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Proposing a Centralized Algorithm to Minimize Message Broadcasting Energy in Wireless Sensor Networks Using Directional Antennas

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Highlights

- Proposing a PSO Algorithm to Minimize Message Broadcasting Energy in Wireless Sensor Networks Using Directional Antennas.
- Energy consumption of this centralized algorithm is better than the previous ones for 20-nodes instances.
- Designing SA, GA, TLBO and HA algorithms on this problem. (Minimize Message Broadcasting Energy in Wireless Sensor Networks Using Directional Antennas)
- Comparing the result of all these algorithms with the result of ACO algorithm in terms of time and energy consumption.
- In terms of energy, GA, PSO and HS methods are better than other three meta-heuristic algorithms in 20-node networks, but not in terms of running time.
- ACO algorithm is better than other meta-heuristic algorithms in 50- nodes networks.
- Time of SA algorithm is better than the time of other meta-heuristic methods in 50-nodes networks.

Abstract: Wireless Sensor Networks(WSN) are utilized in many fields such as environmental monitoring and military applications. The nodes of WSNs are not rechargeable, so energy conservation in these networks is important. One of the important issues in these networks is to optimize energy in message broadcasting. Depending on the ability of nodes and antennas, broadcasting is done in two means: directional and omni-directional antennas. There are centralized algorithms to broadcast message in wireless networks either by directional or omni-directional antennas. The problem of minimizing energy in broadcasting and multicasting is Non-polynomial-hard. In this paper, a centralized algorithm is proposed to improve energy and running time of the algorithm by using directional antennas. As evolutionary algorithms by omni-directional antenna are better than heuristic algorithms in terms of the time and the average result; a new approach based on particle swarm optimization (PSO) as an evolutionary algorithm is proposed in this paper. We have also considered and evaluated most of famous evolutionary algorithms such as Simulated Annealing (SA), genetic algorithm (GA), Teaching-Learning-Based Optimization (TLBO), Harmony Search (HS) and Ant Colony Optimization (ACO). The experiment results indicate that the proposed method is effective especially in term of energy conservation.

Keywords: wireless sensor network, multicasting, broadcasting, omni-directional antenna, directional antenna, particle swarm optimization, centralized algorithm

1. Introduction

In sensitive and military locations, it is possible that wireless sensor networks could not be rechargeable. Inability to recharge puts great importance on energy and optimal use of that.

In general, energy-efficiency in message broadcasting and multicasting, in wireless sensor networks, is divided into two classes [1]. The first class is to maximize the network's lifetime; [2] works on solving

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