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Improving Network Longevity in Wireless Sensor Networks Using an Evolutionary Optimization Approach

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Abstract: Several protocols strive to improve network longevity but fail to ameliorate the uneven overhead imparted upon the sensor nodes that lead to temporal deaths. The proposed work uses a metaheuristic approach that promotes load balancing and energy-efficient data transmission using the fruit fly optimization algorithm (FFOA). The approach combines the LEACH protocol with differential evolution (DE) to select an optimum cluster head in every cluster. The algorithm is designed to provide energy-efficient data transmissions based on the smell and vision foraging behavior of fruit flies. The approach considers the compactness of nodes, energy capacity, and the distance of sensor nodes from the base station and geocentric location, and other factors to select an optimal cluster head. It provides an optimal solution for the nodes in overlapping cluster heads and the energy problem that occurs due to uneven clustering. The metaheuristic approach implements multi-hop routing by finding an optimal path and allows the cluster head re-election strategy when the data transmission is intense. Simulations prove that FFOA-based LEACH increases the network lifetime through energy-efficient clustering and routing when compared with LEACH and DE-LEACH.

Keywords: LEACH; differential evolution; fruit fly optimization algorithm; cluster head selection; multi-hop routing

1 Introduction

Wireless sensor networks (WSNs) have attracted interest in recent years for many applications where human intervention is not possible. Application-oriented sensor nodes are positioned in a geographical location referred to as a sensing field to perceive the changes in the surroundings. These sensor nodes are of low cost, use less power, and have limited transmission capability. Hence, prolonging the lifetime of WSNs is a major challenge in addition to security, reliability, and scalability [1]. Balancing the energy consumption for the sensing and transmission of data can be achieved by clustering. This process organizes a set of sensor nodes, which are referred to as clusters, based on criteria like distance or