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Q-LEARNING FOR CREATING AN IMPROVED ROUTING PROTOCOL FOR UAV SWARM

Abu Hussain. G[1] (student)
Scientific supervisor – Associate Professor of the Faculty of Applied Computer Science Kharitonov A. Y.[1]
[1]ITMO University
akharitonov@itmo.ru

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Abstract

This work examines the problem of routing in highly dynamic ad hoc networks formed by swarms of unmanned aerial vehicles. Traditional deterministic routing protocols prove to be ineffective under conditions of frequent topology changes, stochastic behavior of communication channels, and limited infrastructure. Recent advances in reinforcement learning offer promising approaches to adaptive routing, allowing agents to learn to make optimal decisions under conditions of uncertainty.

The report proposes a routing protocol based on Q-learning and Deep Q Network (DQN) algorithms. Each unmanned aerial vehicle is modeled as an autonomous agent that makes packet-forwarding decisions based on local observations of the network state and accumulated learning experience. Unlike approaches that rely on static metrics such as hop count, the proposed learning-based method optimizes long-term delivery success and routing stability. The novelty of the proposed method lies in integrating deep reinforcement learning into the problem of dynamic routing in UAV swarms, providing an efficient and scalable solution without the use of centralized control.

The conducted study shows that DQN-based routing significantly outperforms classical routing algorithms under conditions of dynamic and unreliable networks. The obtained results confirm the feasibility of applying deep reinforcement learning methods in real communication systems of unmanned aerial vehicle swarms. The proposed solution can be practically implemented in simulation environments and later adapted for use on real UAV platforms after conducting field tests.

Keywords
UAV, DQL, DQN, Routing, Q-Learning

Literature

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