Research Track 2
Statistical Analysis Report

Pedro Figueroa, S5439029
DIBRIS - Dipartimento di Informatica, Bioingegneria, Robotica e Ingegneria dei Sistemi
Universita Degli Studi di Genova

I. Hypotheses

To test if Algorithm 1 is better than Algorithm 2 in a task related to moving a mobile robot in order to find and grab a set of boxes in a simulation environment, the following hypotheses will be proposed:

"If I use a proportional controller to set the linear velocity in my algorithm will be faster than another algorithm with a fixed linear velocity to reach a box"

II. Description of the Experiment

The simulation assignment consists in an environment in which a mobile robot has the task to grab and releasing a silver box close to a golden box and repeating this task for a set of 6 pair of boxes.

In Figure 1, an example of the simulation is shown

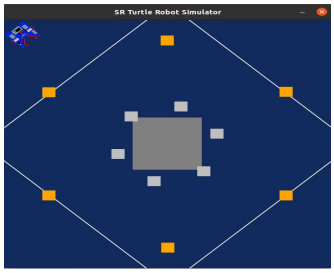

Fig. 1: Simulation Environment

The variables to evaluate in each algorithm will be the time in each case the robot last to grab each silver box and release it close to the golden box. To properly evaluate the time in the simulation implemented in Python, a modification in the time measured will be done, thus obtaining time measurement in seconds.

Each algorithm will be tested 3 times, with the disposition of the boxes being equal for each case. The main difference to evaluate the time depends on the use of a proportional controller to set the linear velocity to reach a box implemented on Algorithm 1.

The modification is shown in the next code lines, which are part of Algorithm 1

```
if -a_th<= rot_y <= a_th:
            #print("Ah, that'll do.")
            vel=dist*50
            #print(vel)
            drive(vel, 0.5)
            #drive(40, 0.5)
```

In the code, "dist" is the variable obtained after the robot finds a box. Compared to algorithm 2 in which the velocity is fixed, in this case depending on the distance between the robot and the box, it will move faster while being far from it and then will be slower as soon as the robot reaches the box.

III. Results

A table with the results after experimenting with each algorithm three times is presented in Figure 2

	ALGORITHM	ALGORITHM 1			ALGORITHM 2		
	EXPERIMENT #	1	2	3	1	2	3
SILVER	1	0.00	0.00	0.00	0.00	0.00	0.00
	2	22.74	15.10	17.63	26.71	28.56	22.18
	3	41.31	31.19	33.22	48.50	49.29	47.26
	4	54.85	45.25	47.77	68.50	69.08	64.52
	5	67.41	61.84	63.37	100.38	100.17	88.82
	6	85.53	82.51	79.47	120.81	120.66	119.79
GOLDEN	1	8.04	5.56	6.06	15.12	14.29	12.73
	2	30.29	20.13	21.66	34.47	36.82	35.38
	3	46.33	35.71	37.24	54.68	56.76	55.28
	4	59.37	50.28	53.82	82.71	83.33	77.35
	5	71.44	67.91	66.38	107.35	107.21	104.16
	6	102.63	99.05	98.06	133.63	133.96	129.60

Fig. 2: Table with Time marks for each box grabbed or released

In Figure 2, the time mark for the first box is 0 for every experiment, thus because of how Python calculates its inner time. For that, by subtracting the time mark at the moment the robot grabs the first silver box for every case to all of the other time marks, it will have a set of time marks properly defined in seconds, having the first silver box as the time reference.

In Figure 3, the graphic bar shows the time mark at which the robot grabs the last golden box in each algorithm, tested three times

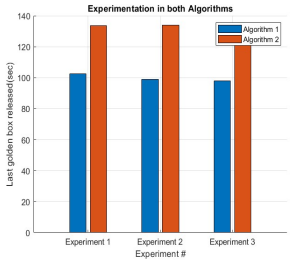

Fig. 3: Graphic Bar for Each Algorithm

IV. Statistical Analysis

To perform the statistical analysis, the values to analyze will be the time marks at which the robot reaches the last golden box to release the last silver box.

For every algorithm, the mean time mark is computed, along with the standard deviation, and will be represented in graphics

In Figures 4 and 5, the graphic shows the same time marks for each algorithm, with the standard deviation for every experiment shown as an error graph. The purple line represents also the average time mark to reach the last golden box.

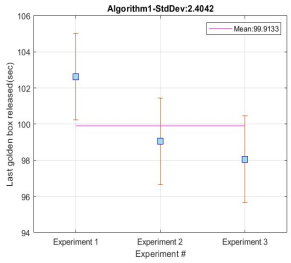

Fig. 4: Mean time mark and Standard Deviation for Algorithm 1

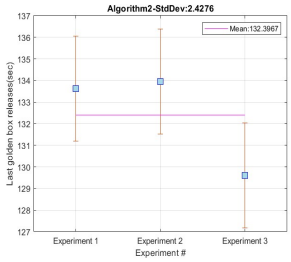

Fig. 5: Mean time mark and Standard Deviation for Algorithm 2

V. Conclusions

After evaluating the statistical graphics, it is concluded that Algorithm 1 is faster to complete the task due to the implementation of a proportional controller to compute the linear velocity to reach every box, rather than implementing a different strategy to do the same task, as shown in Algorithm 2. Thus, proving the initial hypothesis proposed.