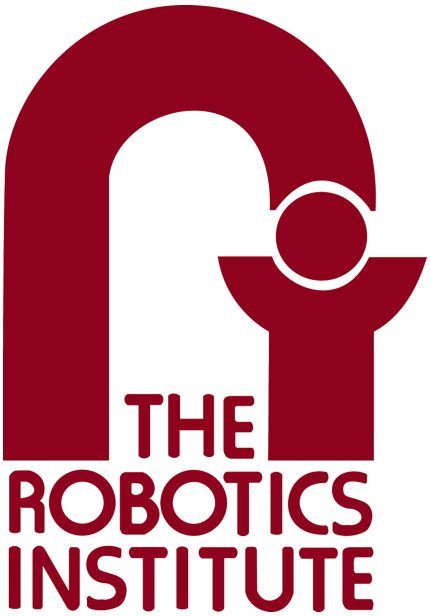

MRSD Project Course

Team I – AIce

Autonomous Zamboni Convoy

Individual Lab Report 7

Team

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Contents

1. Individual Progress

Since the last Progress Review, I majorly worked in three domains:

a. Setting up the object dictionary for acceleration on Zamboni Machine
b. Validation of Localization on ATV
c. Setting up and validation of Drive-by-Control on ATV
d. Sensor mounts for Zamboni

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1.1. Setting up the object dictionary for acceleration on Zamboni

I worked on setting up the Object Dictionary for Canopen communication for the Zamboni machine. The Motor controller on the vehicle is Sevcon which operates at 250 baudrate.

There was no TPDO for acceleration set, so I worked on creating the TPDO and mapping the throttle value to it.

The final object dictionary set up for the vehicle is as follows:

ID 2220h	Def 0	Ack 1	RWW	Scale 0.00390625	Unit V	Description Throttle Input Voltage	Data type Integer 16	Min -32768	Max 32767

Table 1. Object Dictionary for throttle

1.2. Validation of Localization on ATV

I worked on validating the localization stack that is used by ATV. It uses two systems, one is Lidar and IMU integration and other is encoder and IMU integration. The former method publishes the localization data on Super Odometry topic and later method publishes data on Odom Topic.

I tested the methods on bag files where I used the output of GPS as the ground truth.

The output of these methods were within the required error magnitude.

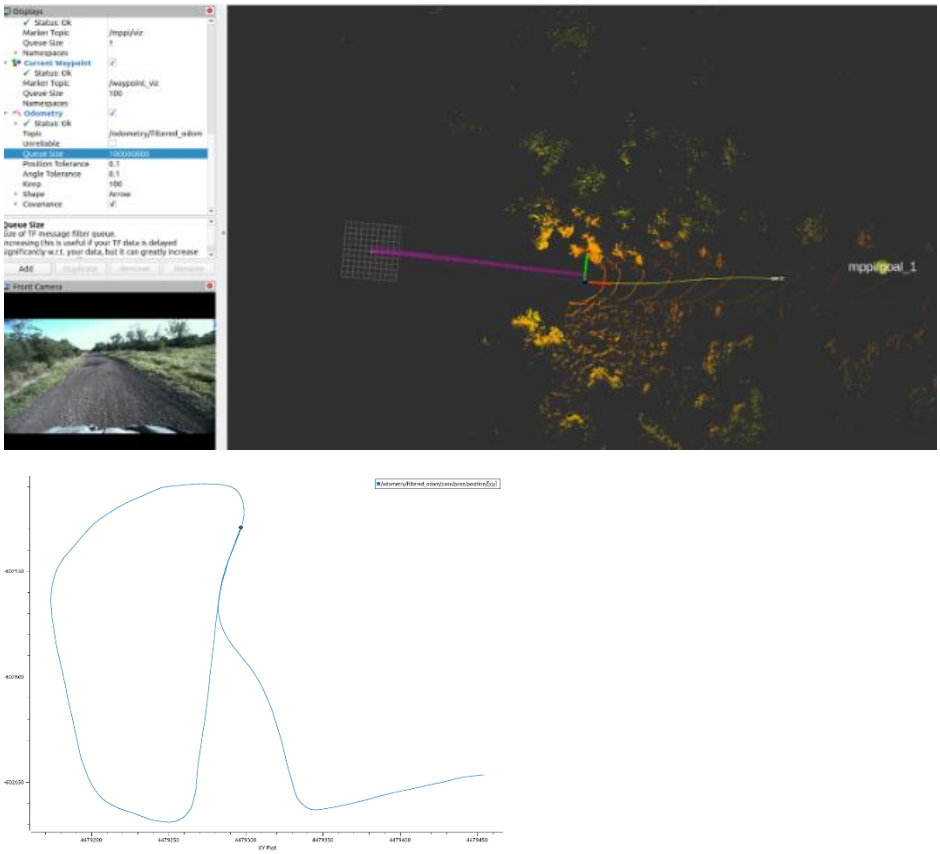

Figure 1. Localization output

1.3. Setting up and validation of Drive-by-Control on ATV

I setup the joystick and drive by wire control system on the ATV with our laptop. I integrated the basic autonomy stack used by us into the ATV stack.

I tested the drive by control by sending the commands through the joystick controller and verified its control.

Figure 2. Drive by Wire control validation

1.4. Sensor mounts for Zamboni

I helped Nick design and decide what type of mounts will be needed for the perception sensor that will go on the Zamboni machine. We had a requirement that we had to use existing holes for mount and not modify or add anything that can permanently change the vehicle.

The mounts designed are shown in the figure below

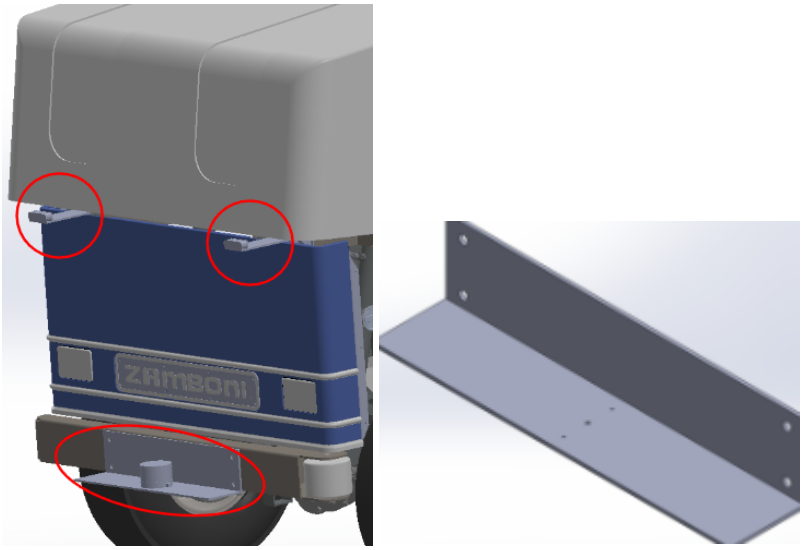

Figure 3. Sensor mounts for Zamboni

2. Challenges

The challenges faced during this time were majorly scheduling and project management related. It was very difficult to get access to Gascola as it required coordination with NREC team which was in California, AiRLab team which was busy with ICRA. Also other logistic issues like shipping the vehicle on time, getting charger installed, etc was difficult.

Technical challenges faced were as follows:

- We had to design the mounts for Zamboni so that it doesn't change anything on the vehicle, i.e we were allowed to drill/weld on the vehicle. So we had to design the mounts based on the existing holes which were unused.
- TPDO was not set for acceleration, so had to create a new dictionary for the command on zamboni's canbus
- ATV itself has a huge code base, it takes time to figure out the code structure and find the interface topic to communicate with our autonomy software

3. Teamwork

a. Kelvin Shen

Kelvin's major contribution was as follows:

He looked into problems of losing aruco markers by testing realsense given 6-meter longitudinal distance as the performance requirements and tested performance of realsense under different camera settings (infrared stream vs rgb stream, low fps vs high fps). He also worked with lidar camera calibration using available data online

b. Nick Carcione

Nick designed mounts for mounting camera onto ATV and camera+lidar onto Zamboni and updated the team's WBS to reflect work to be done this semester. He also helped me understand CAN interface for Zamboni.

Yilin Cai

Yilin majorly worked on the longitudinal PID controller with Jiayi. He also worked on the Rosbag testing for localization. He also contributed in designing the camera mounts for the ATV and in getting the joystick control on the ATV up running.

c. Jiayi Qui

Jiayi majorly implemented a PID longitudinal controller to maintain the distance between the leader and the follower and wrote the script of publishing steering and velocity commands to ATV. She also helped me in coordinating with ISUZU/Zamboni for DBW conversion.

4. Future Work/Plans

Following is the plan for the coming weeks:

1. I will work on testing our lateral controller (pure pursuit) on the ATV
2. Also test the new PID based longitudinal control on the ATV
3. Carry out basic waypoint following test on the ATV