Dynamic Cluster Head Selection Method for Wireless Sensor Network

Dongyao Jia, Huaihua Zhu, Shengxiong Zou, and Po Hu

***Abstract*— In view of the wireless sensor network clustering algorithm at home and abroad, the dynamic cluster head selection methods for a wireless sensor network are put forward in order to solve the problem of the unreasonable cluster head selection that may lead to the overlapping coverage and unbalanced energy consumption in the cluster communication. Experimental results show that this method balances the network node energy in two phases compared with the existed algorithms. The network lifetime is increased by 50%, higher than that of low energy adaptive clustering hierarchy (LEACH), and increased by 30%, higher than that of distribute energy-efficient clustering algorithm (DEEC); also the survival time of the network is longer than that of energy-balanced deterministic clustering algorithm and adaptive energy optimized clustering algorithm, achieving the effectiveness of the network energy consumption, and it has the longest network lifetime.**

***Index Terms*— Dynamic, redundancy node, the average remaining energy.**

I. Introduction

Wireless sensor network (WSN) has some great advantages such as flexible communication and arrangement, low power consumption and low cost [1]–[4]. Wireless sensor network is widely used in modern agriculture [5]–[8], such as application to precision viticulture by Alippi C [9], [10], automatic drip irrigation of farmland by Mafuta M [11]. A WSN is generally composed of hundreds and thousands of distributed mobile sensor nodes, with each node having limited and similar communication, computing, and sensing capabilities. Such sensor networks have many special characteristics. The resource-limited sensor nodes are usually thrown into an unknown environment without a pre-configured infrastructure. Before monitoring the environment, sensor nodes must be able to deploy themselves to the working area. At the same time, the sensor nodes organize themselves into a network. Although sensor nodes are designed with low energy consumption in mind, they can survive for only a very limited lifetime with current technologies. Furthermore, the constraints of the sensor node energy determine that the survival time of the sensor is limited, and the entire network cannot meet the monitoring demand if some nodes cannot work efficiently. Note that the energy consumption of the network can be effectively reduced while the sensor nodes are organized in the form of clusters.

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A. Related Works

At present, the researches about the energy consumption and coverage of the sensor network at home and abroad have made a certain progress, but the energy efficiency and stability are still not satisfactory. Some of the related works have been listed in Table I about the weakness description.

Finally, though all the algorithms discussed above intended to maximize node coverage, minimize coverage overlap and gap, and deploy nodes uniformly, they did not maintain the longer survival time of the network at the same time. In summary, we expect that our algorithm can deploy sensors to cover the maximum working area with the longest survival time of the network. So sensor network coverage and low power consumption are mainly analyzed and a dynamic cluster head selection method for wireless sensor networks (DCHSM) is proposed in this paper. The Voronoi diagram is used to achieve the clustering division in monitoring area, the redundant nodes which have death priority but do not affect the performance of network coverage are selected as the first kind of cluster head nodes. Its perceptive function can be shut down to reduce the energy consumption for perception. After the death of the first kind of nodes, the survival time estimation algorithm is used to choose a new class of cluster head nodes based on the ratio of the residual energy and the average energy of the network nodes. This method overcomes the disproportion of the energy consumption and improves the information redundancy in the process of transmission, along with reducing energy consumption and extending the life time of the network.

II. Research on the Optimized Selection of Cluster Heads

The quality of topology control influences directly on the lifetime and performance of networks, while a good topology scheme relies on a complete evaluation methodology. Composing those characters and system features, three following indicators are taken into major considerations to evaluate the WSN topology control:

Coverage: Coverage is a measure of WSN service quality, which is mainly focused on the coverage rate of initial nodes deployment and whether these nodes can acquire signals of the region of interest (ROI), completely and accurately.

Connectivity: Sensor networks are usually of large scale, thus connectivity is an assurance that data information obtained by sensor can be delivered to sink nodes.

TABLE I
COMPARISON OF THE DIFFERENT METHODS

Methods	Algorithm weakness description
Algorithm[12-14]	Geeta D D utilizes distributed heuristics to respond to the topology changes by adaptively adjusting node transmission capacity and uses the minimum power to establish a wireless sensor network topology, which caused the long information transmission delay and poor stability in a dynamic network.
Algorithm[15-16]	Hosseinirad S M et al put forward a layered LEACH protocol. Not suitable in a heterogeneous network; the protocol is not suitable for large scale wireless sensor networks; cannot apply to the network of imbalance energy nodes.
Algorithm[17-19]	Javaid N et al proposed SEP protocol based on LEACH. Does not consider the residual energy of nodes, which may easily result in uneven energy consumption and death of some nodes;SEP cannot deal with clustered sensor networks with more than two levels of hierarchy and more than two types of nodes.
Algorithm [20]	The oscillation of nodes consumes much more energy than moving to the desired location directly. Moreover, this algorithm can only be used in a bounded area since the nodes must be restricted within the boundary by the virtual force from boundary. Without the boundary, each node will not stop expelling others until there are no other nodes within its transmission range.
Algorithm[21]	The Virtual Force Algorithm (VFA). The cluster architecture may lead to an unbalanced lifetime of the nodes and is not suitable for networks that do not have powerful central nodes.
Algorithm [22]	The Constrained Coverage algorithm can guarantee that each node has at least K neighbors by introducing two virtual forces, but the coverage rate and the lifetime are not long as expected.

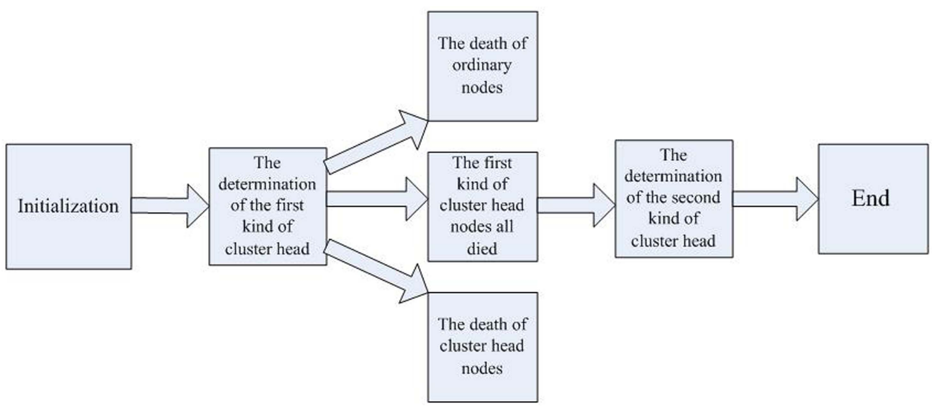

Fig. 1. The process of cluster heads optimized selection.

Network Lifetime: Network lifetime is generally defined as the time duration from the start to when the percentage of dead nodes comes to a threshold.

Coverage control or deployment design, is the cornerstone of wireless sensor Networks. In WSNs, every node has a certain length of sense radius R_s and communication radius R_k. Metrics of Q_{oS} include coverage rate, uniformity, time and distance, and we mainly consider the coverage and distance problem in this paper.

Measuring coverage rate is to detect the ratio of scope inside sense range to the whole object range. Coverage scope is often interpreted as the amount of area. For a node υ_i, its coverage scope COV_i in the object region A equals to its sense range, and the total amount of coverage range of the network is explained in formula (1):

$$COV_A = \bigcup_{i=1}^{k} COV_i \tag{1}$$

thus coverage rate C can be represented as (2):

$$C = \frac{COV_A}{M} \tag{2}$$

where M is the area of object region.

At first, the Voronoi diagram is used to divide the monitoring area to guarantee the maximum coverage, and the divided area are put into small clusters, and the cluster head selection is based on the same coverage area but has the most redundant nodes. So the small cluster can maintain the longest time by changing the cluster head without changing the whole coverage area.

The optimized cluster heads selection process is shown in Figure 1. Specific steps are showed below:

1. Initializing the network. The base station can get the location of all the sensor nodes in monitoring area (ID) and the residual energy of the nodes.

2. The monitoring area is divided into some clusters by Voronoi diagram, and the perception probabilistic model

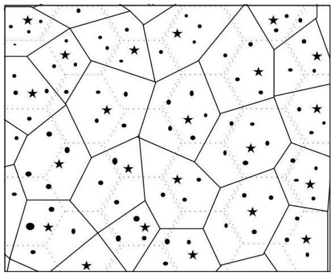

Fig. 2. Hexagon division and the formation of clustering (⋆ denotes the active node).

is proposed. Select network redundant nodes by the attenuation probabilistic algorithm and these nodes are taken as the first kind of hibernation cluster head node.

3. The death of a current cluster head node makes another redundant node active to be the cluster head. If the death node is a current common node, another redundant node ends dormancy to be an ordinary node.

4. The survival time estimation algorithm can be used to estimate the network average residual energy, if the first kind of cluster head nodes all died. Select the second class of cluster head nodes based on the ratio of the residual energy and the average energy of the network nodes.

The impact of redundant nodes and network residual energy on network is larger in the process of practical research, which makes the redundant nodes and the average residual energy mainly analyzed in this paper.

III. The First Stage of the Cluster Head Selection Based on Perceived Probability

Sensor nodes in the monitoring area are generally and randomly distributed, which may lead to existing the overlapping sensing field. Firstly, make part of the nodes active and the other nodes asleep [23], [24] in the initialization phase of the clustering network, then the node coverage model is proposed based on Voronoi diagram. This process mainly includes mesh generation, the selection of active nodes and the generation of Voronoi diagram. The specific steps are as follows:

1. Mesh generation. The monitoring area can be divided to the regular polygon mesh, and the regular hexagonal mesh is used in this paper. For the same monitoring area, the network divided with regular hexagonal mesh requires the minimum number of nodes but covers the largest area, which makes the amount of the forwarded data in the network the least. Therefore, the total energy consumption of the network is the least.

2. Selection of the active nodes. The monitoring area could be divided into some hexagonal grid. Sensing field of the node can be completely covered by other nodes in each grid. And these are the ones taken as the active nodes and the remaining nodes enter into sleep as shown in Figure 2.

3. The generation of Voronoi diagram, as shown in Figure 2. With the characteristics of the Voronoi diagram known, the distance between the remaining nodes and the active node in the Voronoi polygon is minimum, therefore, these nodes in the monitoring area form an active node-centered cluster according to their different Voronoi polygons.

Hexagonal mesh ensures the equal distribution of active nodes, so the size of the Voronoi polygons is similar. Nodes can choose to join a certain cluster to reduce the data transmission distance according to the location of the Voronoi polygons, along with the energy consumption.

Assuming that the model of the monitoring area is a two-dimensional planar rectangular region, and the base station is located in the center. R_s denotes the perceived radius of sensor nodes and R_k denotes the communication radius, which satisfy $R_s \geq R_k$, thus ensuring that the node deployment constitutes a connected network. The sensing range of sensor nodes is defined as: a node-centered circular area which has sensor node s_i, and R_s denotes the radius. Each point m in the monitoring area is represented by its coordinate m(x_j,y_j), and $s_i(x_i,y_j)$ is the coordinate of s_i. The distance from the node s_i to the target point m is as follows:

$$d(s_i, m) = \sqrt{(x_i - x_j)^2 + (y_i - y_j)^2} \tag{3}$$

The perceptual probability model of s_i to m is:

$$P(s_i, m) = \begin{cases} 1 & d(s_i, m) < R_s - u \\ e^{-\alpha d_i} & R_s - u \leq d(s_i, m) < R_s + u \\ 0 & d(s_i, m) \geq R_s + u \end{cases} \tag{4}$$

Where d_i = $d(s_i, m)$ - $(R_s - u)$, α is the parameter related to the physical device monitoring, and μ is the uncertainty factor in the monitoring process of nodes. If m is covered by the monitoring node $s_i(x_i, y_i)$, then $P(s_i, m) \geq M_{min}$, M_{min} is the threshold of the perceived probability.

After completing the clustering of Voronoi diagram, the sensing field of a redundant node which can be completely covered by other nodes is found as a cluster head. A cluster head does not perceive information, so the energy for perception and data fusion can be reduced effectively. In general, when the death of a node does not affect the coverage rate of sensor network and the sensing efficiency, the network performance will be improved and the energy consumption can be reduced. Assuming that the death of the first node which has impact on the network coverage is the evaluation criterion, these nodes which not only does not affect the network coverage but also makes the network work longer are the cluster heads which have a death priority, and the point m can be simultaneously perceived by the other N sensor nodes in the area.

Definition 1: The NPP (node public perception) of m:

$$NPP(m) = \sum_{i=1}^{N} P(s_i, m) = \sum_{i=1}^{N} e^{-\alpha d_i} \tag{5}$$

$$NPC(s_i, m) = \frac{P(s_i, m)}{NPP(m)} = \frac{P(s_i, m)}{\sum_j Ps_i, m} \tag{6}$$

Definition 2: The NPC(s_i) (Network Perception Contribution) of a sensor node $s_i(x_i, y_i)$ to the nodes in the whole monitoring area.

$$NPC(s_i) = \sum_k \frac{P(s_i, m)}{NPP(m)} = \frac{P(s_i, m)}{\sum_j Ps_i, m} \tag{7}$$

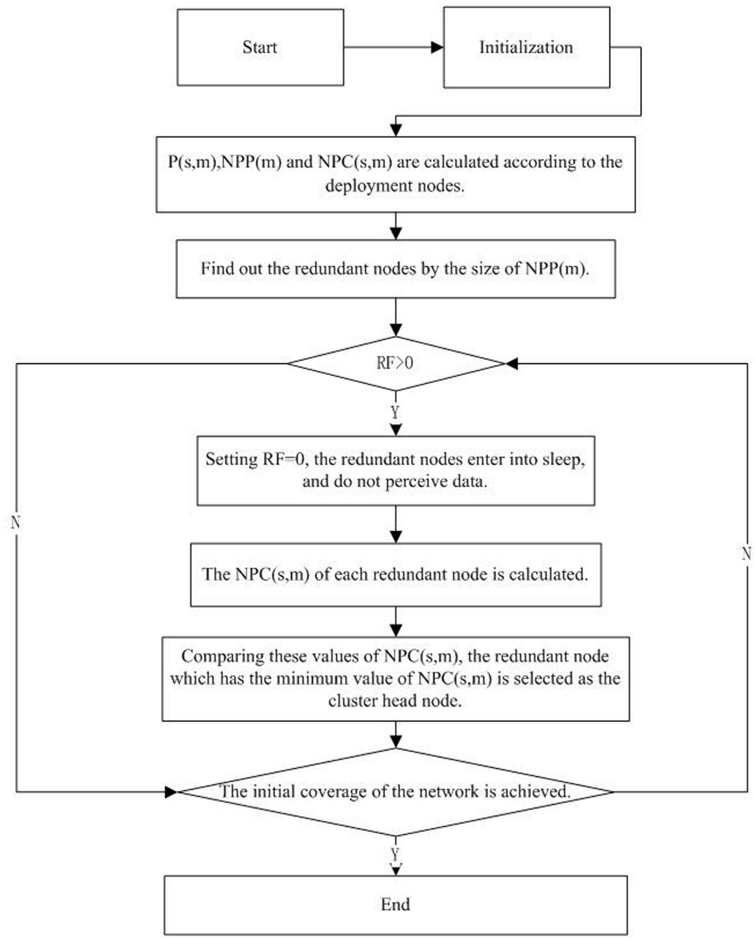

Fig. 3. The flow chart about the first stage selection of the cluster head.

The selection steps of cluster heads:

1. Initialize the network to ensure that the wireless sensor network reaches an initial coverage set by the user;

2. Calculate the perceived probability of all sensor nodes P(s_i,m), according to the formula (4);

3. Use the formula (5) to obtain the network public perception (NPP) of each sensor node based on the calculation of $P(s_i, m)$;

4. Determine a node the redundant node or not, based on the size of NPP (m) in the network. Namely, determine whether its redundant flag RF is 1;

5. The network perception contribution of each sensor network node can be obtained by the results got from step 3 and 4;

6. Select the cluster head node from the redundant nodes. The network perception contribution $NPC(s_i)$ of the cluster head node is the minimum.

Set the sensing intensity of the sleeping sensor node to be 0 and the coverage of the entire network are updated at the same time. The flow chart is shown in Figure 3. When the sensor nodes satisfy NPP(m) $\geq M_{min}$, set the redundant flag of this sensor to be 1, namely RF(s) = 1. The sensing field of those nodes can be covered by other nodes, then such redundant nodes are figured as the first class of cluster head nodes. A cluster head does not perceive information, which can reduce the energy of perception and data fusion.

IV. The Second Stage of the Cluster Head Selection Based on the Survival Time Estimation

Sending and receiving message are the highest energy-consuming processes, and the relationship between the energy and the communication distance is defined in the formula as shown below:

$$E = kd^n \tag{8}$$

Where d denotes the communication distance, 2 < n < 4. The value of n should be combined with the practical application [25]–[28], and n is usually taken three. when 1 byte message is transmitted and received, the energy consumption model is shown below:

$$P(s_i, m) = \begin{cases} 1 & d(s_i, m) < R_s - u \\ e^{-\alpha d_i} & R_s - u \leq d(s_i, m) < R_s + u \\ 0 & d(s_i, m) \geq R_s + u \end{cases} \tag{9}$$

$$E_{Rx}(l) = lE_{elec} \tag{10}$$

Where E_{elec} represents the energy consumed by per bit data in the running process of transmission circuit or receiving circuit, $\varepsilon_{fs} d^2$ and $\varepsilon_{mp} d^4$ are the energy consumed by the amplifier.

After the first class of the cluster head node died, a new class of cluster head nodes are selected from the remaining nodes

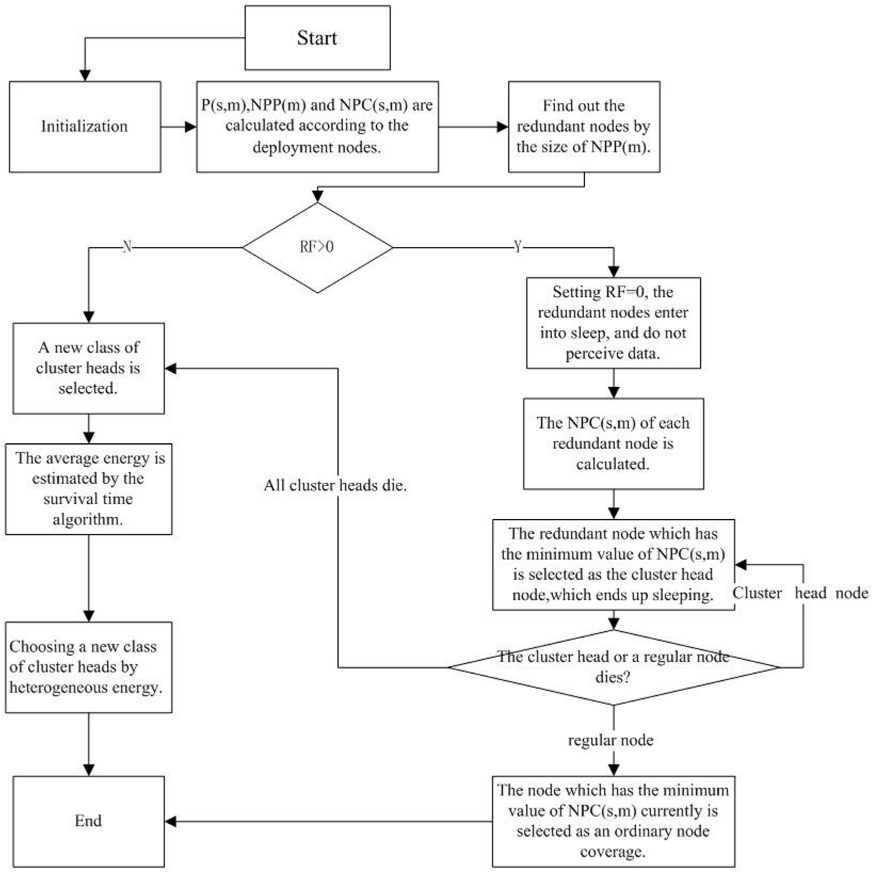

Fig. 4. The dynamic clustering algorithm.

based on the ratio of their energy and the residual energy of the network, and all nodes in the cluster should take turns to become the cluster head. Obviously, the node with higher residual energy has a greater opportunity to become a cluster head node, which not only adapts to the changes in energy, but also prolongs the network lifetime. The probability of a remaining node to become the cluster head node is shown in formula (11) and (12):

$$p_i = p[1 - \frac{\bar{E}(r) - E_i(r)}{\bar{E}(r)}] \tag{11}$$

$$\bar{E}(r) = \frac{1}{N}\sum_{i}^{N} E_i(r) \tag{12}$$

Where p is the ratio of the cluster head nodes, $E_i(r)$ represents the residual energy of the nodes in the round of r, $\bar{E}(r)$ refers to the average residual energy of nodes in the sensor network. Knowing from the formula (12), the current total energy of all nodes in the network should be known by each node in order to calculate the average remaining energy, which is very difficult to obtain. It does not affect the performance of the network to calculate the average energy by using the lifetime estimation algorithm, since the average energy $\bar{E}(r)$ is only used for comparison.

First, calculate the network lifetime by the formula (13):

$$R = \frac{E_{total}}{E_{round}} \tag{13}$$

Where R is the total number of rounds of the network life cycle, E_{total} is the initial total energy of the network, and E_{round} is the energy consumed by the network in each round.

$$E_{round} = l(2NE_{elec} + NE_{DA} + \lambda\varepsilon_{mp}d_{toBS}^4 + N\lambda\varepsilon_{fs}d_{toCH}^2) \tag{14}$$

Where λ is the total number of the cluster heads in the monitoring network, E_{DA} denotes the loss in the process of data fusion, d_{toBS} is the average distance between the cluster heads and the base stations, and d_{toCH} is the average distance between the common nodes in the cluster and the cluster head. The literature [29] shows that:

$$d_{toCH} = \frac{M}{\sqrt{2\pi k}}, \quad \frac{P(s_i, m)}{NPP(m)} = 0.765\frac{M}{2} \tag{15}$$

Take the derivative of E_{round} with respect to λ, ensure that the partial derivative is 0, then the optimal number of cluster heads λ is:

$$\lambda = \sqrt{\frac{N\varepsilon_{fs}}{2\pi\,\varepsilon_{mp}}} * \frac{M}{d_{toCH}} \tag{16}$$

Assuming that each node in each round has the same energy consumption, the average energy of each node in the first round is:

$$\bar{E}(r) = \frac{1}{N}E_{total}(1 - \frac{r}{R}) \tag{17}$$

TABLE II
DATA TABLE OF THE SIMULATION PARAMETERS

Parameters	Value	Parameters	Value
E_{elec}	5nJ/bit	E_{DA}	5nJ/bit/message
ε_{fs}	10pJ/bit/m^2	d_0	80m
ε_{mp}	0.0013nJ/bit/m^4	M_{min}	0.3

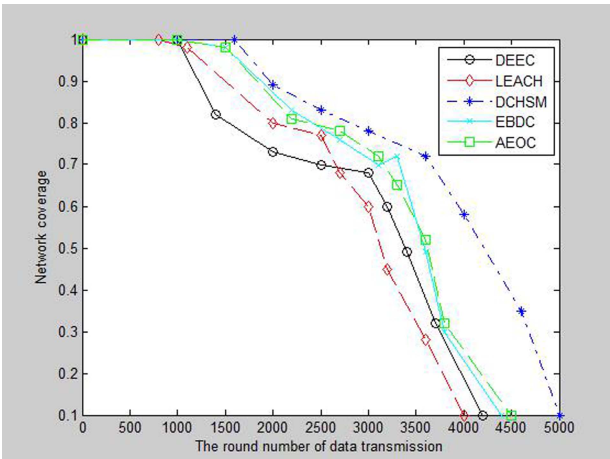

Fig. 5. Coverage simulation.

Finally, a new kind of cluster head node is selected to achieve uniform network energy consumption, according to the ratio of the residual energy of nodes and the average residual energy of the network nodes. The flow chart of the whole dynamic clustering algorithm is shown in Figure 4.

A. Simulation Analysis

Assuming that the simulation is carried out in the 100 * 100m monitoring area, the base station is located in the central of the area. It takes 200s to send information from each cluster head node to the base station, which means that a round of information transmission needs 200s. 250 sensor nodes are deployed in the network and the monitoring area is divided with regular hexagon. The Voronoi polygon method is used to achieve clustering, the simulation experiments is done with MATLAB, and the threshold of the perceived probability $M_{min} = 0.3$. The experimental parameters are shown in Table II.

Considering the heterogeneity of the network, the energy of the data transmission node is not the same, so the probability of each node becomes different. Distribute Energy-Efficient Clustering Algorithm (DEEC) algorithm is the improvement of LEACH algorithm, taking into account the initial and residual energy of the nodes, and it can increase the network's life cycle. The coverage simulation is shown in Figure 5. The widely used clustering algorithms are LEACH and DEEC algorithm and the relatively new methods are the adaptive energy optimized clustering algorithm (AEOC) [30] and the Energy-balanced deterministic clustering algorithm (EBDC) [31]. LEACH first appears the coverage holes at the 800th round, then the coverage gradually decreases to 0 at the 4000th round. Comparing with LEACH, DEEC appears the coverage holes at the 1000th round, although the coverage ratio of DEEC is small than that of LEACH between the 1100 to 3000 rounds, the network can run into 4200 rounds, which can get a longer life cycle. DEEC is a heterogeneous clustering algorithm based on energy consumption with the energy evenly distributed within the cluster, so the DEEC has a longer survival time compared to LEACH which chooses cluster heads based on random probability. But the design of regional coverage algorithm of DEEC is not good enough, DEEC is a bit worse than LEACH in terms of network coverage. AEOC and EBDC first appear the coverage holes at about 1000th round, then the coverage gradually decreases to 0 at the 4700th and 4500th round, which both have a great improvement than that of the LEACH and DEEC. The dynamic cluster head selection algorithm with the consideration of the coverage and energy consumption is proposed in this paper. The algorithm appears the blind area when running to the 1500th round and gradually reduced to 0 at the 5000th round. DCHSM algorithm is a theory based on network coverage and energy consumption with the goal to achieve the optimization of the energy consumption while ensuring the coverage.

In statistics, the standard deviation (STD) is a measure that is used to quantify the amount of variation or dispersion of a set of data values. A standard deviation close to 0 indicates that the data points tend to be very close to the mean (also called the expected value) of the set, while a high standard deviation indicates that the data points are spread out over a wider range of values. This estimator, denoted by s_N, is known as the standard deviation and is defined as follows: where x_i(i=1,2...N) are the observed values of the sample items and $\bar{x}$ is the mean value of these observations, while the denominator N stands for the size of the sample: this is the square root of the sample variance, which is the average of the squared deviations about the sample mean. Standard deviation may serve as a measure of uncertainty. In physical science, for example, the reported standard deviation of a group of repeated measurements gives the precision of those measurements. When deciding whether measurements agree with a theoretical prediction, the standard deviation of those measurements is of crucial importance: if the mean of the measurements is too far away from the prediction (with the distance measured in standard deviations), then the theory being tested probably needs to be revised. This makes sense since they fall outside the range of values that could reasonably be expected to occur, if the prediction were correct and the standard deviation appropriately quantified. So this result, to a certain extent, shows that the proposed algorithm is more stable. In other words, we can believe that our systems can meet the demanded requirements with the least risk of network breakdown and can be used in a more wide field.

Each experiment based on different algorithms is carried out for 50 times, and the result of each algorithm is different in each experiment. Taking three results of life time of LEACH algorithm as example, including (3906, 4023), (3943, 4008), (3990, 4040). Then calculate the STDs of the life time and

TABLE III
ROUND NUMBER OF LIFETIME AND COVERAGE HOLE APPEARANCE

Parameters(round)	LEACH	DEEC	AEOC	EBDC	DCHSM
Coverage hole appearance	800	1000	1050	1100	1500
Life time	4000	4200	4700	4500	5000
STD of life time	1.87	1.52	1.37	0.98	0.34

TABLE IV
ROUND NUMBER OF THE FIRST AND HALF DEATH NODE

Parameters(round)	LEACH	DEEC	AEOC	EBDC	DCHSM
First node death	775	1000	1300	1100	1500
Half nodes death	1600	1800	2100	2200	2600
STD of half nodes death	1.78	1.46	1.07	1.03	0.45

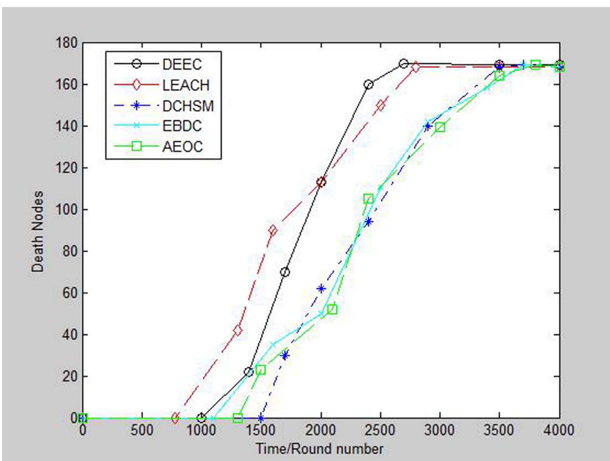

Fig. 6. The lifetime of nodes.

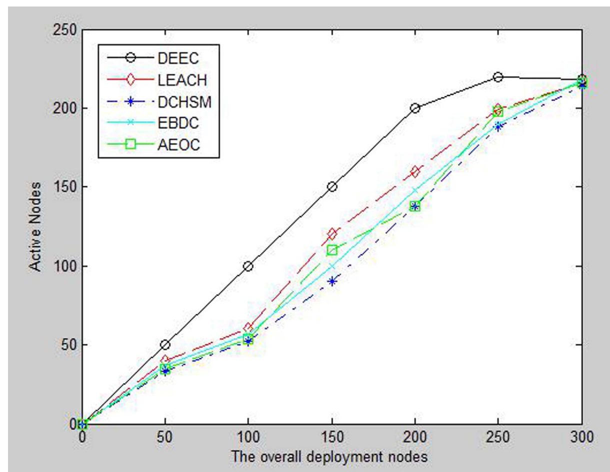

Fig. 7. The total deployment nodes and the active nodes.

the round number of the half nodes death. The STD of each algorithm is different, the obvious comparison can be seen in Table II. Also we can get from the table III and table IV below that STD of the proposed method is the least. STD represents the degree of dispersion of the result data. Standard deviation is the square root of the variance of the sample mean, it is usually relative to the mean of the sample data dependent, showing one of data results how far apart from the mean value. The smaller the standard deviation is, the more the data is gathered, that means the results fall into a very small range; the larger the standard deviation is, the more discrete the data is, that means the results can change to a large range. So this result, to a certain extent, show that the proposed algorithm is more stable. In other words, we can believe that our systems can meet the demanded requirements with the least risk of network breakdown.

The diagram of node life cycle is shown in Figure 6. LEACH algorithm appears the first dead node at the 755th round and DEEC algorithm appears one at the 1000th round. AEOC algorithm appears the first dead node at the 1300th round and EBDC algorithm appears one at the 1100th round. The death time of the first node in DCHSM is at the 1500th round, whose performance increases by 50% than LEACH and increases by 30% than DEEC. When half of the nodes died, the time in LEACH is 1600 rounds, and that in DEEC is 1800 rounds, that in AEOC is 2100 and that in EBDC is 2200. The time in DCHSM algorithm is 2600 rounds, which is 1.62 times than that of LEACH and 1.44 times than that of DEEC, also better than that of AEOC and EBDC. The result shows that this method can extend life of the network. We can see from the results that the coverage about the proposed algorithm is almost the same with the AEOC and EBDC, but the survival life time has a great difference, which shows the advantages of the longest survival time of our method.

Assuming that the cluster head and the ordinary nodes which do not fall into sleep are active nodes, the random probability threshold (0, 1) is used to select the cluster head node in LEACH and DEEC chooses the cluster head node based on the energy heterogeneity. Although the EBDC and AEOC algorithms select the cluster header with different methods, which show some advantages about the coverage area and survival time, the active nodes is still more than the proposed

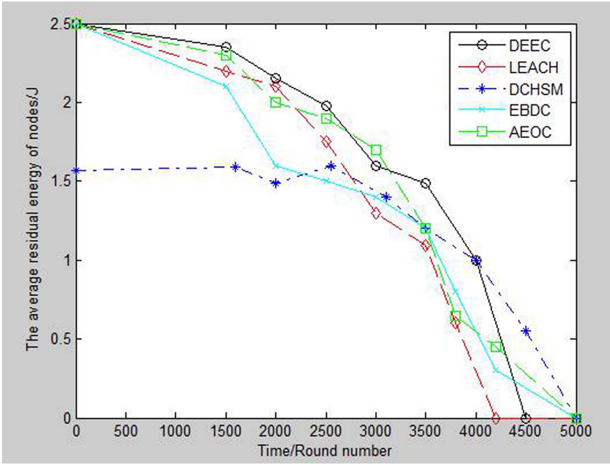

Fig. 8. The average residual energy of nodes.

method. As shown in Figure 7, the algorithm needs the least active node, since a part of the redundant nodes go into sleep in the process of selecting a cluster head at the first stage.

The number of cluster head nodes in the LEACH and DEEC network which are not in the dormant state is more than that of the controller embodies traffic system communication algorithm (TSCA). TSCA is able to provide the system with adaptive and efficient traffic estimation represented by the dynamic change in the traffic signals' flow sequence and traffic variation. All the nodes involved in the work is a waste of energy and increase the pressure of the cluster head nodes for processing the redundant information. When the process has progressed to a certain stage, the active nodes remain stable, since the dormant nodes have been activated in order to meet the network coverage.

We just don't put the sleeping nodes' energy into consideration in order to show the stable performance of the network in the figure 8, since one node dies, one residual node wakes up to compensate for the network and the number of nodes alive is the same at the first stage. Although all the alive nodes' energy is less than that at the first part, also the total number of nodes in the network decreases, the curve is basically the same. The average residual energy of the networks is shown in Figure 8, which are gradually reduced both in LEACH and DEEC, but the algorithm has been significantly improved in this experiment compared with LEACH and DEEC algorithms. And the coverage area of the EBDC or AEOC is almost the same with the proposed method, but the values of the lifetime show the advantage of the proposed method of the longer network lifetime under the same coverage area. The clustering division of the monitoring area at the initial stages makes a part of the nodes sleep and reduce the energy consumption at the same time. Before running to 2000 rounds, the curve of DCHSM is relatively smooth, and the sleep nodes make the average residual energy of the network stable. DEEC algorithm has a longer life cycle compared with LEACH algorithm.

V. Conclusion and Future Work

A dynamic cluster head selection method for wireless sensor networks (DCHSM) is proposed in this paper by analyzing the sensor network energy consumption based on the redundant nodes and energy heterogeneity. The experiment analysis are carried on from four aspects, including coverage, life cycle, the active nodes and the average residual energy. The method proposed in this paper overcomes the disproportion of the energy consumption, improves the information redundancy in the process of transmission, reduces energy consumption and extends the life time of the network. The extension of this work would be a further discussion of the redivision of the monitoring area after the death of all the redundant nodes under the same coverage area, also we should do more work to extend the time of the first period and to prolong the lifetime of networks consist of mobile nodes.

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