

## Adaptive Energy-Aware Routing (AEAR) for Optimized Performance in Resource-Constrained Wireless Sensor Networks

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**Abstract :** Wireless Sensor Networks (WSNs) are crucial for numerous applications, yet they face significant challenges due to resource constraints such as limited power and memory. Traditional routing algorithms like Dijkstra, Ad hoc On-Demand Distance Vector (AODV), and Bellman-Ford, while effective in path establishment and discovery, are not optimized for the unique demands of WSNs due to their large memory footprint and power consumption. This paper introduces the Adaptive Energy-Aware Routing (AEAR) model, a solution designed to address these limitations. AEAR integrates reactive route discovery, localized decision-making using geographic information, energy-aware metrics, and dynamic adaptation to provide a robust and efficient routing strategy. We present a detailed comparative analysis using a dataset of 50 sensor nodes, evaluating power consumption, memory footprint, and path cost across AEAR, Dijkstra, AODV, and Bellman-Ford algorithms. Our results demonstrate that AEAR significantly reduces power consumption and memory usage while optimizing path weight. This improvement is achieved through adaptive mechanisms that balance energy efficiency and link quality, ensuring prolonged network lifespan and reliable communication. The AEAR model's superior performance underlines its potential as a viable routing solution for energy-constrained WSN environments, paving the way for more sustainable and resilient sensor network deployments.

**Keywords :** wireless sensor networks (WSNs), adaptive energy-aware routing (AEAR), routing algorithms, energy, efficiency, network lifespan

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