Clustering

The clustering remains based on the Fuzzy C-means but in two steps:

Level1: Clustering of the nodes and initial CH selection

Level 2: Clustering of the initial cluster heads into two groups, one each for a sub-controller. The sub-controllers will form the centroids of the level 2 clusters and level one clusters (CH) are attached to them based on their degree of membership (FCM).

Note: the sub-controllers, divides the entire sensing field into two, and each is located at the centroid of each half.

Sub-controllers at the end of first round

1. All nodes communicate their residual energies to their sub-controllers via their CHs
2. Sub-controller creates an energy table for the nodes in each
3. Using the duration of the round, the sub-controller computes the average consumption rate of non-CH nodes in each cluster under it, and the consumption rate of CH too
4. Use the consumption rates to update the energy table at the end of subsequent rounds.

Sub-controllers at the end of subsequent rounds

1. Updates the energy Table
2. Check if the residual energy of the current CH is less than or equal to the average residual energy in the cluster
3. If yes, elects a new CH for next round and update the routing table
4. If No, the current CH is maintained, so also the routing Table
5. Sub-controller indicates the beginning of next round.

CH election by Sub-controllers

Nodes with highest residual energy and the closest to their sub-controllers are elected as CH after the first round.

Intra-cluster communication

Non-CH nodes in each cluster, have a one hop (direct communication) with their CH

CHs may form a multi-hop communication to their sub-controllers via other cluster heads. The route is defined by the sub-controller via the routing table. Hence, CHs have a different version of routing table.

Sub-controllers also have a direct communication with the super controller.