An Unequal Multi-hop Balanced Immune Clustering protocol for wireless sensor networks

Nabil Sabor Mohammed Abo-Zahhad Shigenobu Sasaki Sabah M. Ahmed

Abstract:

In multi-hop routing, cluster heads near the base station act as relays for far cluster heads and thus will deplete their energy very quickly. Thus, hot spots in the sensor field result. This paper introduces a new clustering algorithm named an Unequal Multi-hop Balanced Immune Clustering protocol (UMBIC) to solve the hot spot problem and improve the lifetime of small and large scale/homogeneous and heterogeneous wireless sensor networks with different densities. UMBIC protocol utilizes the Unequal Clustering Mechanism (UCM) and the Multi-Objective Immune Algorithm (MOIA) to adjust the intra-cluster and inter-cluster energy consumption. The UCM is used to partition the network into clusters of unequal size based on distance with reference to base station and residual energy. While the MOIA constructs an optimum clusters and a routing tree among them based on covering the entire sensor field, ensuring the connectivity among nodes and minimizing the communication cost of all nodes. The UMBIC protocol rotates the role of cluster heads among the nodes only if the residual energy of one of the current cluster heads less than the energy threshold, as a result the time computational and overheads are saved. Simulation results show that, compared with other protocols, the UMBIC protocol can effectively improve the network lifetime, solve the hot spot problem and balance the energy consumption among all nodes in the network. Moreover, it has less overheads and computational complexity.

Keywords:

Hot spot problem; Unequal clustering; Multi-hop routing; Multi-objective immune algorithm; Homogeneous and heterogeneous networks

Published In: