Sensor Relocation in Mobile Sensor Network

Guiling Wang,Guohong Cao,Tom La Porta

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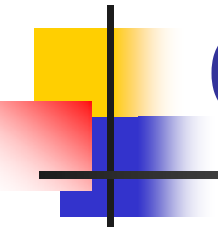
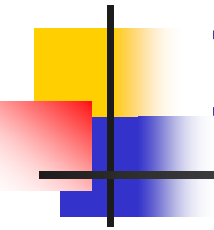


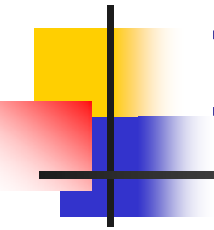
Outline

- Introduction
- Two phase relocation solution
- Performance evaluations
- Conclusion and Discussion



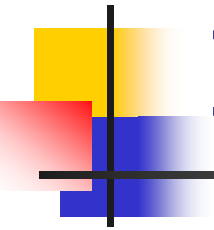
Introduction

- Mobile sensor is useful to coverage requirements and sensor failure
- in some environment, remote harsh or disaster areas can't access again, it is necessary to make use of mobile sensors to reach an adequate coverage level



Introduction

- Challenge:
  - strict response time requirement
  - shouldn't affect the application
  - minimize its effect while application working
  - must achieve balance energy costs with response time
  - balance the energy cost of a single node with the overall network energy cost to ensure max network lifetime



Introduction

- Sensor relocation method
  - VEC
  - Minimax
  - Two-phase method
    - Finding the redundant sensors
    - Sensor relocation

Two phase relocation solution

- Finding the redundant sensor
  - broadcast advertisement
  - broadcast request
  - middle of the network

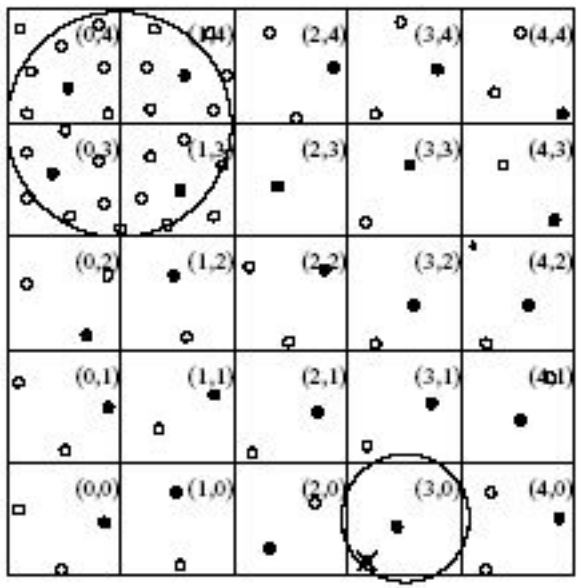


Fig. 1. The system model

Finding the redundant sensor

- Grid-Quorum solution

  Grids in one row are organized into one supply quorum ,and grids in one column are into one demand quorum.

- The message overhead is $O(\sqrt{N})$

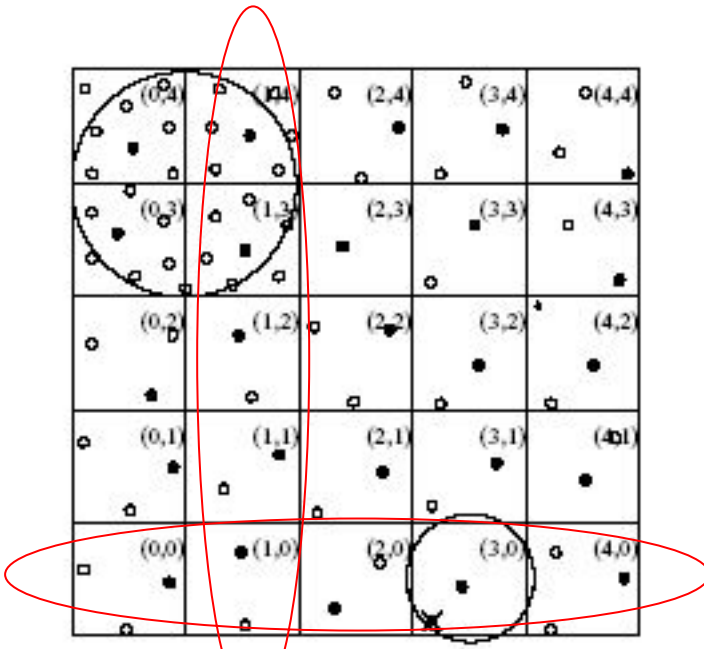


Fig. 1. The system model

Find the redundant sensor

- How to get the closest redundant sensor ->stopping criteria

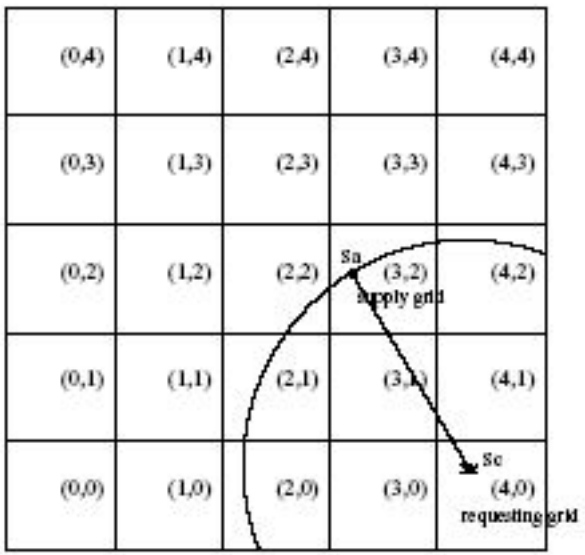


Fig. 2. Stopping criteria

Sensor relocation

- Direct movement

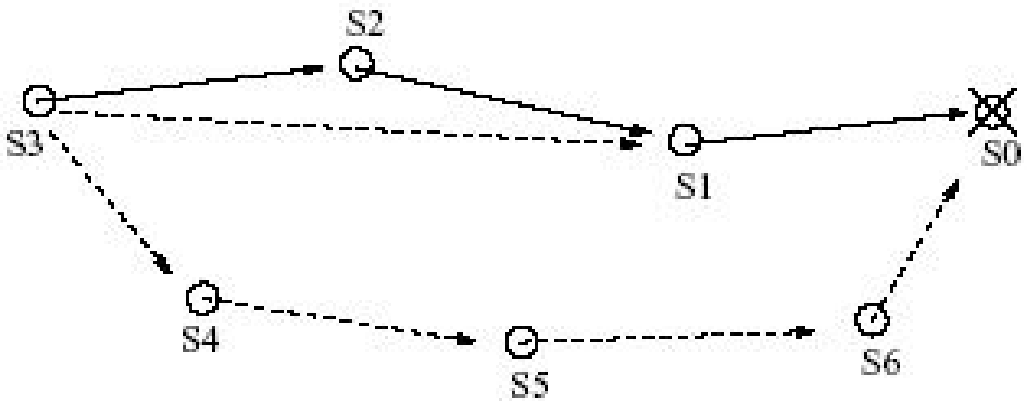
  adv--快,對整体網路最省電

  Disadv--單單消耗某一個的電,容易因耗盡而有新洞如果距離太長,不能符合時間要求

- Cascaded movement

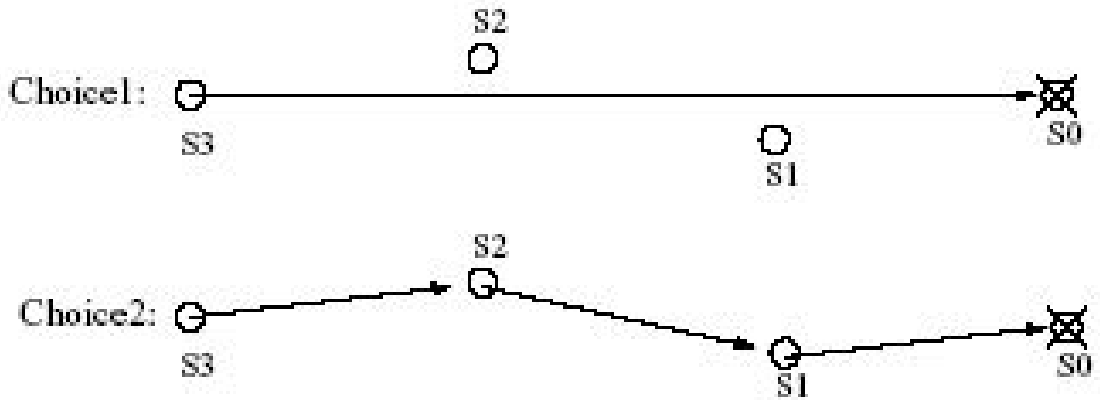
Sensor relocation

- Cascaded movement



Sensor relocation

- How to select cascading node
  - may affect the sensing or the application task, to achieve the time requirement of application, the movement must take place in Ti.



Cascading schedule

- achieve balance of max remaining energy and min energy consumption
- Two cascading schedule with

E1-Emin1 <= E2-Emin2

E: the total energy consumption of whole system
Emin: the minimum remaining energy of the system

- The cascading schedule with min difference between the E and Emin is the best

Cascading schedule

- Modified Dijkstra's algo

ModifiedDijkstra(Graph G(V,E), Vertex s_0)

Initialization: $S = \{s_0\}$, $Q = V$
DeleteEdge(s_0,0)
while not Empty (Q)

1. Let $\mathcal{F} = \{\langle s_k, s_l \rangle \mid \langle s_k, s_l \rangle \in S \times Q, d_{lk} \leq (T_k + t_k) * speed\}$
2. Find $\langle s_i, s_j \rangle \in \mathcal{F}$ such that $\forall \langle s_k, s_l \rangle \in \mathcal{F}, d_{ji} \leq d_{lk}$
3. s_j.predecessor $= s_i$
4. $t_j = T_i + t_i - d_{ji}/speed$
5. $P'_j = P_j - d_{ji}$
6. Add s_j to S
7. DeletedEdge(s_j, t_j)

end

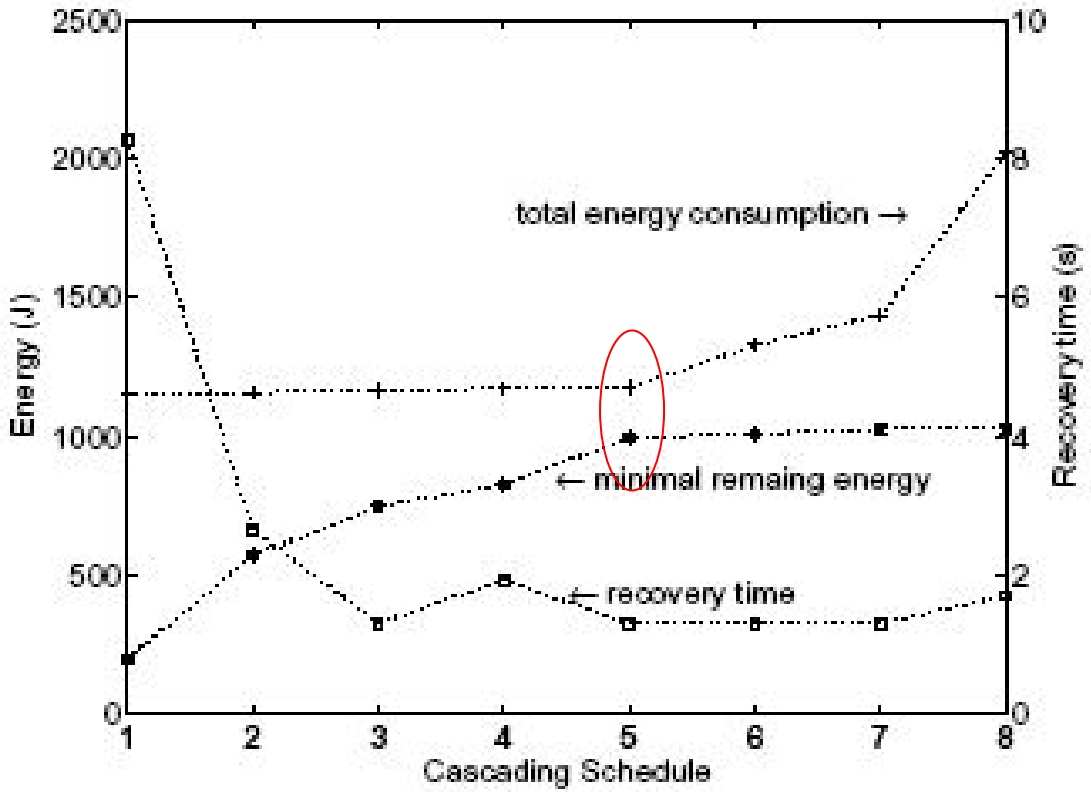
Cascading schedule

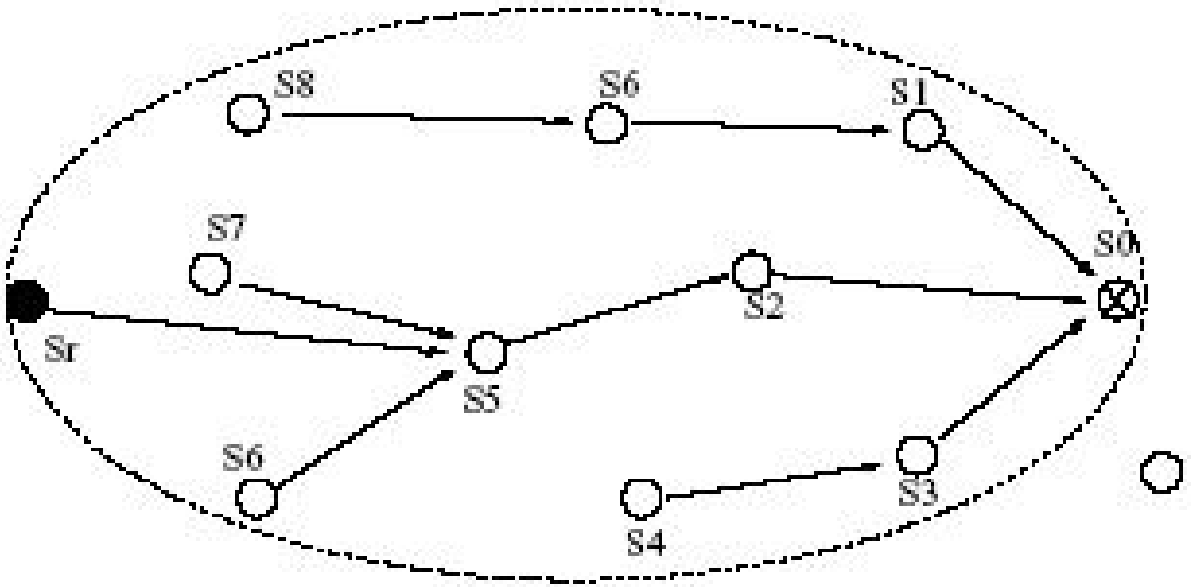
Initialization: $E = 0, Emin = -2, E' = 0, Emin' = -1$

while (1)

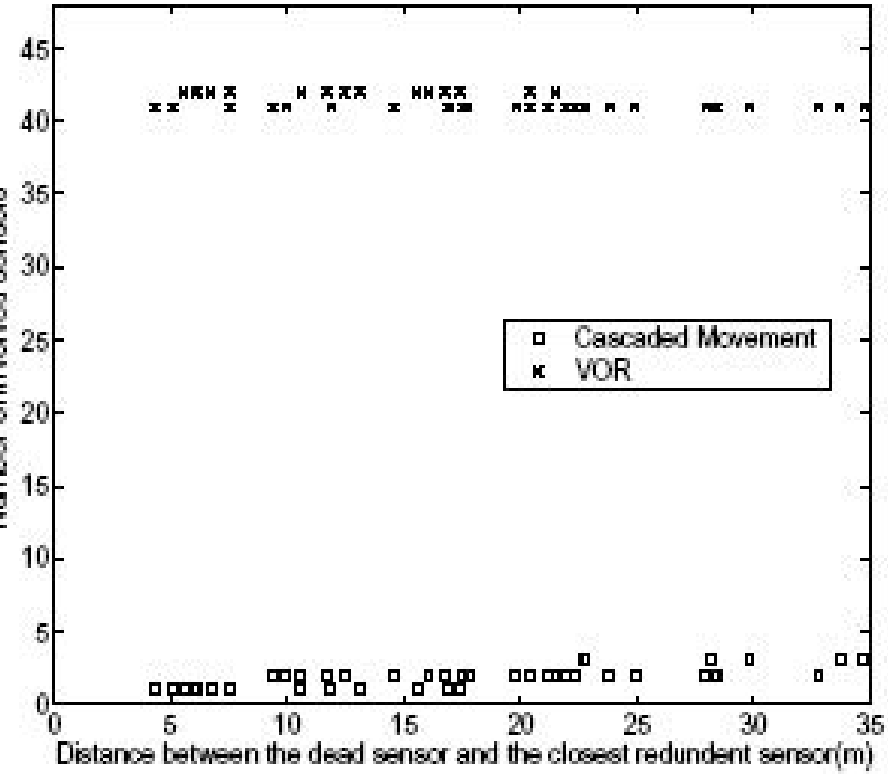
1. find the shortest cascading schedule using the Modified Dijkstra's algorithm
2. record the minimum remaining power as $Emin'$
3. delete all edges $s_i s_j$ if $P_i - d_{ij} \leq Emin'$
4. **if** $E' - Emin' < E - Emin$ **then**
   $E = E', Emin = Emin'$
   else
   return the previously calculated schedule

Cascading schedule

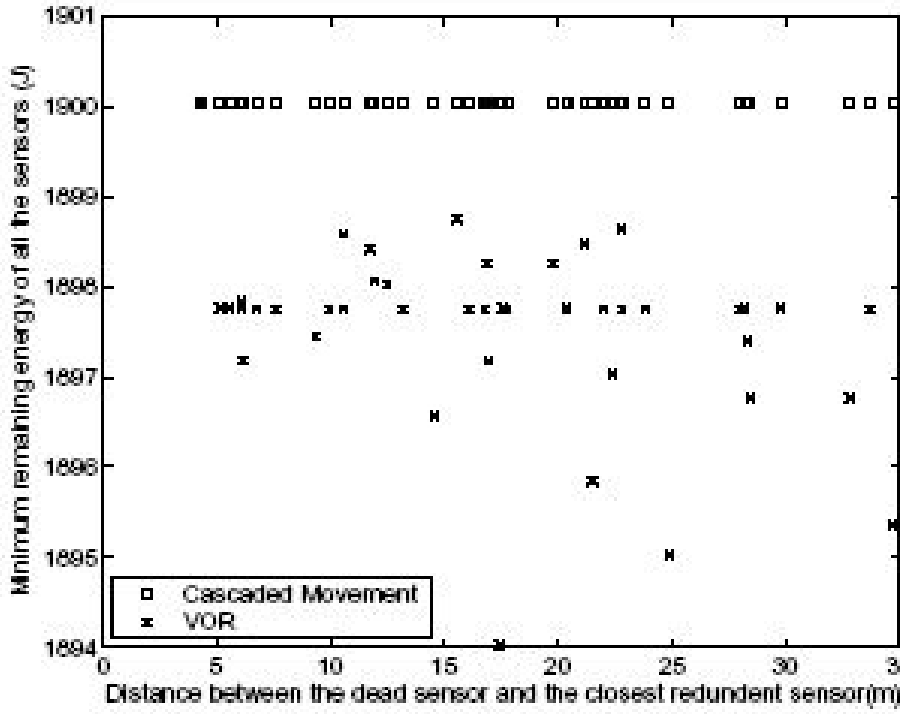



S8
S6
S1
S7
S0
S2
Sr
S5
S6
S3
S4

Performance evaluations

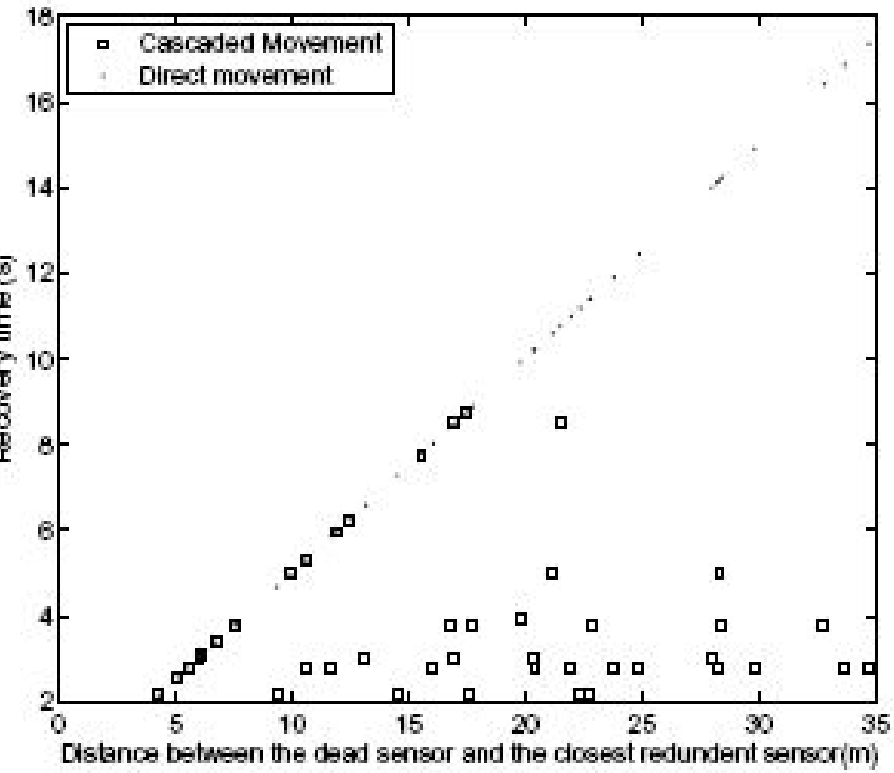


(a) Number of sensors moved

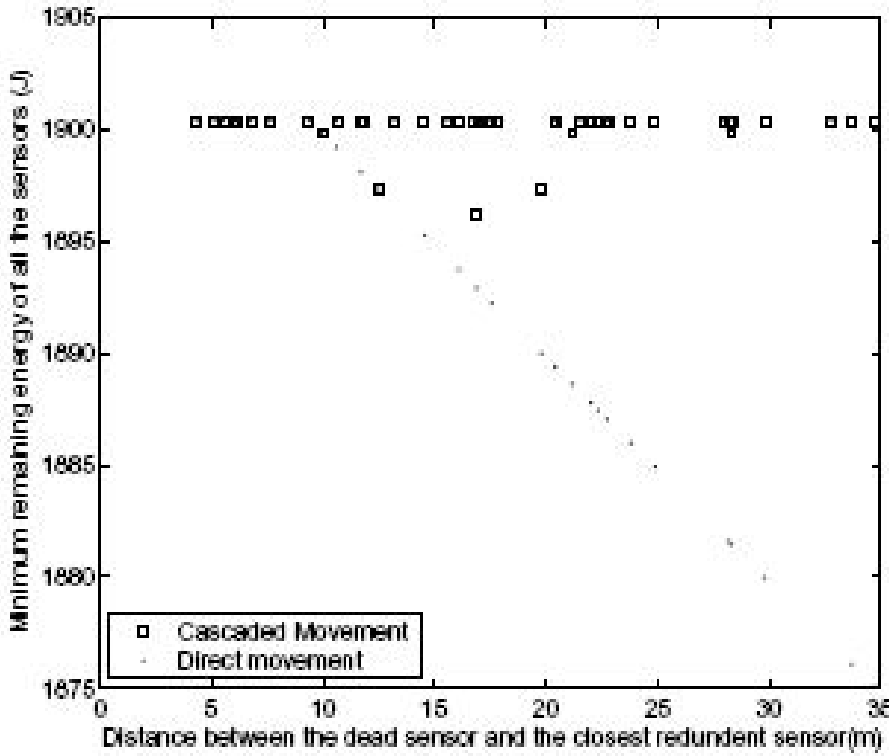


(c) Minimum remaining energy

Performance evaluations



(a) Relocation time



(c) Minimum remaining energy

Conclusion and Discussion

- Solves the problem of sensor relocation which can deal with sensor failure effectively and minimize the effect on applications
- The cascaded movement can reduce the relocation time
- To find the best cascading schedule can minimize the difference between the total energy consumption and the minimum remaining power

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