TEB1113/TFB2023: Algorithm and Data Structure
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REPORT:

Drone Swarm Simulation

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Introduction

This project focuses on developing a sophisticated control algorithm for managing and coordinating multiple drones using C# within the Unity game engine. Our primary goal is to design and implement an effective system that ensures precise navigation and seamless coordination of drones in a simulated environment. By leveraging Unity's simulation capabilities, we aim to address key challenges in drone swarm management and demonstrate the potential of this technology for various real-world applications.

Objectives

- Make drone swarm algorithms from scratch in Unity
- Explore already available Unity libraries for the drone swarm simulation
- Compare the runtime for each approach
- Discuss the scalability, efficiency, and ease of implementation for both approaches

How Drone Swarms Work

A **drone swarm** is a group of autonomous drones working together in a coordinated manner, mimicking the behavior of swarms seen in nature, like birds or insects. Swarm drones are designed to communicate, collaborate, and perform tasks collectively, which is particularly useful in scenarios where a single drone's capabilities are limited.

Concept That We Can Apply

We can apply consensus-based algorithms that are based on the idea that each drone has a desired state, such as a position, a velocity, or a color, and tries to reach an agreement with the rest of the swarm. To do so, each drone exchanges information with a subset of its peers, usually the ones within a certain range or visibility, and updates its state according to a mathematical formula. For example, one of the simplest consensus-based algorithms is the average consensus, where each drone computes the average of its own state and the states of its neighbors and moves towards that value.

Challenges

While drone swarms show great potential, several hurdles remain:

Coordination: As the swarm grows larger, coordinating the movements of each drone becomes more challenging, making it difficult to maintain smooth operations and may risk collision.

Battery Efficiency: Effective task distribution is key to maximizing energy use, especially as the swarm scales up in size.