

# "AI-driven Reinforcement Learning for Energy-efficient Clustering and Routing in Dynamic Wireless Sensor Networks"

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## Abstract

Wireless Sensor Networks (WSNs) are pivotal in healthcare, IoT, and critical real-time monitoring systems. Energy efficiency and fault tolerance are key challenges, especially in dynamic node distribution environments. This paper introduces an AI-driven approach to optimize clustering and routing mechanisms in WSNs by integrating reinforcement learning (RL) into the S-CSRSM (Smart Clustering and Routing Mechanism). The proposed method adaptively determines optimal cluster head (CH) placement and multi-hop routing paths based on historical and real-time data. Experimental results demonstrate significant improvements in network lifetime, energy efficiency, and fault tolerance compared to conventional methods such as LEACH and ERP. This research contributes to the development of intelligent, energy-efficient WSNs tailored for dynamic and mission-critical applications.

**Keywords:** Wireless Sensor Networks, Reinforcement Learning, Clustering, Routing, Energy Efficiency, Fault Tolerance