Improved Ant Colony Navigation

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Motivation

“Research on Path Planning Based on Improved Ant Colony Algorithm” – Wenliang Peng, Lili Wang, Huizhan Yang, and Guiping Lu.

- They have introduced improved navigation algorithm called Ant Colony Algorithm (ACO).
- Leverages the strengths of Swarm Robotics.

Swarm Robotics

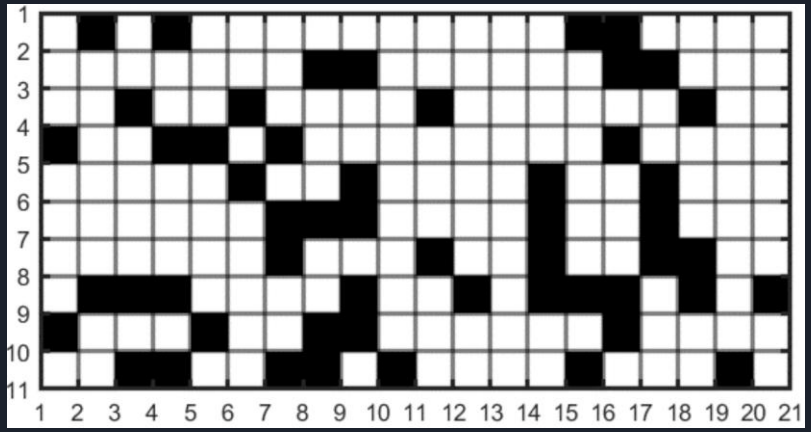
- Multiple robots working together to complete some sort of unified task.
- Leverages multi-processing approach.
- Helpful for large tasks that would be difficult or tedious for a single unit to complete.
- Individual robots are relatively simple, but robust when used collectively.

Ant Colony Algorithm

- One of the solutions for Travelling salesman shortest path problem.
- It imitates the way that ants communicate to find food.
- Pheromone trails indicate “hotspots” that encourage other units to take the same path.

Ant Colony Algorithm(Contd.)

- Initial pheromone on all blocks is 0.
- Pheromone placed by ant on any path it travels.
- Pheromone amount increases when food found on the return path.
- Their implementation is for simple 2D matrix and not for robot navigation.



Their example map (2D matrix)

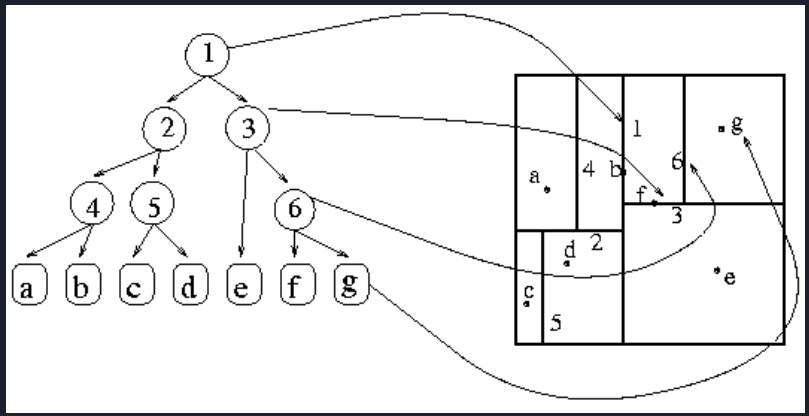
Modified Implementation

1. Initially, the robots start a random walk and leave a pheromone trail behind.
2. When a robot finds food, it traces back its original pheromone trail to home and while doing this, it places another pheromone trail.
3. There's two types of pheromones being placed, one for the robot itself and one for all the robots.
4. When a robot finds no food, the path is deleted. Simulating the evaporation of pheromone trail.

Modified Implementation (contd.)

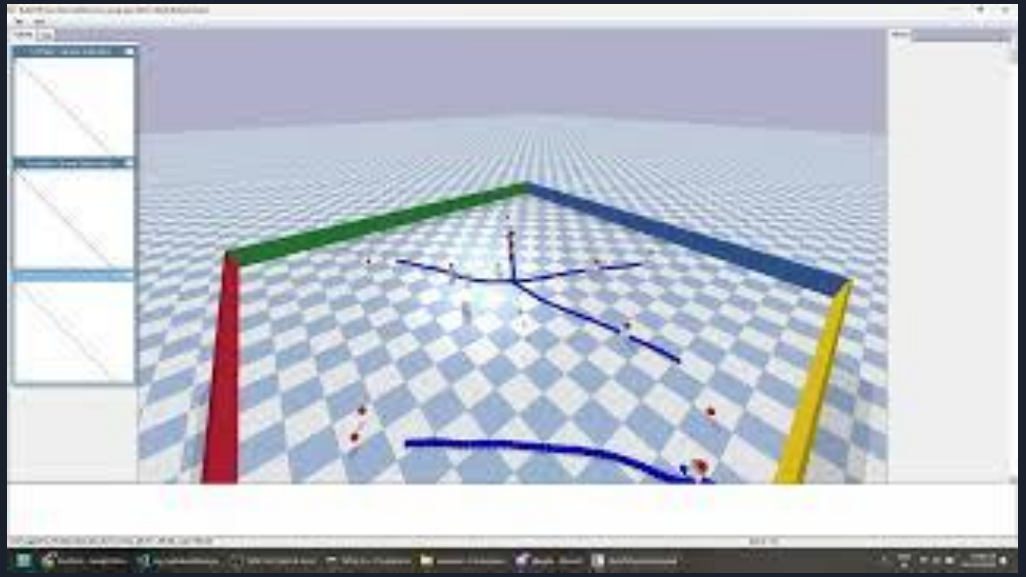
5 . Pheromone search: The pheromone trail points are stored in a KD Tree for fast search.

6. Point check: Checks current position in the KD Tree to check if a pheromone path exists from this point.



Example KD Tree

Demo

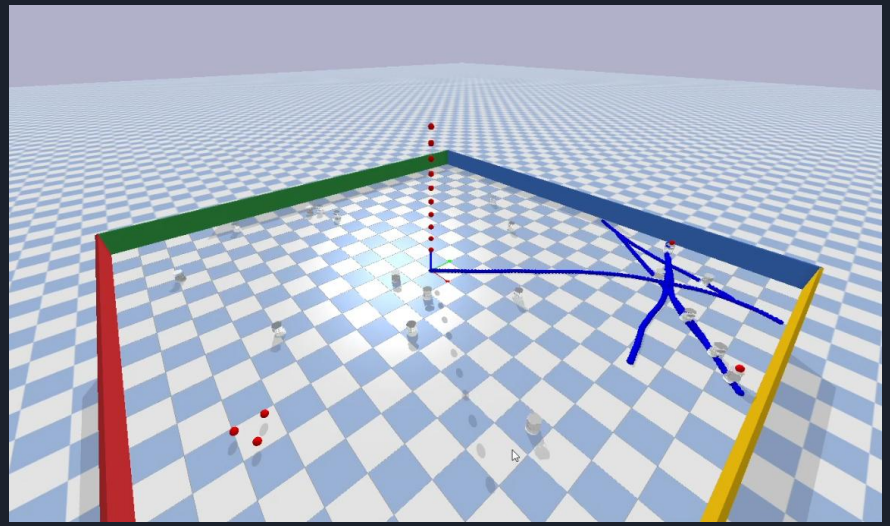


Simulation for 20 Robots, 5 food posts

Next Steps

- Fix long paths. Set buffer for random search come back home start another random search.

- Run simulations with different amounts of food, number of robots and get an average clearance time and memory usage to compare with other navigation methods.



Took too long to find food

Thank You