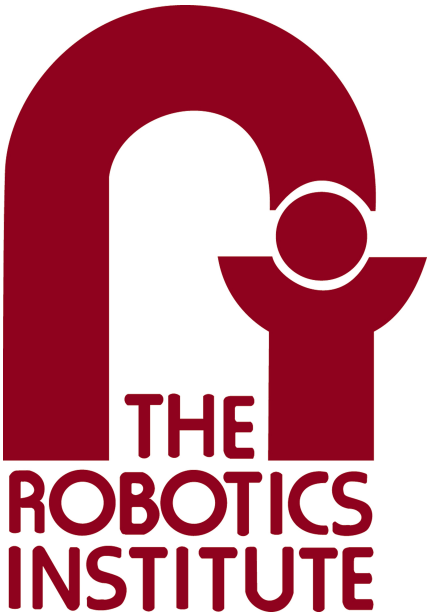

MRSD Project Course

Team I – AIce

Autonomous Zamboni Convoy

Individual Lab Report 9

Team

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Individual Progress

During the past two weeks, I have been helping integrate the improved perception subsystem into the whole system and testing the system in terms of both longitudinal and lateral control. My contributions are debugging the code when integrating multiple subsystems into one.

One of the major bottlenecks that I have spent a lot of time resolving was the inconsistent initial frame between the vehicle frame and the world frame. The vehicle frame is the ego frame that moves with respect to the world frame as vehicle starts moving, whereas the world frame is just the fixed frame for all the modules as the reference. Whenever the vehicle starts and the odometry gets initialized, the vehicle frame is not aligned with the world frame; there's always a random rotation between the two frames. Therefore, modules that involve both the relative position between the vehicle and the marker and the global position of the vehicle did not function. For example, the marker frame, which represents the relative pose of the leader with respect to the follower, is broadcasted from the camera frame which is moving together with the vehicle frame. When the waypoints are generated, they are with respect to the world frame. This means even though the leader position is broadcasted correctly in the follower's frame, it cannot be translated to waypoints of the leader directly without reversing the initial transform between the vehicle frame and the world frame when the stack is started. To make things easier, I broadcasted a "fake" world frame that is forced to be the same as the very first vehicle frame when the latter is broadcasted. As such, we force the world frame and the vehicle frame to be aligned in the very beginning and all the ongoing modules can refer to this new world frame instead of the old one. The solution sounds straightforward, but it actually cost me one day to find the real cause when I tried to integrate the perception with the planning, as well as another day to test the new frame for all downstreaming subsystems, including perception, localization and planning.

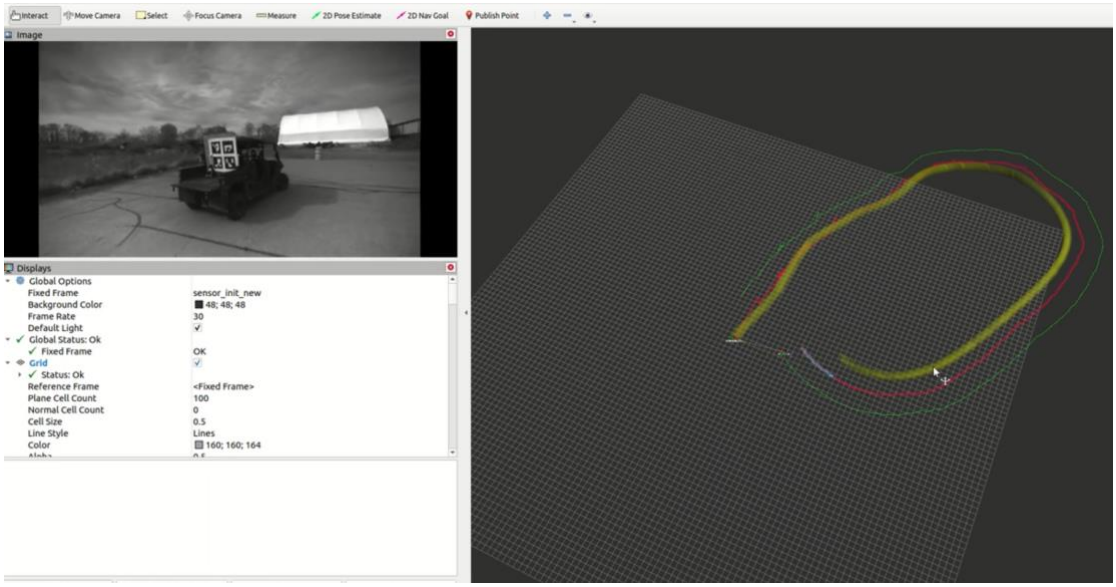

Figure 1. Lateral Controll

The remaining time was spent to help with the subsystem-level testing and validation. For example, during the lateral controller test in a small parking lot, manually controlling the throttle on the follower ATV is crucial because the turning radius is small and the follower will easily lose the marker when the leader takes turns. Figure 1 shows an ideal throttle control on the follower ATV such that the marker can be in the center of the image without being lost or occluded.

Challenges

The major challenges I have encountered are:

- The vehicle frame and the world frame are not aligned when the software stack is launched on the ATV. This has been explained in detail as above.
- Different schedules among members are causing troubles to the teamwork. Due to the interview as well as coursework, sometimes we are not able to have a common time for everyone to go to Gascola and work on the ATV. The immediate challenge of this is that we might waste time and efforts trying to understand the code of the person who could not come. For example, there was one time when only Yilin, Nick and I went to Gascola to test the perception together with the lateral controller, where the latter was implemented by Jiayi. The lateral controller did not work at all in the beginning, and we had to “reverse engineer” her code in order to find the bug. We spent the entire day and finally found out that we put a large threshold to determine whether the leader has started which we thought was the distance from the leader but it was actually the velocity of the leader.

Teamwork

- All of us collaborated to test both lateral and longitudinal controllers on the ATV after integrating all subsystems together. Rathin and Nick also worked on the brake actuator for the ATV including the component study for it. Yilin helped clarify the autonomy software architecture to ISUZU for them to better design the DBW interface. Jiayi led the longitudinal and lateral controller testing and documented the steps in detail.

Plans

I plan to work on the LiDAR camera calibration on the Zamboni as well as implement the obstacle detection functionality as soon as the Zamboni arrives. I will also work on the perception unit testing on the Zamboni.