

# Swarm Robotics: Exploration and Mapping in Simulated Environments

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Interim report

Computer Science and Artificial Intelligence BSc



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# 1 Introduction

Swarms exist everywhere in life. Nearly all organisms exhibit some form of swarming behaviours within their communities. Starlings display impressive organisational behaviour, positioning themselves with respect to the movement of their neighbours. Humans show swarm behaviours when moving in crowds, for example, moving around sports venues or exiting buildings in emergencies. No matter how hard you look, regardless if the context, swarms are typically present.

These behaviours can also be artificially created in robotics. Within the realm of computing, parallelising processes is breaking barrier after barrier - swarm robotics brings the same benefits. Being able to divide and conquer a problem has the ability to reduce computational complexity by whole orders of magnitude. Therefore, it would be wasteful not to properly dedicate the time which this discipline deserves.

My agents will be placed within close proximity inside a simulated environment and then allowed to explore and combine their findings; ultimately creating a visualization map of its environment. The agents will need to both navigate the environment and avoid collisions, whilst creating an internal representation of its surroundings. The best-case scenario for the swarm I am developing is a fully decentralised system in simulation.

I will initially explore this problem by creating SLAM simulations, and then attempting to apply similar techniques to a centralised system. These initial simulations will employ techniques such as particle filters, loop closures and [insert something here] in order to create a base-line representation of the environment.

# 2 Professional and Ethical Considerations

My project maintains compliance towards all ethical considerations, as there is minimal external involvement from humans. The majority of my project will be carried out in simulation, therefore no ethical approval is required. Should my project progress to physically implementing agents, considerations such as safety around the robots, will be considered. All tests will be carried out in an environment where people cannot be hit, therefore mitigating any trip hazards.

Research in this project is within the professional competence of myself, as it significantly relies upon knowledge obtained from modules such as "Acquired Intelligence and Adaptive Behaviour" and "Fundamentals of Machine Learning." I will further ensure all relevant gaps in knowledge are explored through reading extensively in the area and communicating any areas of concern with my supervisor.

Requirement	Justification
R1	The system must be able to create a map of its environment

Table 1: Requirements and their justification

## 3 Related Work

### 3.1 SLAM

### 3.2 Swarm

### 3.3 Requirements Analysis

## 4 Project Plan

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## 5 Methods and Preliminary Results

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## 5.1 Supervisor Meetings

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## 6 Appendices

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