بسم الله الرحمن الرحيم

MONA MAGHRABY

شبكة المعلومات الجامعية

التوثيق الالكتروني والميكروفيلم

MONA MAGHRABY

شبكة المعلومات الجامعية

التوثيق الإلكتروني والميكروفيلم

جامعة عين شمس

التوثيق الإلكتروني والميكروفيلم

قسم

نقسم بالله العظيم أن المادة التي تم توثيقها وتسجيلها
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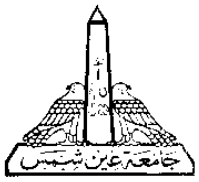


Ain Shams University

Faculty of Engineering

Mechanical Mechatronics Department

Decentralized Control of Multi Agent Cooperative Mobile Robots

A Thesis submitted in partial fulfillment of the requirements of the degree of Master of Science in Mechanical Engineering (Mechatronics Engineering)

By **Abdulrahman Ibrahim Eid Ahmed**

Bachelor of Science In Mechanical Engineering

(Mechatronics Engineering)

Higher Technological Institute (HTI), 2015

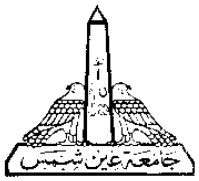
Supervised by

Prof. Dr. Farid Abdelaziz Tolbah

Associate Prof. Dr. Mohammed Ibrahim Mohammed Hassan Awad

Dr. Shady Ahmed Maged

Cairo - (2021)



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Date:10/ 7 /2021

Statement

This thesis is submitted as a partial fulfillment of M.Sc. degree in Mechanical engineering, Faculty of Engineering, Ain Shams University.

The author carried out the work included in this thesis and no part of it has been submitted for a degree or qualification at any other scientific entity.

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Thesis Summary

Formation pattern is a global research problem in Multi Agent robots that draw the attention of many researchers who are working in autonomous systems due to its significant role in critical applications such as military and surveillance. In this study we develop fully distributed controllers to enable agents to form a predefined pattern. Two different approaches used for the design of controllers: (1) Bio inspired behavioral approach and (2) learning-based approach.

The first approach built over an algorithm that based on bio-inspired behaviors occurring in animal flocks which means the algorithm depends on the current flocks distribution and the predefined shape is detected through a main controller to estimate the shape. Shapes are previously trained through a deep neural network on the controller to detect the geometric shape. Deep Neural network's input is a given current robot's distribution in the map after eliminating potential pixels in the map according to obstacles and map borders. Simulation based tests are done to validate self-organizing algorithms and measure efficiency and computational time to achieve desired geometric shapes compared to popular Brute-Force search.

The second approach relies on a method that depends on collaborative learning between agents to explore their relative positions in the map to form a specific pattern and receive online feedback by the controller. Agents are trying to minimize the relative errors between each other to reach the shape. Deep Reinforcement learning is used as an essential optimizer to enable agents discovering best policy throughout exploring in a defined environment to find the desired shape. A framework through the study proposes a general framework that enables agents to overcome the complex noises extracted from each agent sensor to lower dimensions that represent the state. Results have been discussed in terms of convergence