

Research Track 2 assignment 3 report

Nicolò Torre, Alberto Bono

May 2024

1 Introduction

In this project, we aim to compare the performance of two different box moving robot control algorithms ("robot1_algorithm.py" and "robot2_algorithm.py") using a statistical approach. A first look on the two algorithms seemed to suggest that the first algorithm was faster than the second one: as such we set the null hypothesis to be that the algorithm 2 is faster than or as fast as the algorithm 1.

2 experiment methodology

In order to test the established null hypothesis the two algorithms have been used to control a robot simulated in the robotic simulator's environment in 30 different arenas. In each arena n_i boxes were placed. The positions of these boxes are determined by placing them in a circular arrangement, with angular offset between two boxes set to $\frac{2\pi}{n}$ and radius randomly generated between 0.5 and 2.5. The 30 environments are created using 30 numbers previously generated randomly as seeds for generating the radii of the boxes. This ensures that both robots operate in the same environment for each trial, providing consistency and allowing for a fair comparison. This sequence generation is implemented in the program "generate_seeds.py". Each obtained by placing the boxes at a randomly generated distance from the center of the arena (one random radius between 0.5 and 2.5 generated for each box). The seed used for the current simulation needs to be set manually inside of the "sr/robots/arenas/two_colour_assignment_arena.py" file. The measurement of the time taken by each robot to complete the task is integrated into the algorithms controlling the behavior of the robots and then saved in one file per algorithm: "times1.txt" and "times2.txt" In order to ensure an easy collection and errorless analysis of the obtained data. If a robot fails to complete the task within a reasonable time frame, we assign a default time of 300 seconds to that attempt. This ensures that our data accounts for failures in task completion.

3 statistical test

Since the two algorithms were tested on the same 30 environments the comparison between them is made using a paired t-test. For this test mean, variance and standard error are computed for the variable $d = t_1 - t_2$ together with the resulting t-value for the aleatory variable inside of the program "tester.py".

4 results and conclusion

The time measurement obtained gave us a t-value of $t \approx -10.397$ with 29 DOF. After looking up the associated confidence values using tables available online, this result brings us to refuse the Null hypothesis with a chance of error of less than 0.05%. As such we can conclude that the algorithm 1 is faster than algorithm 2 with a confidence level bigger than 99.95%.