Swarm Robotic Exploration Using Bacterial Foraging Optimization

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1 Introduction

The main point of interest in this research is distributed optimization and control using the Bacterial Foraging Optimization (BFO) algorithm. The algorithm is inspired by the foraging behavior of bacteria in search of nutrients to maximize energy in unit time. In the context of swarm robotics, the BFO algorithm is applied to a group of robots to optimize their behavior for efficient exploration and information gathering.

2 Chemotaxis

Chemotaxis is a key process in the BFO algorithm, analogous to the movement of bacteria. The robots perform random walks in the environment, evaluating the quality of their positions based on task-specific criteria or environmental factors. They move towards areas with higher potential for accomplishing the exploration task, such as unexplored regions or regions with rich information.

3 Reproduction

The reproduction process in the BFO algorithm mimics the reproduction of bacteria. Robots with higher fitness, which indicates better performance in exploration, have a higher probability of reproducing. The offspring inherit slight variations in their positions from their parent robots. This diversity allows for exploration of different areas of the environment, increasing the chances of finding optimal solutions.

4 Elimination-Dispersal

In response to sudden environmental changes, the BFO algorithm incorporates an elimination-dispersal mechanism. This mechanism imitates the behavior of

bacteria that are either killed or dispersed to new areas when unfavorable conditions arise. Similarly, in the swarm of robots, some robots may be eliminated or dispersed to adapt to changing environmental factors or to explore unexplored regions.

5 Swarm Behavior

The swarm behavior is an iterative process in the BFO algorithm. The fit robots, which have higher fitness, repeat the chemotaxis, reproduction, and elimination-dispersal processes until a satisfactory solution is obtained. Through iterations, the swarm gradually converges towards optimal solutions for exploration and information gathering.

6 Research Paper Aim

The aim of the research paper is to explore and optimize the navigation and decision-making processes in swarm robotic exploration using the Bacterial Foraging Optimization algorithm. The goal is to efficiently explore unknown environments, gather information, and achieve specific tasks collectively as a swarm.

7 Conclusion

By applying the Bacterial Foraging Optimization algorithm to swarm robotic exploration, this research aims to enhance the swarm's ability to navigate, make decisions, and efficiently explore unknown environments. The algorithm's stages, including chemotaxis, reproduction, elimination-dispersal, and swarm behavior, contribute to achieving optimal solutions for exploration and information gathering. The BFO algorithm provides a mechanism for distributed optimization and control in swarm robotics, enabling the swarm to adapt to changing conditions and efficiently accomplish complex tasks.