Multi-Robot Exit Width Estimation Simulation

Introduction

This report describes a simulation of multi-robot exit width estimation within a controlled environment. The simulation involves 50 robots randomly placed in a 100 by 100 room, tasked with estimating the width of a single exit. The exit width fluctuates between 16 to 26 units, and the estimation accuracy is influenced by the robot's proximity to the exit. This simulation is implemented in C++ using pthread.

Code Overview

The code consists of several components to simulate the behavior of the robots and the global aggregation of their estimates. The key components are as follows:

Robot Struct: Each robot is represented by a Robot structure, storing its unique identifier, coordinates, and estimated exit width.

Accuracy Calculation: The accuracy of exit width estimation is determined by the function calculateAccuracy, considering the distance between a robot and the exit.

Neighbor Check: The function isNeighbor checks if two robots are neighbors based on a predefined distance threshold.

Average Estimation: The function computeAverageEstimate calculates the average estimate based on the estimates received from neighboring robots.

Robot Behavior Simulation: The main function robotBehavior simulates the behavior of a robot over a period of time, updating its own estimate and communicating with neighbors.

Global Aggregation: The function globalAggregation aggregates the average estimated widths from all robots after a specified duration.

User Manual

Compilation

Compile the code using a C++ compiler that supports the pthread library.

bash

g++ -o robot_simulation robot_simulation.cpp -lpthread

Execution

Run the compiled executable:

bash

./robot_simulation

Simulation Details

The simulation involves 50 robots estimating the width of a single exit. Each robot's estimate is influenced by its proximity to the exit, and the accuracy varies accordingly.

Accuracy Thresholds:

If the distance to the exit is 5 units or less, the accuracy is 95% or greater.

If the distance is between 5 and 10 units, the accuracy ranges from 88% to 95%.

Robot Behavior:

Each robot communicates its estimated width to all other robots.

A robot retains the received estimate only if the sender is its neighbor (distance <= 5 units).

Each robot computes an average of the estimates received from neighbors along with its own estimation.

Global Aggregation:

After a duration of 10 seconds, all robots aggregate the average estimated widths into a global common variable called 'Total_width.'

The average width of all robots is calculated using 'Total_width.'

Output:

The estimated and true values of the exit width, along with the absolute difference, are displayed for each robot.

After global aggregation, the total width and average width are displayed.

Conclusion

This simulation provides insights into the collective behavior of robots estimating the exit width, considering proximity-based accuracy. The provided code and user manual offer a comprehensive understanding of the simulation and its execution. Adjustments can be made to parameters such as the number of robots, room dimensions, and exit width range to observe different scenarios.