# Mobility assistance in Wireless Sensor Network

Xiujuan Yi
Nalini Venkatasubramanian
University of California, Irvine

# Outline

- Background

  Why people introduce robots into wireless sensor network?

- Trade-off

  Advantages & Overheads

- Challenges

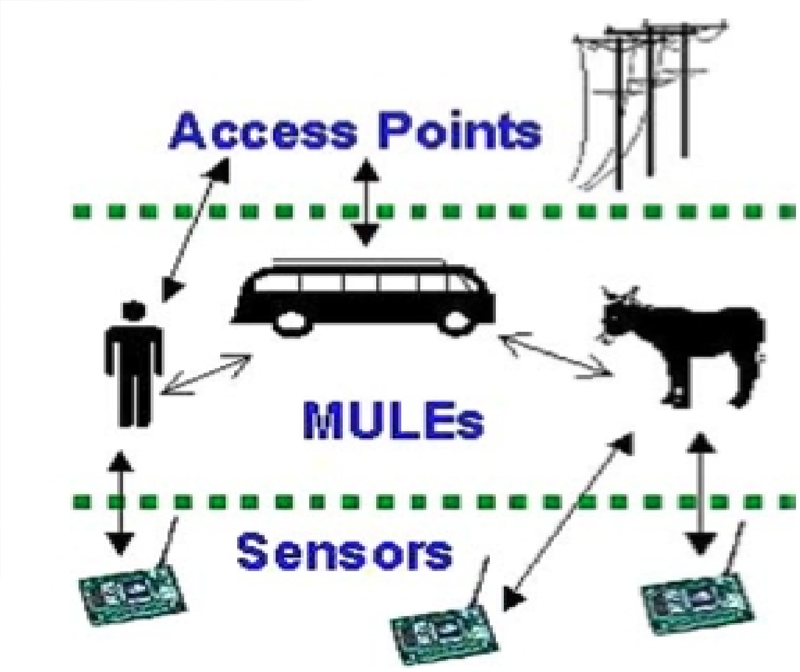
  What's the problem by employing robots?

- Solution

  How to overcome these problems?

# Background

- Energy Concern in Wireless Sensor Network
  - Low-energy design
  - Energy harvesting
  - Hierarchy deployment
  - Abundant deployment
  - Mobility




- Sparsely deployed sensors

# Background

Mobile nodes' possible responsibility

- Sensing
- Mobile relay(router)
- Mobile Sink
- Energy deliverer
- ......

# Tradeoff

Advantages

- flexibility: multi-functional robots
- hierarchy: sensors could be made simple and inexpensive

Overhead

- long latency
- large buffer
- complexity in robots

# *Mobile Sink-Challenges*

Schedule of mobile robots

Subject to the following requirements, find a set of points, and the times and the sequence to visit them for the robot(s).

- Minimizing the length of the tour
- No data overflow
- No missed deadlines
- etc.

# Solution-Overview

Transform such optimization problems to already known problems.

- Shortest path for the robot(s)

TSPN, Mixed-Integer Problem

- No buffer overflow

k-TSPN, Mobile-Element-Schedule

- others

# Solution-Category

- Random Walking
- Straight line

  applicable to uniformly deployed sensor nodes

- Basic TSP

  Given a collection of cities and the cost of travel between each pair of them, the traveling salesman problem(TSP) is to find the cheapest way of visiting all of the cities and returning to the starting point.

- TSPN (TSP with neighborhood)

  Given a collection of n disjoint regions(neighborhoods), find a shortest tour that visits each region.

- K-TSPN (multi-robot)

  k travelers visit n cities, and the objective is to minimize the length of the maximum tour.

- Periodic VRP with Dynamic Time Windows

  nodes have dynamic deadline to be visited

# Solution-Category[4]

*Table 1.* Comparison of leveraging sink mobility in WSN.

| | References | Random, predictable, or controlled sink mobility | Single-hop or multihop forwarding | Single-sink or multiple sinks |
|---|---|---|---|---|
| Data MULEs, SENMA, DFT-MSN | [3–6] | Random | Single-hop | Multiple |
| CarTel, Message Ferry | [7–10] | Random | Multihop | Multiple |
| Mobile Element Scheduling | [11, 12] | Controlled | Single-hop | Single |
| AIMMS | [13–15] | Controlled | Multihop | Single/multiple |
| Predictable Mobile Observer | [16] | Predictable | Single-hop | Single |
| SEAD | [17] | Predictable | Multihop | Multiple |
| TTDD, EARM | [2, 18] | Random | Multihop | Single |
| HLETDR, Joint Mobility and Routing | [19, 21] | Predictable | Multihop | Single |
| Base Station Relocation, Maneuverable Relays | [22–27] | Controlled | Multihop | Multiple |

# References


[1]M. Ma and Y. Yang, "Data gathering in wireless sensor networks with mobile collectors," *IEEE IPDPS*, Miami FL, April 2008.

[2]B. Yuan, M. Orlowska, and S. Sadiq. On the optimal robot routing problem in wireless sensor networks. *IEEE Trans. on Knowl. and Data Eng.*, 19(9):1252–1261, 2007.

[3]Somasundara, A., Ramamoorthy, A., Srivastava, M.: Mobile Element Scheduling for Ef- ficient Data Collection in Wireless Sensor Networks with Dynamic Deadlines. In: IEEE RTSS. (2004)

[4]JIAN MA, CANFENG CHEN AND JYRI P. SALOMAA,mWSN for Large Scale Mobile Sensing, Journal of Signal Processing Systems 51, 195–206, 2008