Scientific Journal Impact Factor (SJIF): 1.711

e-ISSN: 2349-9745
p-ISSN: 2393-8161

International Journal of Modern Trends in Engineering and Research
www.ijmter.com

ENERGY EFFICIENT OPTIMIZED SLEEP SCHEDULING AND TARGET PREDICTION IN WIRELESS SENSOR NETWORK

TARGET PREDICTION

R.Saranya[1], V.Subathra[2], S.Mangai[3]
[1]Computer science and engineering,Vivekanandha college of engineering for women,
[2]Computer science and engineering,Vivekanandha college of engineering for women
[3]Vellalar College Of Engineering And Technology

Abstract-In the development of various large-scale sensor systems, a particularly challenging problem is how to dynamically organize the sensors into a wireless communication network and route sensed information from the field sensors to a target system. A surveillance system, which tracks mobile targets, is one of the most important applications of wireless sensor networks. When nodes operate in a duty cycling mode, tracking performance can be improved if the target motion can be predicted and nodes along the trajectory can be proactively awakened. However, this will negatively influence the energy efficiency and constrain the benefits of duty cycling. The prime motivation of our work is to balance the inherent trade-off between the resource consumption and the accuracy of the target tracking in wireless sensor networks. Toward this objective ,a new energy-efficient dynamic optimization-based sleep scheduling and target prediction technique for large-scale sensor networks. We present an optimization-based sleep scheduling protocol (OSSP) to improve energy efficiency of proactive wake up duty cycle. A cluster-based scheme is exploited for optimization-based sleep scheduling. At every sampling instant, only one cluster of sensors that located in the proximity of the target is activated, whereas the other sensors are inactive. To activate the most appropriate cluster, we propose a non myopic rule, which is based on not only the target state prediction but also its future tendency. Finally, the effectiveness of the proposed approach is evaluated and compared with the state-of-the-art protocols in terms of tracking accuracy, inter node communication, and computation complexity.

Keywords-Energy efficiency, target prediction, sleep scheduling ,proactive wakeup, wireless sensor networks(WSNs).

I. INTRODUCTION

Recently, the research focus of geographic routing is centering on WSNs with duty-cycles, since dutycycled WSNs have a natural advantage of saving energy by dynamically putting nodes to sleep and waking them according to some sleep scheduling algorithms.**First,** need optimization methods, i.e., imposes no performance constraints when reducing the energy consumption. Without performance constraints, it is difficult to configure the protocol toward the best energy performance tradeoff for a specific network environment.**Second,** the prediction method cannot cover special cases such as the target movement with abrupt direction changes. This is the expense that earlier works pays for the energy efficiency enhancement. Given these limitations, the potential of our work includes optimization-based sleep scheduling and target prediction.

In a large-scale sensor network, hundreds or thousands of tiny sensor nodes are randomly deployed into a monitoring field to gather data. The complexity of computation and communication increases with the number of active sensor nodes tracking the target. The amount of energy used in the network is proportional to the number of active sensor nodes. It is best for sensor nodes to be arranged into collaborative m groups. Group collaboration should be limited to a tracking area around the target so that the communication and computation will be independent of the size of the network. Multiple nodes surrounding the target may collaborate and gather information. The tracking accuracy and performance is limited to the information in those sensors. In a large-scale sensor network, it is important to locate the target with high accuracy while consuming the least amount of energy. The problem of target tracking in wireless sensor networks is encountered in many scenarios such as monitoring physical environments such as tracking animal migrations in remote-areas, weather conditions in national parks, habitat monitoring on remote islands, city traffic monitoring etc.

Target tracking in WSNs has been studied extensively. Due to the limited sensing capability and limited resources for communications and computation, collaborative resource management is required to trade-off between the tracking accuracy. Therefore, energy-efficient target tracking should improve the tradeoff between energy efficiency and tracking performance—e.g., by improving energy efficiency at the expense of a relatively small loss on tracking performance.As a compensation for tracking performance loss caused by duty cycling and sleep scheduling, proactive wake up has been studied for awakening nodes proactively to prepare for the approaching target.

II. LITERATURE SURVEY

2.1.Energy-Quality Tradeoffs for Target Tracking in Wireless Sensor Networks

The tradeoffs involved in the energy-efficient localization and tracking of mobile targets by a wireless sensor network. This work focuses on building a framework for evaluating the fundamental performance of tracking strategies in which only a small portion of the network is activated at any point in time. We first compare naive network operation with random activation and selective activation. In these strategies the gains in energy-savings come at the expense of increased uncertainty in the location of the target, resulting in reduced quality of tracking. We show that selective activation with a good prediction algorithm is a dominating strategy that can yield orders-of-magnitude energy savings with negligible difference in tracking quality. We then consider duty-cycled activation and show that it offers a flexible and dynamic tradeoff between energy expenditure and tracking error when used in conjunction with selective activation.

There is an emerging trend towards the use of sophisticated wireless networks of unattended sensor devices for intelligence gathering and environmental monitoring. One \ canonical application of sensor networks that has received considerable attention in the literature is the tracking of a mobile target (point source) by the network. In a tracking scenario, information obtained from nodes far away from the region of activity is of little or no use. For a typical sensor network with a large number of nodes, a major portion of these falls in the above category. In addition, if the nodes are densely deployed information obtained from some sensors close to the region of activity might be redundant. An obvious way to save energy is to switch on only a subset of the sensor nodes. We discuss in this paper various possible activation strategies: (1) naive activation, (2) randomized activation (3) selective activation based on trajectory prediction and (4) duty-cycled activation. In these sensor activation strategies, energy savings come at the expense of a reduction in the quality of tracking. In other words, relying on the information provided by a small subset of the sensor nodes results in an increased uncertainty in the sensed location of the mobile. In this paper we study the energy-quality tradeoffs involved by building a model to quantify both the energy expenditure and the quality of tracking. Also for a particular strategy, we study the impact of the following: a) deployed/activated density of sensors b) their sensing range c) capabilities of activated and un-activated nodes d) the target's mobility model.

2.2.DCTC: Dynamic Convoy Tree-Based Collaboration for Target Tracking In Sensor Networks

Most existing work on sensor networks concentrates on finding efficient ways to forward data from the information source to the data centers, and not much work has been done on collecting local data and generating the data report. This paper studies this issue by proposing techniques to detect and track a mobile target. We introduce the concept of dynamic convoy tree-based collaboration, and formalize it as a multiple objective optimization problem which needs to find a convoy tree sequence with high tree coverage and low energy consumption. We propose an optimal solution which achieves 100% coverage and minimizes the energy consumption under certain ideal situations. Considering the real constraints of a sensor network, we propose several practical implementations: the conservative scheme and the prediction-based scheme for tree expansion and pruning; the sequential and the localized reconfiguration schemes for tree reconfiguration. Extensive experiments are conducted to compare the practical implementations and the optimal solution. The results show that the prediction-based scheme outperforms the conservative scheme and it can achieve similar coverage and energy consumption to the optimal solution.

This approach assumed that a single node close to a target can detect the status of the target, and did not consider the collaboration among nodes that can detect the target at the same time. Since sensor nodes deployed in current sensor networks do not have a large sensing distance, or a high level of sensing accuracy and node reliability, Cerpa et al suggested that multiple nodes surrounding the target should collaborate to make the collected information more complete, reliable, and accurate. However, no concrete algorithm was given.

A big challenge of implementing the DCTC framework is how to reconfigure the convoy tree in an energy efficient way as the target moves. To address this problem, we first formalize it as an optimization problem of finding a min-cost convoy tree sequence with high tree coverage, and give an optimal solution (o-DCTC) based on dynamic programming. Considering the constraints of sensor networks, we propose some practical solutions. Specifically, we propose two tree expansion and pruning schemes: the conservative scheme and the prediction- based scheme; and two tree reconfiguration schemes: the sequential reconfiguration and the localized reconfiguration. We also evaluate the performance of the optimal solution and the practical implementations through extensive simulations. Based on the simulation results, when the same reconfiguration scheme is used, the prediction-based scheme outperforms the conservative scheme and it can achieve a similar coverage and energy consumption to the optimal solution. When using the same scheme for tree expansion and pruning, the localized reconfiguration scheme outperforms the sequential reconfiguration scheme when the node density is high, and the trend is reversed when the node density is low.

2.3.An Algorithmic Approach to Geographic Routing In Ad Hoc and Sensor Networks

The one type of routing in ad hoc and sensor networks that currently appears to be most amenable to algorithmic analysis is geographic routing. This paper contains an introduction to the problem field of geographic routing, presents a specific routing algorithm based on a synthesis of the greedy forwarding and faces routing approaches, and provides an algorithmic analysis of the presented algorithm from both a worst-case and an average-case perspective. Furthermore, in a sense, geographic routing can be considered a lean version of source routing appropriate for dynamic networks: While in source routing the complete hop-by-hop route to be followed by the message is specified by the source, in geographic routing the source simply addresses the message with the position of the destination. As the destination can generally be expected to move slowly compared to the frequency of topology changes between the source and the destination, it makes sense to keep track of the position of the destination instead of maintaining network topology information up to date; if the destination does not move too fast, the message is delivered regardless of possible topology changes among intermediate nodes. Finally, from a less technical perspective, it can be hoped that by studying geographic routing it is possible to gain insights into routing in ad hoc networks in general, without availability of position information.

The early proposals of geographic routing, suggested over a decade ago, were of purely greedy nature: At each intermediate network node the message to be routed is forwarded to the neighbor closest to the destination. This can, however, fail if the message reaches a local minimum with respect to the distance to the destination that is a node without any “better” neighbors. Also a “least deviation angle” approach (Compass Routing) cannot guarantee message delivery in all cases. The first geographic routing algorithm that does guarantee delivery was Face Routing introduced (called Compass Routing). Face Routing walks along faces of planar graphs and proceeds along the line connecting the source and the destination. Besides guaranteeing to reach the destination, it does so with messages, where is the number of network nodes. However, this is unsatisfactory, since also a simple flooding algorithm will reach the destination with messages. Additionally, it would be desirable to see the algorithm cost depend on the distance between the source and the destination. There have been later suggestions for algorithms with guaranteed message delivery, however, without better worst case performance than original Face Routing.

2.4.Energy Efficient Sleep Schedule for Achieving Minimum Latency in Query Based Sensor Networks

Energy management in sensor networks is crucial to prolong the network lifetime. Though existing sleep scheduling algorithms save energy, they lead to a large increase in end-to-end latency. We propose a new Sleep schedule (Q-MAC) for Query based sensor networks that provide minimum end-to-end latency with energy efficient data transmission. Whenever there is no query, the radios of the nodes sleep more using a static schedule. Whenever a query is initiated, the sleep schedule is changed dynamically.

Based on the destination's location and packet transmission time, we predict the data arrival time and retain the radio of a particular node, which has forwarded the query packet, in the active state until the data packets are forwarded. Since our dynamic schedule alters the active period of the intermediate nodes in advance by predicting the packet arrival time, data is transmitted to the sink with low end-to-end latency. The objectives of our protocol are to (1) minimize the end-to-end latency by alerting the intermediate nodes in advance using the dynamic schedule (2) reduce energy consumption by activating the neighbor nodes only when packets (query and data) are transmitted. Simulation results show that Q-MAC performs better than S-MAC by reducing the latency up to 80% with minimum energy consumption.

In query based sensor networks, the sensors report their results in response to an explicit request from the user. Users input the queries at the sink that describes the data they wish to collect. In a home network, user may send a query for eg. "Whether the gas tank should be refilled or the lights are 'on'". Based on the query for a particular detail, data can be collected from the corresponding subset of nodes in the complete network. The flow of data packets from the sensors to sink can be classified as broadcast, unicast or multicast based on the queries.

However, if energy efficiency is enhanced, the quality of service (QoS) of target tracking is highly likely to be negatively influenced. For example, forcing nodes to sleep may result in missing the passing target and lowering the tracking coverage. Therefore, energy-efficient target tracking should improve the tradeoff between energy efficiency and tracking performance—e.g., by improving energy efficiency at the expense of a relatively small loss on tracking performance.

III. PROBLEM DESCRIPTION

However, nearly all these works overlook one important fact that sensors can actually be mobile to gain better energy efficiency, channel capacity, etc., and enable a lot of new application scenarios. In many surveillance applications of WSNs, tracking a mobile target (e.g., a human being or a vehicle) is one of the main objectives.

3.1.Geographic Routing

The basic idea of geographic routing is greedy routing. Specifically, each packet is tagged with the coordinates of its destination, all nodes know their own coordinates, and a node forward the packet to its neighbor that is geographically closest to the destination. The earliest proposal for geographic routing, which has a local minimum problem in that a node may have no closer neighbor to the destination. For this reason, face routing and its variants are proposed to use geometric rules (e.g., right hand rule) to route around voids near the local minimum in case it happens. Moreover, there is also a hole problem in geographic routing, in that a hole can be formed by a set of dead sensor nodes running out of energy or being damaged. To solve this problem, some research work try to identify the hole boundary nodes first and then use these boundary nodes to avoid the hole.

3.2.Sleep Wake Scheduling

The basic mechanism for sleep scheduling is to select a subset of nodes to be awake in a given epoch while the remaining nodes are in the sleep state that minimizes power consumption, so that the overall energy consumption can be reduced. Existing works on sleep scheduling in WSNs mainly focus on two targets: point coverage and node coverage. For point coverage (also known as spatial coverage), the awake nodes in each epoch are chosen to cover every point of the deployed field. Existing point coverage oriented algorithms differ in their sleep scheduling goals: minimizing energy consumption, or minimizing average event detection latency. For node coverage (also called network coverage), awake nodes are selected to construct a globally connected network such that each asleep node is an immediate neighbor of at least one awake node. However, all these works generally focused on the medium access layer of static WSNs with static nodes.Previous methods do not consider the scenarios in which sensor nodes can be mobile, and previous methods like CKN and GSS determine the awake or asleep state of each node based only on a random rank, which may keep awake many nodes far away from the destination.

3.3.Drawbacks

- However, in geographic based routing face routing, solution for the hole problem works only consider WSNs with static nodes.
- Geographic routing oriented sleep wake scheduling which degrade the performance.
- Moreover, almost all current works about geographic routing in duty-cycled WSNs try to change the geographic forwarding mechanism to deal with the dynamic topology caused by some nodes being cycled off or going to sleep mode.

IV. PROPOSED SYSTEM

The proposed addresses the sleep scheduling problem in dutycycled WSNs with mobile nodes employing geographic routing. We propose two geographic-distance-based connected-k neighborhood (GCKN) sleep scheduling algorithms. The first one is the geographic-distance-based connected k neighborhood for first path1 (GCKNF) sleep scheduling algorithm, aiming at geographic routing utilizing only the first transmission path in duty-cycled mobile WSNs. The second one is the geographic-distance-based connected-k neighborhood for all paths2 (GCKNA) sleep scheduling algorithm, for geographic routing concerning all paths explored in duty-cycled mobile WSNs. By theoretical analysis and performance evaluations by simulations, we show that when there are mobile sensors, geographic routing can achieve much shorter average lengths for the first transmission paths searched in mobile WSNs employing GCKNF sleep scheduling and all transmission paths explored in mobile WSNs employing GCKNA sleep scheduling compared with those in mobile WSNs employing CKN or GSS sleep scheduling.

Specifically, we consider the following six factors for both,

4.1.*GCKNF and GCKNA.*

1) A node should go to sleep assuming that at least *k* of its neighbors will remain awake so as to save energy as well as keep it *k*-connected.

2) The asleep or awake state of nodes should be allowed to change between epochs so that all nodes can have the opportunity to sleep and avoid staying awake all the time, thus distributing the sensing, processing, and routing tasks across the network to prolong the network lifetime.

3) Although each node decides to sleep or wake up locally, the whole network should be globally connected so that data transmissions can be performed.

4) Each node should have enough initial neighbors, in order to make it easier for the node to satisfy the connected-*k* neighborhood requirement; thus, it is more likely to be asleep after

sleep scheduling. For GCKNF, which emphasizes the first transmission path of geographic routing, we further take the following factor into account.

5) The neighbor of each node, which is closest to sink, should be awake so that geographic routing can utilize these nearest neighbor nodes to make the first transmission path as short as possible. For GCKNA, which considers all transmission paths, we further take the following factor into consideration.

4.2. Optimization-based sleep scheduling protocol (OSSP)

As a compensation for tracking performance loss caused by duty cycling and sleep scheduling, proactive wake up has been studied for awakening nodes proactively to prepare for the approaching target. However, most existing efforts about proactive wake up simply awaken all the neighbor nodes in the area, where the target is expected to arrive, without any differentiation. In fact, it is sometimes unnecessary to awaken all the neighbor nodes. Based on target prediction, it is possible to sleep-schedule nodes precisely, so as to reduce the energy consumption for proactive wake up.

In this work, a system is developed in such a way that target tracking in WSN is done in efficient way using an energy efficient prediction- based clustering algorithm. Energy efficient prediction based Clustering algorithm, reduces the average energy consumed by sensor nodes and thereby increase the lifetime of the network and also achieve better tracking performance.

Resource consumption of the network is thus restricted to the activated cluster, where intra cluster communication is dramatically reduced so achieves optimization based sleep scheduling. Therefore, the cluster activation phase has a great importance not only in minimizing resource consumption but also in tracking accuracy. First, all the CHs need to measure the distances between the target and themselves at every sampling instant; then, a comparison among them is required to choose the nearest one. When a target enters the wireless sensor network, the CH that detects the target becomes active while other nodes are in sleep mode.

We utilize two approaches to reduce the energy consumption during this proactive wake-up process:

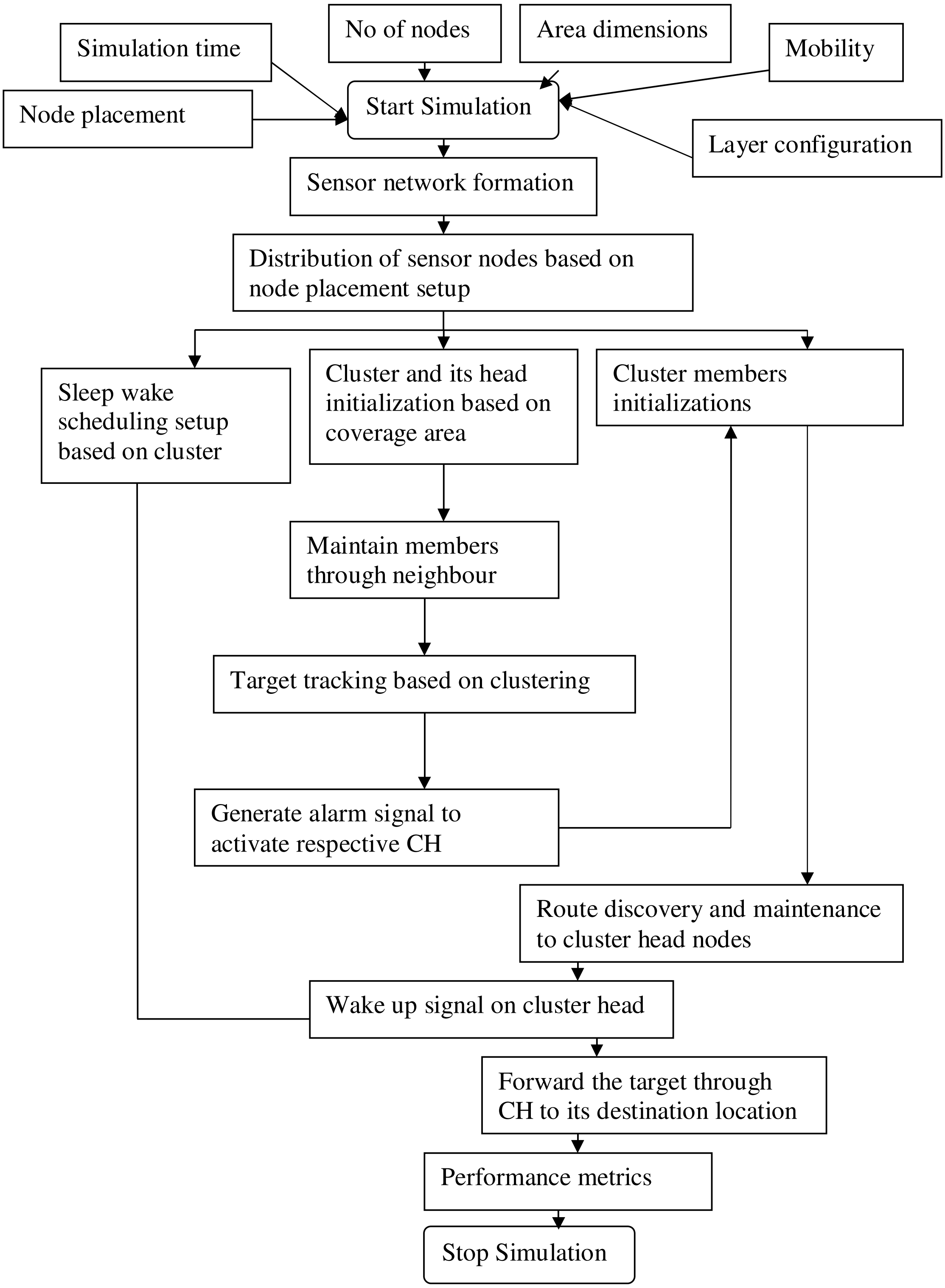
1. Reduce the number of awakened nodes.
2. Schedule their sleep pattern to shorten the active time.

First, the number of awakened nodes can be reduced significantly, because:

1) Those nodes that the target may have already passed during the sleep delay do not need to be awakened;

2) Nodes that lie on a direction that the target has a low probability of passing by could be chosen to be awakened with a low probability. For this purpose, we introduce a concept of awake region and a mechanism for computing the scope of an awake region.

Second, the active time of chosen awakened nodes can be curtailed as much as possible, because they could wake up and keep active only when the target is expected to traverse their sensing area. For this purpose, we present a sleep scheduling protocol, which schedules the sleep patterns of awakened nodes individually according to their distance and direction away from the current motion state of the target.



"Figure 1.Architecture diagram"

4.3. Advantages

- In a duty-cycled sensor network, proactive wake up and sleep scheduling can create a local active environment to provide guarantee for energy efficient routing.

- In other words, geographic routing can have access to as many as possible closer neighbor nodes to the sink under the priority of network connectivity after sleep scheduling. Thus, the length of all transmission paths searched by geographic routing can also be as short as possible.

V. CONCLUSION

Recently, the research focus of routing is centering on WSNs with duty-cycles, since duty cycled WSNs have a natural advantage of saving energy by dynamically putting nodes to sleep and waking them according to some sleep scheduling algorithms. However, if energy efficiency is enhanced, the quality of service (QoS) of target tracking is highly likely to be negatively influenced. For example, forcing nodes to sleep may result in missing the passing target and lowering the tracking coverage. Many techniques have already been proposed for on-line duty cycle management or transmission power control. However, they have been developed and analyzed separately. Thus, the mutual interactions and synchronization issues that come with linking them together have not been taken into account until now. Therefore, energy-efficient target tracking should improve the tradeoff between energy efficiency and tracking performance—e.g., by improving energy efficiency at the expense of a relatively small loss on tracking performance.

REFERENCES

[1] B. Leong, B. Liskov, and R. Morris, "Geographic routing without planarization," in Proc. NSDI, 2006, pp. 339–352.
[2] Y.-J. Kim, R. Govindan, B. Karp, and S. Shenker, "Lazy cross-link removal for geographic routing," in Proc. SenSys, 2006, pp. 112–124.
[3] L. Zhang and Y. Zhang, "Energy-efficient cross-layer protocol of channel aware geographic-informed forwarding in wireless sensor networks," IEEE Trans. Veh. Technol., vol. 58, no. 6, pp. 3041–3052, Jul. 2009.
[4] Z. Jiang, J. Ma,W. Lou, and J.Wu, "An information model for geographic greedy forwarding in wireless ad-hoc sensor networks," in Proc. IEEE INFOCOM, 2008, pp. 825–833.
[5] H. Zhang and H. Shen, "Energy-efficient beaconless geographic routing in wireless sensor networks," IEEE Trans. Parallel Distrib. Syst., vol. 21, no. 6, pp. 881–896, Jun. 2010.
[6] Q. Cao, T. Abdelzaher, T. He, and J. Stankovic, "Towards optimal sleep scheduling in sensor networks for rare-event detection," in Proc. IPSN, 2005, pp. 20–27.
[7] H. Le, J. V. Eck, and M. Takizawa, "An efficient hybrid medium access control technique for digital ecosystems," IEEE Trans. Ind. Electron., vol. 60, no. 3, pp. 1070–1076, Mar. 2013.
[8] P. Cheng, F. Zhang, J. Chen, Y. Sun, and X. Shen, "A distributed TDMA scheduling algorithm for target tracking in ultrasonic sensor networks," IEEE Trans. Ind. Electron., vol. 60, no. 9, pp. 3836–3845, Sep. 2013.
[9] C. Zhu et al., "A survey on communication and data management issues in mobile sensor networks," Wireless Commun. Mobile Comput., vol. 14, no. 1, pp. 19–36, Jan. 2014.
[10] R. C. Luo and O. Chen, "Mobile sensor node deployment and asynchronous power management for wireless sensor networks," IEEE Trans. Ind. Electron., vol. 59, no. 5, pp. 2377–2385, May 2012.
[11] H. Song, V. Shin, and M. Jeon, "Mobile node localization using fusion prediction-based interacting multiple model in cricket sensor network," IEEE Trans. Ind. Electron., vol. 59, no. 11, pp. 4349–4359, Nov. 2012.
[12] J. Pan, L. Cai, Y. T. Hou, Y. Shi, and X. X. Shen, "Optimal base-station locations in two-tiered wireless sensor networks," IEEE Trans. Mobile Comput., vol. 4, no. 5, pp. 458–473, Sep./Oct. 2005.

