

William Seto

Team B: Auto Pirates

Teammates: Bikramjot Hanzra, Shiyu Dong, Tae-Hyung Kim, Tushar Chugh

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Individual Progress

For this progress review, I focused on improving the costmap functionality so that the path planner will react earlier in order to avoid an obstacle.

During our last field test, we observed that while the uniform obstacle inflation initially looked good, the problem was that due to competing desires in the costmap (staying away from the shores or driving on the right side), the path planner can sometimes generate varying paths around an obstacle. This caused the boat to sometimes swerve before avoiding the obstacle at the last moment. So we decided to inflate the costs of the obstacle according to the direction that the boat is approaching from, or more generally, the slope at the current location of the river. This should help by forcing the path planner to take an action earlier to avoid an obstacle. Also, in the presence of noise, the inflation should not magnify the problem as much since most of the cost inflation would be parallel to direction the boat is traveling and still allow a path to pass through.

In order to implement this functionality, I used a Gabor filter to stretch the costs in a specified direction. I combined this with the gaussian blurring we had previously in order to get the right amount of inflation. We will also experiment with this further during the field test. In order to determine the angle to use for the Gabor filter, I created a lookup table that specifies the angle for every possible location on the map. To create this lookup table, I used an image of the middle line of the river and computed the gradient orientations. In order to assign these values to all other locations in the map, OpenCV library functions were used to map locations to the closest pixel locations which corresponded to the river. Finally, angles were assigned using this mapping. Figure 1 below gives a graphical depiction of the lookup table.



Figure 1: Image of the angle lookup table

Challenges

Although implementation-wise, the extra cost inflation consists of just a few extra lines of code, it took me a while to tune the parameters so that the inflation was not too much or not too little. I tried many different combinations in which I would either Gabor filter multiple times, and blur several times after that, or maybe interleave them in some order, while changing the parameters of each filter.

Additionally, I had some difficulty with creating the angle lookup table such that the values were actually accurate. Because of the resolution of the middle line image, the initial result of computing the gradient orientation caused some parts of the image to have incorrect values for the angle of the river. Because of this, I had to do some additional filtering of the result before assigning the values to the nearest neighboring pixels. In this part, I spent a good deal of time playing around with filtering the result so that the problematic values would be removed. The solution I eventually decided on was to erode the original image of the middle line a little bit. This is because the problematic results generally occurred at the boundary of the edges. By eroding the original middle line, the remaining pixels corresponded to the “middle of the middle line,” where the results of the gradient orientation were most accurate.

Teamwork

Shiyu Dong

Shiyu worked on displaying the velocity and adding routes to the GUI. He also integrated the GUI with the planner.

Bikramjot Hanzra

Bikram worked on adding synthesized voice messages to the GUI in order to improve the user experience.

Tae-Hyung Kim

Tae-hyung worked on analyzing the data from the bag files which was logged from the Novatel INS.

Tushar Chugh

Tushar worked on improving the waypoint skipping functionality, and adding a stopping condition for when the boat reaches the goal.

Plans

Because we didn't get to do our field test before this PR, our upcoming test would be our actual dress rehearsal. During this, we will test our new obstacle inflation and hopefully see improved planning results. Moreover, we will ensure that we can traverse the paths corresponding to the possible destinations on the GUI. Finally, we will polish up our GUI by making sure this functionality will allow us to smoothly execute the script we've outlined for the SVE. We may possibly overlay a landmap similar to that of Google Maps so that it looks nicer cosmetically as well.