# Progress Review 8


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Team B / Auto Pirates

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# 1. Individual Progress

1. GPS test

I've been working on GPS test which is NMEA data of GPS to UTM coordinate and then ultimately world frame coordinate data. In the long run plan, I plan to test the GPS and INS to do state estimation of the boat using the Kalman filter and integrate some ROS navigation packages into the boat.

For the first step, I worked on the GPS hardware interface work with Tushar. After purchasing the GPS, it didn't provide USB connector. That meant that we needed to do works including stripping wires and soldering each other. As the serial to USB converter didn't supply the power. we needed the two USB connector cables, one of which was for supplying power and the other of which was for communicating RS232 data. We completed to make the wire connection between GPS and USB connector like the Figure 1. After doing some cabling works, we checked if the laptop received the GPS data using gpscat program in the linux which was printing out the GPS raw data (shown in Figure 2). At first time, it didn't receive any GPS data. One possible solution was to change the RX and TX pin connection. After doing that, we could check that laptop received raw GPS data.


Figure 1. GPS with USB-RS232 converter

```
james@james-virtual-machine:~$ gpscat -s 19200 /dev/ttyUSB0
$GPRMC,043706.4,A,4026.60979,N,07956.78510,W,000.53,285.5,260216,009.3,W*5A
$GPGGA,043706.4,4026.60979,N,07956.78510,W,1,05,1.4,334.9,M,-33.4,M,,*6F
$GPGSA,A,3,01,,06,17,24,28,,,,,,,1.6,1.4,0.9*34
$GPVTG,285.5,T,294.8,M,000.53,N,0000.98,K*74
$GPRMC,043706.6,A,4026.60981,N,07956.78517,W,000.53,285.5,260216,009.3,W*58
$GPGGA,043706.6,4026.60981,N,07956.78517,W,1,05,1.4,334.9,M,-33.4,M,,*6D
$GPGSA,A,3,01,,06,17,24,28,,,,,,,1.6,1.4,0.9*34
$GPVTG,285.5,T,294.8,M,000.53,N,0000.98,K*74
$GPRMC,043706.8,A,4026.60981,N,07956.78523,W,000.53,285.5,260216,009.3,W*51
$GPGGA,043706.8,4026.60981,N,07956.78523,W,1,05,1.4,334.9,M,-33.4,M,,*64
$GPGSA,A,3,01,,06,17,24,28,,,,,,,1.6,1.4,0.9*34
$GPVTG,285.5,T,294.8,M,000.53,N,0000.98,K*74
$GPRMC,043707.0,A,4026.60981,N,07956.78532,W,000.53,285.5,260216,009.3,W*58
$GPGGA,043707.0,4026.60981,N,07956.78532,W,1,05,1.4,334.9,M,-33.4,M,,*6D
$GPGSA,A,3,01,,06,17,24,28,,,,,,,1.6,1.4,0.9*34
$GPVTG,285.5,T,294.8,M,000.53,N,0000.98,K*74
^C
james@james-virtual-machine:~$
```

Figure 2. Displaying raw GPS data

After work of hardware, I've been worked on software part to implement GPS in the ROS. I found that gpsd daemon utility in the linux, which was a server to get the GPS data from USB port and publish GPS data on the specific port. How the gaps daemon was working was that gpsd daemon received gps data from the device file, /dev/ttyUSB0 and publish the GPS data on the port 4000.

gpsd -S 4000 /dev/ttyUSB0

I could check if the gpsd was working properly when I connected to port 4000 to use telnet program like the below command (shown in Figure 3).

telnet localhost 4000


Figure 3. Telnet with received GPS data from gpsd server

Now, I worked on gps package in the ROS which converted the GPS NMEA data type into UTM coordinates. I tested gpsd_client ROS package like the following command.

rosrun gpsd_client gpsd_client _host:=localhost _port:=4000

Although I checked that /fix and /extended_fix ROS topics published by gpsd_client package, it didn't print out GPS data on the topic. At this point, I spent lots of times to figure out reasons. I tried to debug using the gdb program. In conclusion, gpsd_client package did work well except for receiving GPS data, which was abnormally filled with zeros. Finally, I decided to test other ROS package, which was nmea_gps_driver package.

```
james@james-virtual-machine:~$ rostopic list
/fix
/rosout
/rosout_agg
/time_reference
/vel
james@james-virtual-machine:~$ rostopic echo /fix
header:
  seq: 1
  stamp:
    secs: 1456463579
    nsecs: 344399929
  frame_id: /gps
status:
  status: 1
  service: 1
latitude: 40.443331
longitude: -79.9465306667
altitude: 263.8
position_covariance: [6.760000000000001, 0.0, 0.0, 0.0, 6.760000000000001, 0.0, 0.0, 0.0, 27.040000000000003]
position_covariance_type: 1
---
header:
  seq: 2
  stamp:
    secs: 1456463579
    nsecs: 545710086
  frame_id: /gps
status:
  status: 1
  service: 1
latitude: 40.4433313333
longitude: -79.946531
altitude: 263.8
position_covariance: [6.760000000000001, 0.0, 0.0, 0.0, 6.760000000000001, 0.0, 0.0, 0.0, 27.040000000000003]
position_covariance_type: 1
---
```

Figure 4. nmea_gps_driver package publishing GPS data in UTM

Lastly, I succeeded to print out the GPS data in UTM data type, which includes latitude and longitude (shown in the Figure 4). Based on the GPS UTM data, I got my current location in the Openstreetmap shown in Figure 5.

## 2. Challenges

When I tested gpsd_client package, I couldn't find why the package didn't print out GPS data on the /fix topic. There were lots of possible factors causing that case. I didn't know how to resolve the problem. So I discussed this issue with teammates Shiyu and William. I explained what I tried to do and we did to find the solution of the problems. Then, I came up with debugging the program with gdb debugger which could possibly give us direct clues to the problem. In conclusion, I decided to try other packages because there were too many scope that I covered about the reason why the program didn't get the GPS data. The choice to use nmea_gps_driver was better than debugging gpsd_client program.

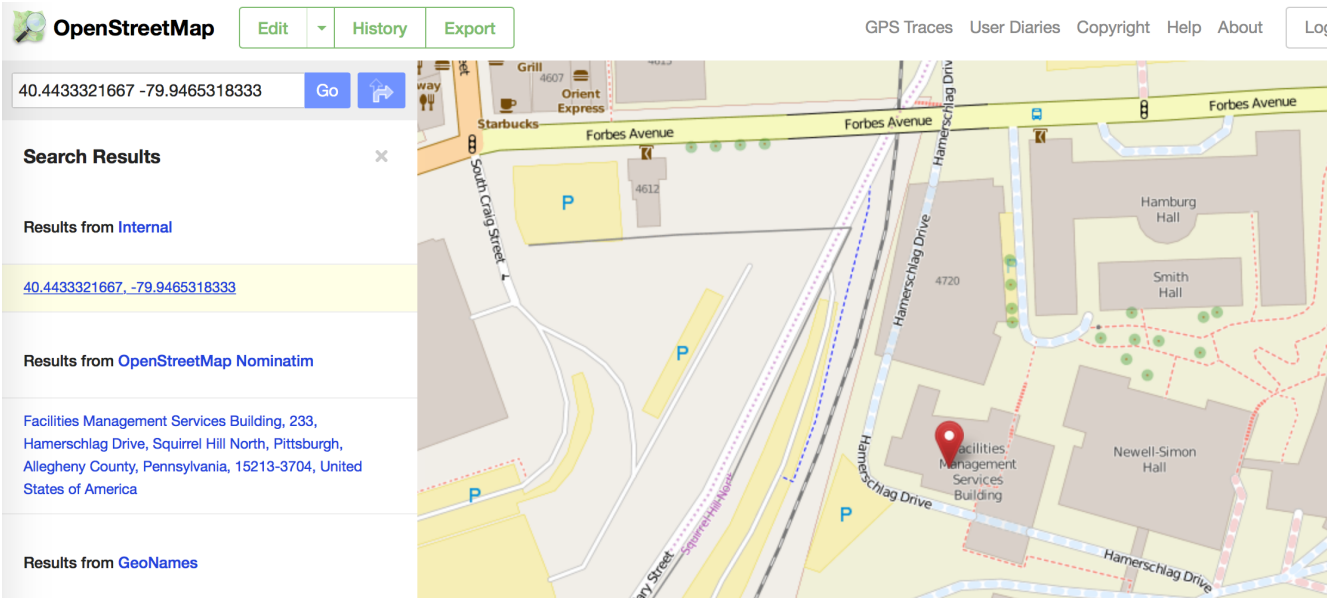


Figure 5. Openstreetmap with GPS latitude and longitude coordinate

## 3. Teamwork

1) Shiyu Dong: Shiyu worked on path planning with motion primitives and improving the simulator, specifically setting the start point in rviz and update boat location without using ROS bag files.

2) Bikram Hanzra: Bikram worked on improving the obstacle simulator.

3) William Seto: William worked on improving the radar filtering through integrating octomap package. As a result, he improved both filtering quality and speed.

4) Tushar Chugh: Tushar worked on adding USB to GPS and updated project website.

# 4. Future Plans

1) GPS test
Indicating GPS data on the Occupancy Grid map, specifically to the world map frame to show relationship of the map and the body frame.

2) INS Test to improve state estimation
Connecting INS directly and collecting INS data.
Testing various ROS state estimation packages to integrate the navigation stack and simulation simultaneously.