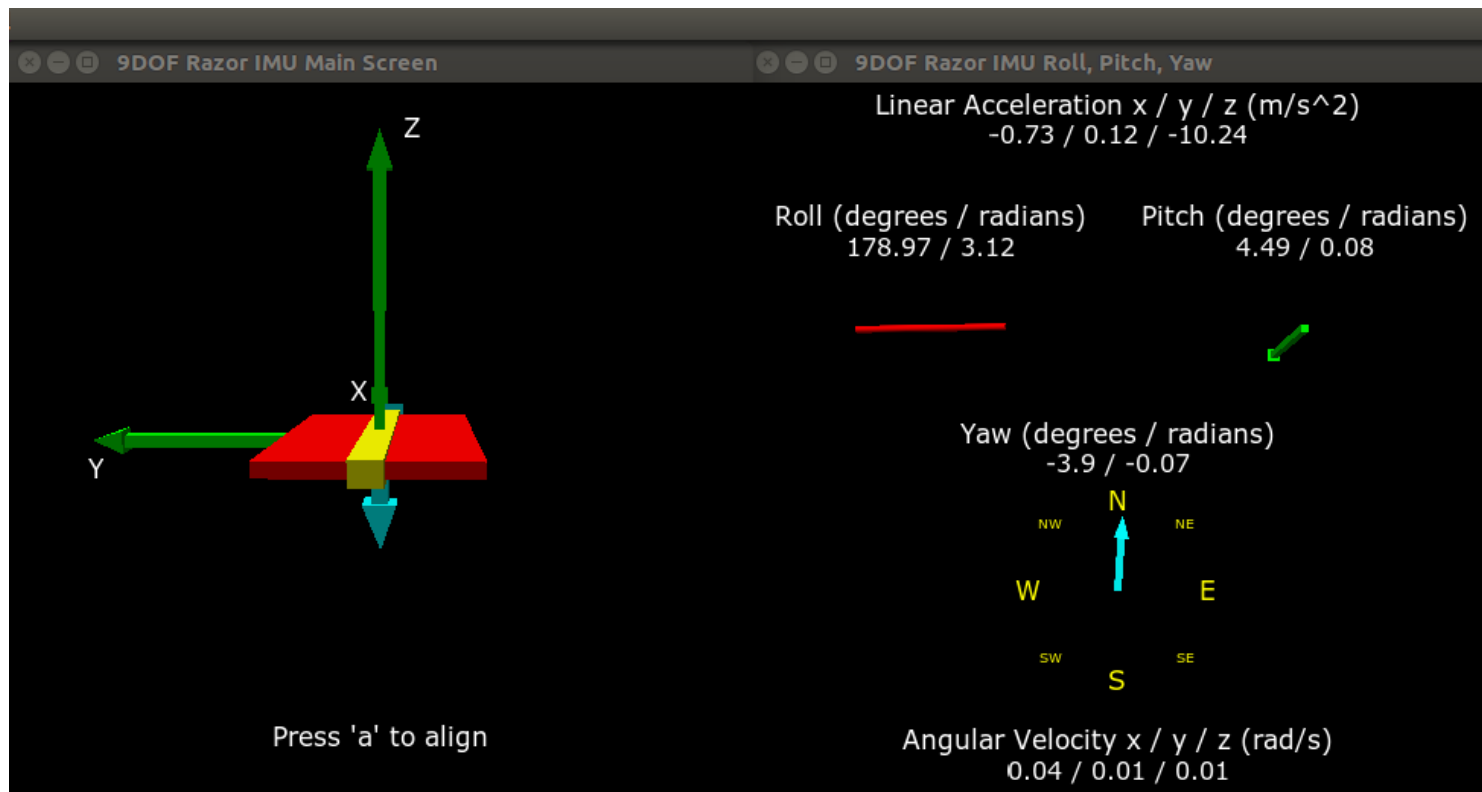
05. WeCar Sensor Demos

- IMU Sensor

cd wecar-ws

source devel/setup.bash

roslaunch razor_imu_9dof razor_pub_and_display.launch



05. WeCar Sensor Demos

- USB Camera
 - ✓ Recording and playing back a robots actions is easy using r osbags

```
cd wecar-ws
Source devel/setup.bash
Roslaunch racecar teleop.launch
```

```
cd wecar-ws
source devel/setup.bash
roslaunch usb_cam usb_cam.launch
```

```
rqt
Pulgins->Introspection->Node Graph
Plugins->Visualization->Image View
```

```
cd wecar-ws
source devel/setup.bash
rosbag record /Ackermann_cmd /camera
/rgb/image_raw -o wecar.bag
```

```
cd wecar-ws
source devel/setup.bash
rosbag play wecar.bag
```

```
roslaunch image_view image_view image:=/
video_stuff
```

```
cd wecar-ws
source devel/setup.bash
rosbag play wecar.bag /Ackermann_cmd:
=/Ackermann_cmd_mux/input/navigation
/camera/rgb/image_raw:=/video_stuff
```

05. WeCar Sensor Demos

- RPLiDAR
 - ✓ Simple RPLiDAR View Demo

```
cd wecar-ws  
source devel/setup.bash  
roslaunch rplidar_ros view_rplidar.launch
```

- ✓ ROS AMCL Known map example

```
cd wecar-ws  
source devel/setup.bash  
roslaunch racecar teleop.launch  
rviz known_map_localization.rviz
```

05. WeCar Sensor Demos

- RPLiDAR
 - ✓ RPLiDAR gmapping Demo

```
cd wecar-ws  
source devel/setup.bash  
roslaunch racecar teleop.launch
```

```
roslaunch static_transform_publisher 0 0 0 0 0 0 /base_link /scan 10  
roslaunch gmapping slam_gmapping  
roslaunch laser_scan_matcher laser_scan_matcher _node _fixed_frame:=odom
```

```
roslaunch map_server map_saver -f mymap
```

