Detecting Ducks in the World II

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***Abstract*— The goal of this lab practice is to explore about reference frames. We used the color filter and blob detection to detect a yellow duck and collected data to perform linear approximation to estimate the location of the duck with respect to the front of the robot. We then used the linear approximation function that to plot all the detected ducks in the world frame.**

I. Useful Functions for Duck Detection

A. Function that receives u and returns θ

$$\theta = -0.5003834 + u \cdot 0.00290751 \tag{1}$$

B. Function that receives S_b and returns d

$$d = 3.5927166302253113 + \frac{1}{\sqrt{S_b}} \cdot 1107.16448546 \tag{2}$$

II. Conclusion

A. How noisy is the information of the duck?

The more obvious factor that introduces noise to the blob detection is the facial feature of the rubber ducks. However, this is rather trivial. Due to the lighting of the environment, the body of the rubber ducks is also not uniformed colored, which reduces the accuracy of the measurement. Some actions I took to make the result more accurate is measuring the *x* and *y* coordinates of the duck instead of distance and angle. I then compute the distance and angle using trigonometry to obtain a more reliable measurement. In general, as reflected in Fig. 1, the noise is rather manageable as it doesn't interfere a lot with the results.

B. Would the information be reliable in a search a rescue scenario?

Depending on how you use it, it could be helpful. However, I don't see the immediate benefits of obtaining the accurate measurement of distance and angle as we might just want to simply use the blob information to make the control policy.

C. How can you improve the detection method?

I want to improve the detection method by making the searching process more robust. I would use the center of the biggest blob to compute ω and its size to compute *v*. I will also make the camera higher so that once a duck is captured, so that the cnmera doesn't see it anymore, it starts look for the next one in the environment.

D. The robot moved in a circular trajectory. Can you make the robot move to describe a spiral trajectory?

It is possible to make a robot move in a spiral trajectory. Building off of moving in a circular trajectory, the robot would need to simultaneously move inwards or outwards from the center of the circle. The new control policy would be varying the speed of the robot's rotation while also adjusting its forward movement speed. As the robot's forward movement speed *v* increases, with ω holding constant, it moves inwards towards the center of the spiral; and as *v* decreases, the robot moves outwards towards the edge of the spiral. Eventually, the robot will trace out a spiral path.