

Density controlled-Divide and Rule Scheme for Energy Efficient Routing in WSNs

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Motivation

Objectives

- Stability period enhancement
- Instability period reduction
- Network lifetime enhancement
- Throughput maximization
- Delay minimization

Motivation...

Problems in existing work

- Non uniform distribution of load
- Coverage hole formation
- Energy hole formation

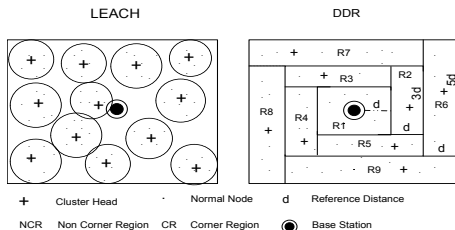
Proposed Scheme

- Cluster formation
- Energy consumption in different segments
- CH selection and energy consumption of CH

Proposed scheme...

Cluster formation

- Static clustering technique is used
- Nodes are uniformly distributed in the network but randomly distributed in the clusters
- BS segmentizes network area into segments called clusters
- Segmentation reduces the communication distance



Proposed scheme...

Energy consumption in different segments

- Energy consumption in I_s segment

$$E_{I_s}^{T_x} = 4\rho d^2 T_{Energy} \quad (1)$$

- Energy consumption in M_s segments

$$E_{M_s/Seg}^{T_x} = 4(3\rho d^2 - 1) T_{Energy} \quad (2)$$

- Energy consumption in O_s segments

$$E_{O_s/Seg}^{T_x} = 4(3\rho d^2 - 1) T_{Energy} \quad (3)$$

where, $\rho =$ node density

Proposed scheme...

CH selection

- New CH is selected in each round, in each segment
- Node with minimum distance from central reference point is selected rst then second least, third least and so on
- Number of CHs in each round remain x throughout network operation
- In order to reduce communication distance multi-hop communication strategy is adopted in inter-cluster communication

Proposed scheme...

Energy consumption of CH

- O_s CHs transmit their cluster members data to CHs of M_s . Thus, they consume transmit energy only
- M_s CHs aggregate data from O_s CHs with their own and transmit it to BS. So, they consume receive, aggregate and transmit energies

Performance Evaluation

Performance metrics and Simulator used

- Stability period
- network lifetime
- throughput
- optimum number of CHs

MATLAB R2011

Performance Evaluation...

Assumptions and Radio parameters

- Nodes are equipped with initial energy of $0.5J$
- Network field, $100m^2$
- Total number of nodes are 100

$$E_{elec} = E_{tx} = E_{rx} = 50nJ/bit$$

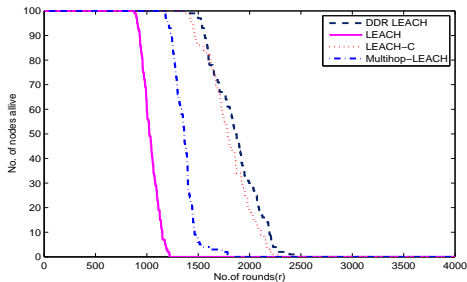
$$EDA = 5nJ/bit/signal$$

$$E_{fs} = 10pJ/bit/m^2$$

$$E_{mp} = 0.0013pJ/bit/m^4$$

Performance evaluation...

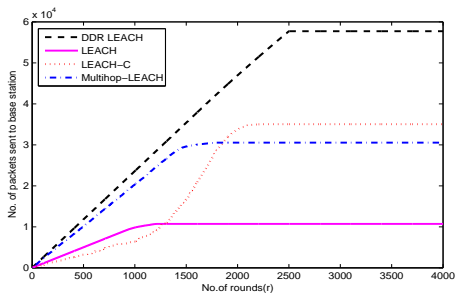
Stability period and Network lifetime



- DDR clustering approach minimizes communication distances and optimum number of CHs remain same in each round which, ultimately enhances stability period of the network
- Balanced energy utilization and avoidance of coverage hole enhances the network lifetime

Performance evaluation...

Throughput



- Enhanced stability period and network lifetime, increase DDR's throughput

Conclusion

- DDR is based on static clustering and optimum number of CH selection in each round
- Segmentation process helps to reduce communication distance between node and CH, and between CH and BS
- Multi-hop communication in inter-cluster further reduces communication distance
- We have tried to overcome the problem of coverage hole and energy hole through density controlled uniform distribution of nodes in different segments of network
- Optimum number of CHs in each round helps to achieve balanced load distribution