# Multi-robot Foraging using Virtual Pheromone (VP) Algorithm

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**Project Objective:** Multi-robot foraging is one of the first behaviors researched in Swarm Robotics and Swarm Intelligence. There are many variations of the foraging behaviour, but a common theme is to deploy the swarms to locate certain targets and then bring them back to the initial location, which may be called a “nest”, or to another location, either as a group, or individually. Particular properties of multi-robot foraging include the following:

1. Swarm size: The number of robots used for in the swarm deployed for the foraging task.
2. World size: The size of the simulation arena where the swarm would be deployed
3. Swarm density: Size of the swarm with respect to the size of the arena/world.
4. Target-nest distance: The distance between the target and the nest. sensors used and coordination methods used.
5. Simulation time: The amount of time steps measured for the robot to cover the target-nest distance multiple times. This will help us gauge the performance of a foraging algorithm.
6. Communication radius: This is the maximum distance for which an individual robot can detect/communicate with an object.

Foraging has multiple potential applications such as sample collection from a hard-to-traverse environment, cleaning an environment of debris/litter, clustering objects into specific shapes/groups, locating scattered hard-to-locate objects, structure construction, object reshaping, etc.

**Methodology:** The “Virtual Pheromone” (VP) algorithm will be used for performing the foraging. In this algorithm, the all robots start randomly translating from the nest. After a certain amount of time, some of the robots will become stationary and serve as beacons. These beacons will store real-valued floating-point numbers called virtual pheromones (VPs) as well as provide the VPs to the non-stationary robots. The VPs give information about target proximity and decay at a certain rate. The robots would follow the VP distribution along the strongest value. The nest would be the initial position, and the target would be a certain spot providing an unlimited supply of food.

Webots simulator would be used to carry out the simulations. Matlab would be used for plotting the “total food” returned to the nest in 100 time-steps. Khepera II robot would be used for the simulations. The arena would be a walled arena so that the robots do not travel indefinitely and get lost. 2 parameters would be varied: (1) Target-neighbour (TN) distance and (2) number of robots used, each in 3 steps, giving us 9 graphs in total or 3 graphs if we are overlapping. The purpose of doing so would be examine how the algorithm scales with the TN distance and the swarm size. The videos of these simulations would also be recorded in order to observe the robot swarm behaviour.

References:

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