Chapter 65
Adjust Fuzzy Model Parameters for Head Election in Wireless Sensor Network Protocols

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ABSTRACT

The clustering routing protocols attract many research papers that result from their well topology control, less demand resources, and less energy dissipation. The cluster routing protocols consist of single hop communication and multi hop communication. Single hop is applied between sensor node and its related cluster head. Multi hop is applied between cluster heads to base station. The previous two communication modes depend on the cluster head election. Appropriate cluster-head election can drastically reduce the energy consumption and enhance the lifetime of the network. The fuzzy models are used frequently for cluster head election. The fuzzy models can be built either expert's knowledge or numerical data. The authors propose fuzzy model using adaptive Takagi-Sugeno for wireless sensor network protocol (FATSN). The FATSN protocol is implemented by modified merging algorithm of fuzzy clustering with expected value (MCFEV). The FATSN protocol compares with the famous cluster routing protocol LEACH, EEUC, CHEF, and FCM protocols. The results show that FATSN protocol is efficiency

INTRODUCTION

Wireless sensor networks are receiving a considerable degree of research interest due to their deployment in an increasing number and variety of applications. Wireless sensor networks are large scale networks that consist of hundreds or thousands of sensor nodes. The limited energy resource is the main constraint of the sensor node (Azzedin, 2009). Routing protocols are divided into cluster and multi hop routing protocols. Cluster routing protocols are more energy efficient than multi hop routing protocols. They are less demand resources and more scalable. Figure 1 shows cluster network topology. Sensor nodes are

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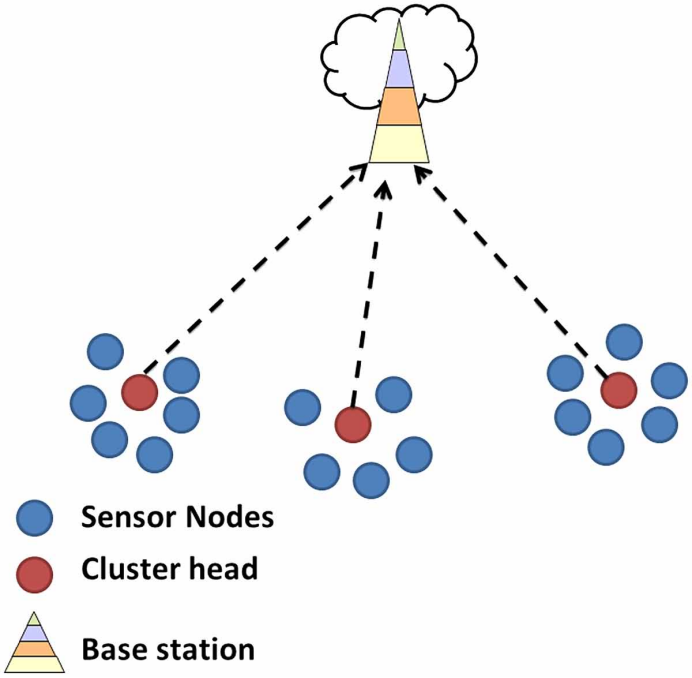
Figure 1. Cluster network topology



organized into 3 groups. Each group has a cluster head. Cluster heads aggregate data from other nodes in the same group, and deliver aggregating data to base station via single hop. The cluster head election has an important role in the increasing network life time, which is defined as the number of rounds until the first node dead (I.F Akyildizet al., 2002; Mohammad & Imad, 2005).

The common cluster routing protocol is a low energy adaptive clustering hierarchy protocol (LEACH) (Hinzelmanetal., 2000). Cluster heads are elected randomly. Rotating the cluster heads' roles applies at each round. Cluster heads connect to base station via single hop. The drawbacks of LEACH protocol are:

1. Unbalancing energy dissipation.
2. Cluster heads consumed a lot of energy in a transmitting data to base station.
3. Cluster head election doesn't take into account the energy level of sensor node.

In recent years, the multiple criteria are used to elect cluster heads such as energy, node degree, distance to base station, and centrality. (Chuen, 1990) Due to the malfunction sensor devices, the uncertainty degree of the collecting data may be presented. The fuzzy set theory can deal with the uncertainty data due to the partial membership values. The object belongs to multiple sets with membership degree $\in [0,1]$. The fuzzy models are the famous application of fuzzy set theory. The fuzzy models are used more in the control applications and the decision making applications. The fuzzy models are built either by expert's knowledge or from numerical data. The experts are not easy to find. Even if you find one, knowledge changes with time and is incomplete. There are multiple cluster routing protocols that use fuzzy models. They led to reduce energy dissipation, but these routing protocols are built from expert's knowledge.