Autonomous Navigation: Harnessing Neural Networks for Effective Drone Fleet Control

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Abstract:

This study explored the utilization of neural networks to enhance autonomous fleet management within drone technology, with the general goal of integrating of neural networks to improve navigation, and leverage their effectiveness in image processing and object recognition. The research addressed the implementation of neural networks in fleet management, autonomous drone control, communication, and navigation through a mixed-methods approach, encompassing both theoretical and practical components.

The theoretical component involved a comprehensive literature review on autonomous navigation, drone fleet management, and neuro-inspired computing. The practical aspect focused on the development of an autonomous drone navigation system that independently trained a neural network to recognize and classify objects and obstacles in real-time, enabling drones to navigate and map designated spaces autonomously.

Experimental testing comprised simulated and real-world scenarios, evaluating the system's performance in tasks such as object tracking, obstacle avoidance, and formation flying. A multi-agent approach was adopted, treating each drone as an individual agent communicating with others to achieve common objectives.

Assessment of the developed system included training a neural network using TensorFlow, integrating it into the navigation system, and conducting tests to evaluate its effectiveness in simulated and real environments. Data analysis encompassed task completion time, fleet performance, and communication efficiency. The statistical analysis revealed significant results that address specific scalability and robustness issues in real-world deployment of large fleet autonomous drone navigation systems, and suggests avenues for future research in enhanced neural network algorithms and optimized communication efficiencies, as well as specific applications in the areas of environmental monitoring, precision agriculture, infrastructure inspection, and disaster response.