Dual Prediction-based Reporting for Object Tracking Sensor Networks

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Outline

- Introduction
- Background
- Dual Prediction-based Reporting
- Performance Evaluation
- Conclusion and Future work

Introduction

- Definition: DPR achieves energy efficiency by trading off multi-hop transmissions with one-hop/short-range communications of object movement history.

- Object tracking sensor network(OTSN) imply
  - intricate collaborative operations
  - immense raw streaming data

Introduction(cont)

- Two critical operations:
  - 1).monitoring
  - 2).reporting
- Monitoring methods
  - 1). naive
  - 2). scheduled monitoring
  - 3). continuous monitoring
  - 4). PES
- Reporting methods
  - 1).naive
  - 2).PREMON

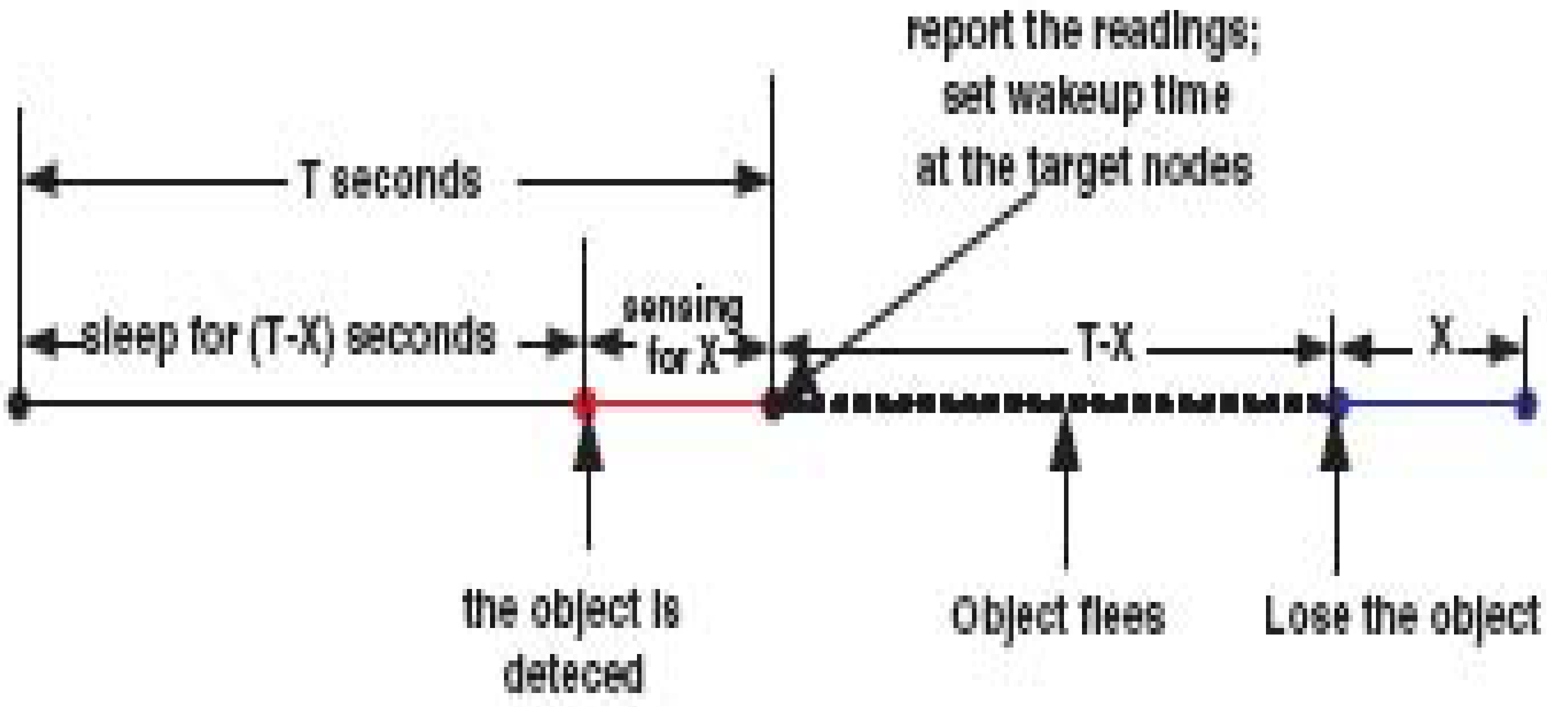


Figure 2. The current node misses the object

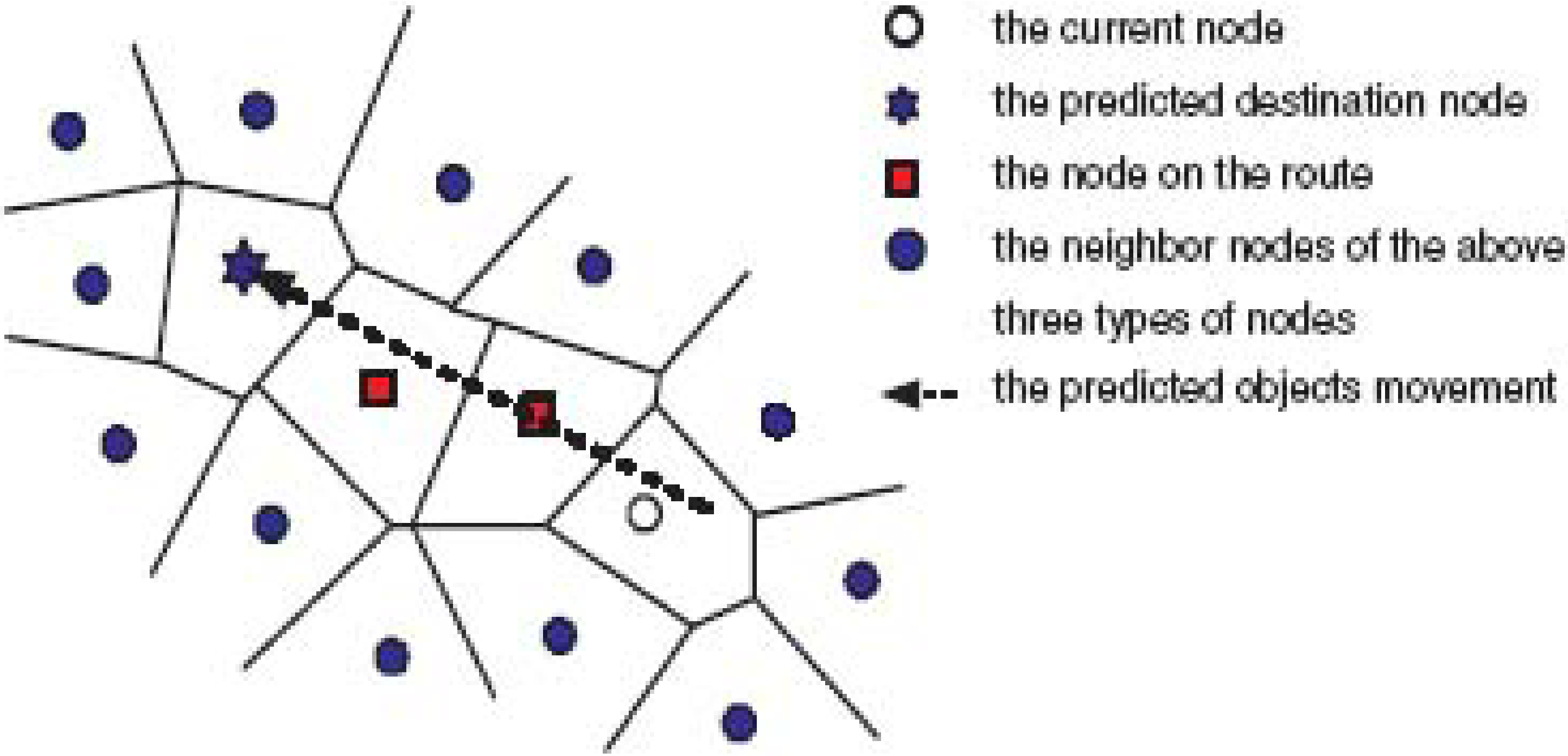


Figure 3. Heuristics for wake up mechanisms

Background

- A sensor node tracking objects intruding its
  - Detection area
  - Reporting with certain frequency
- A base station knows about the locations of each sensor
- Every object can be identified by object code table

Background(cont)

- The factors have impacts on OTSN:
  - Network workload
  - Reporting frequency
  - Data precision
  - Location models

Dual Prediction-based Reporting

- minimizing the number of long distance transmissions between sensor nodes and the base station with a reasonable overhead

- Reporting Mechanism
  - Location model: regulate the granularity of the location Information
  - Prediction model: analyze the moving history and estimate the future movement.

Dual Prediction-based Reporting(cont)

- Some design factors
  - Prediction model is deployed at both sensor and BS
  - BS assumes its predictions are correctly, until it receives an update packet
  - BS can obtain the historical data from its prediction or update.
  - Historical packet is broadcasted among one-hop neighbor so that consumes less energy

Prediction model

- Instant: the object continues to move in the same direction and velocity as the last observed
- Average: predicts moving states by averaging the historical data.
- Exponential: lends more weight to recent history

- The model will compress the historical data so that won't waste too much space

Location model

- Time → longer or shorter
- geometric and symbolic model
  - sensor cell
  - triangle
  - Grid
  - coordinate

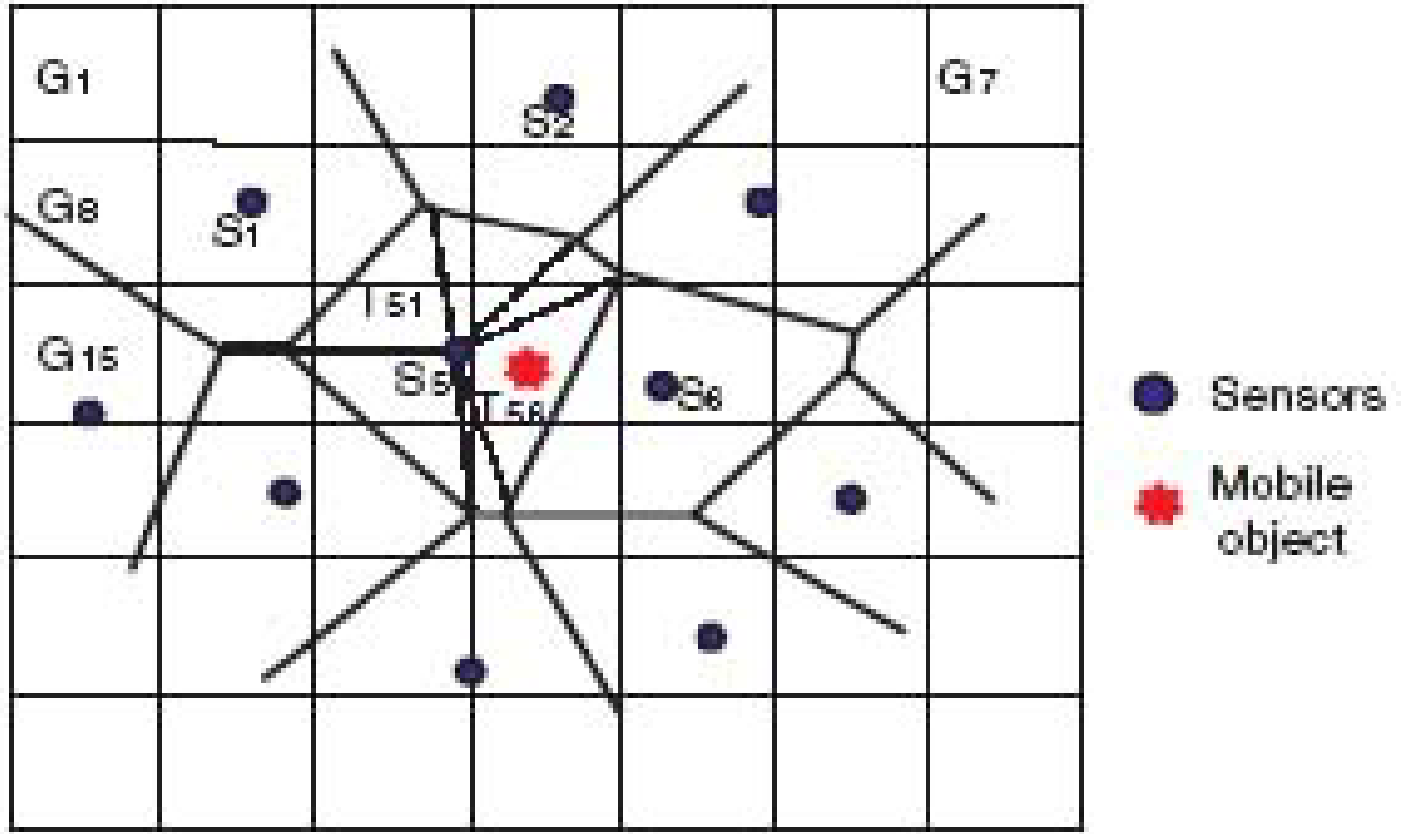


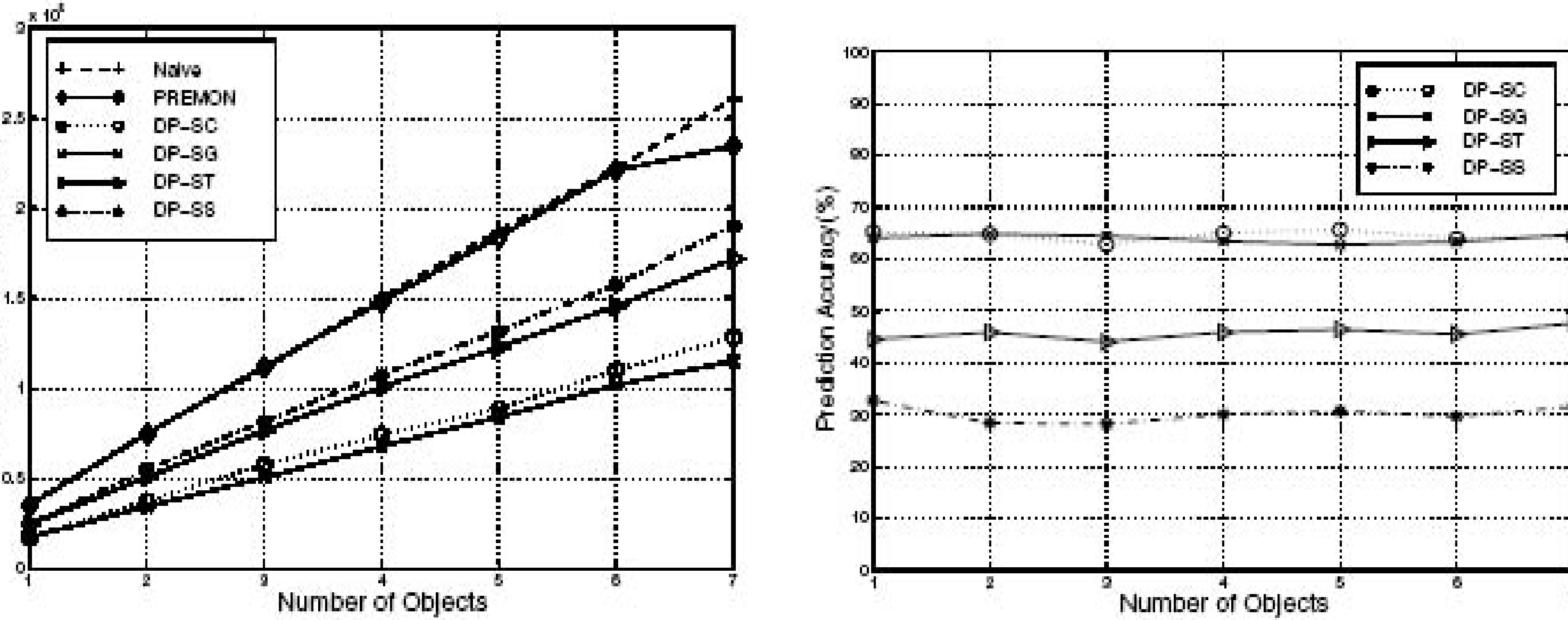
Figure 1. Location Models for DPR

Performance Evaluation

- Evaluation background
  - Use shortest path multi-hop routing algo
  - instant prediction
  - continuous-monitoring scheme
- Two metrics are used to evaluate the performance
  - total energy consumption
  - prediction accuracy

Performance Evaluation (cont)

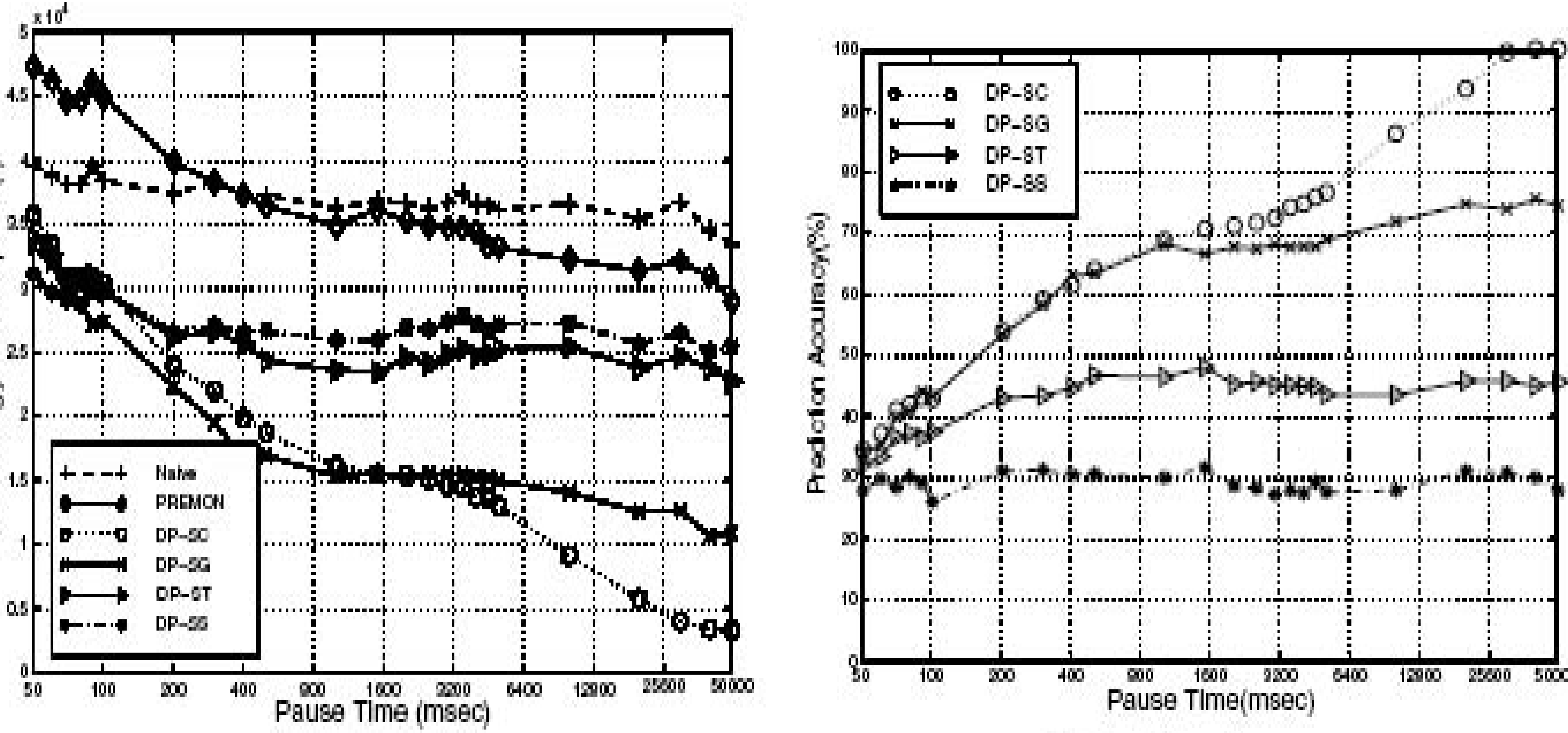
- network workload for number of objects



(a) Total Energy Consumption (b) Prediction Accuracy

Performance Evaluation (cont)

- moving behavior
  - moving duration
  - moving speed
- Moving duration :controls the frequency that objects change the moving states (direction and speed)

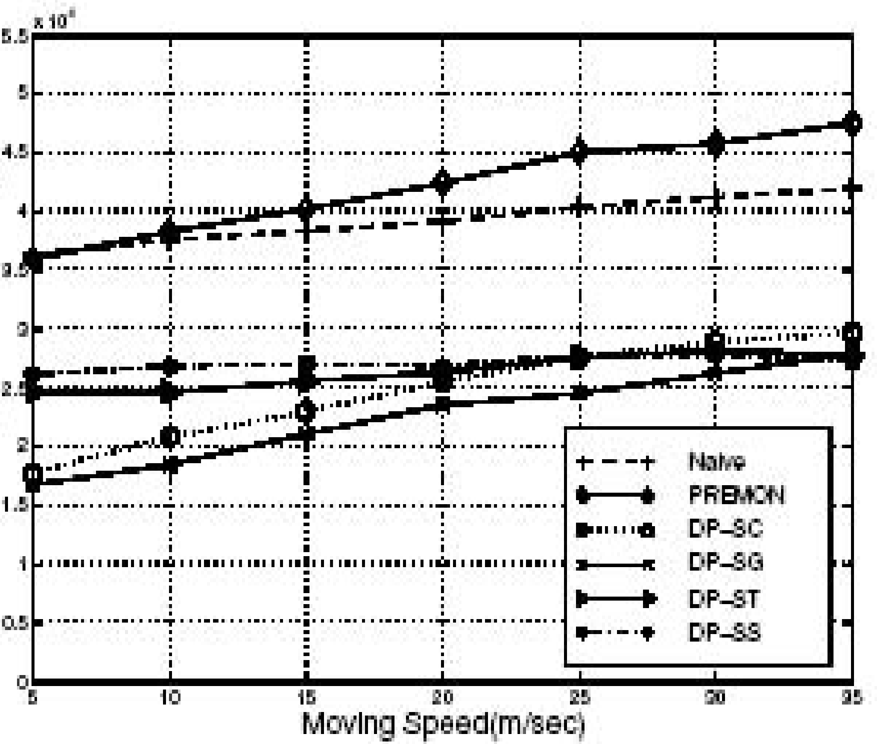


(a) Total Energy Consumption

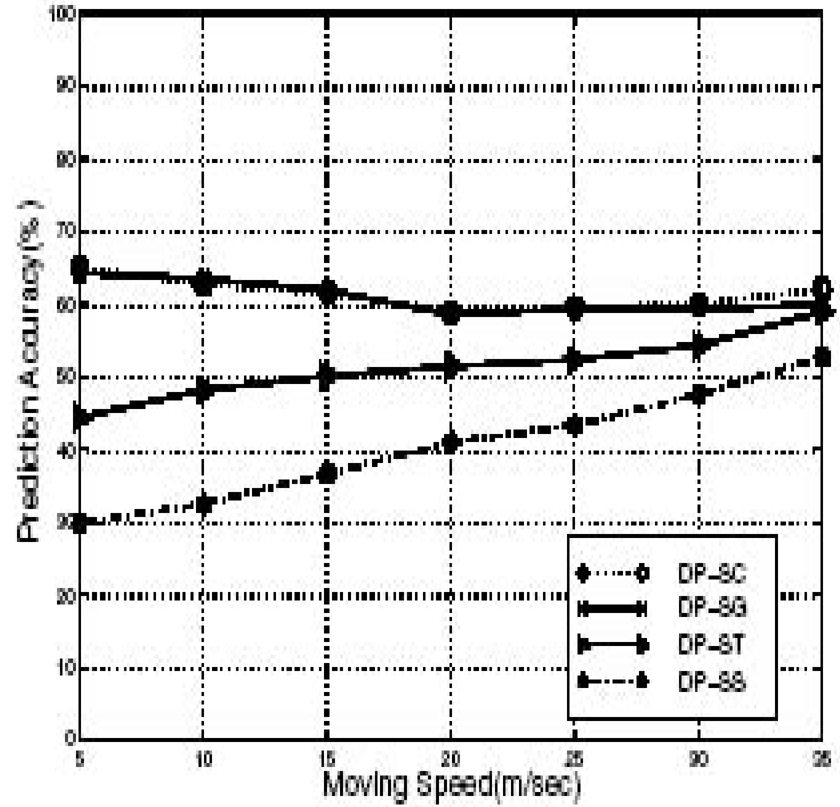
(b) Prediction Accuracy

Performance Evaluation (cont)

- Moving speed:



(a) Total Energy Consumption

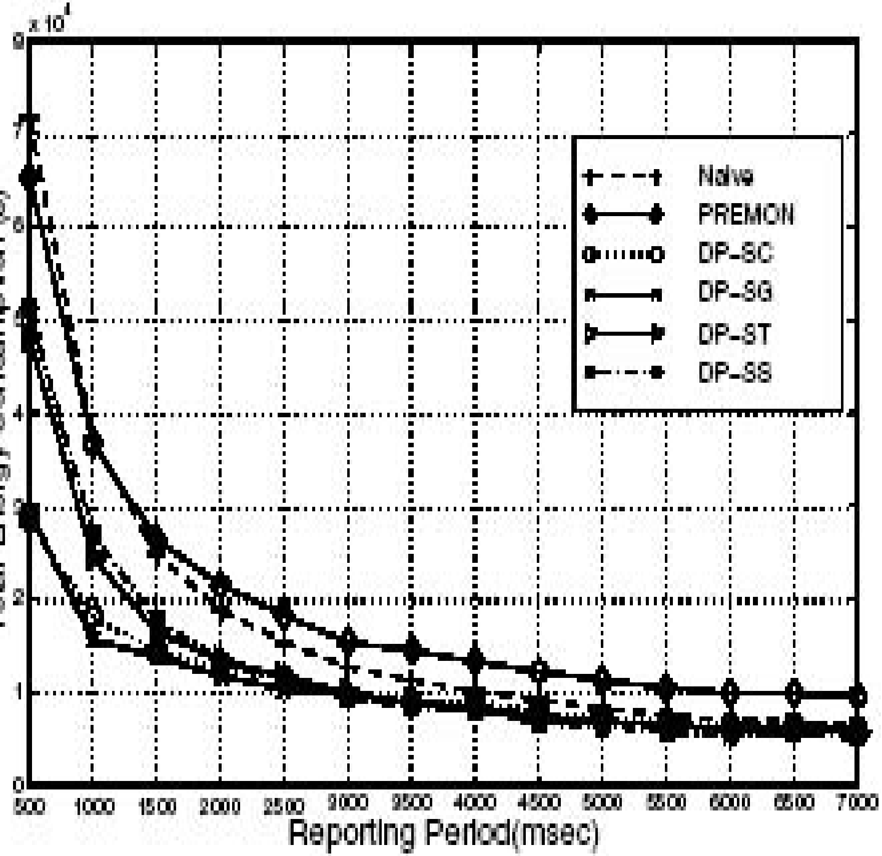


(b) Prediction Accuracy

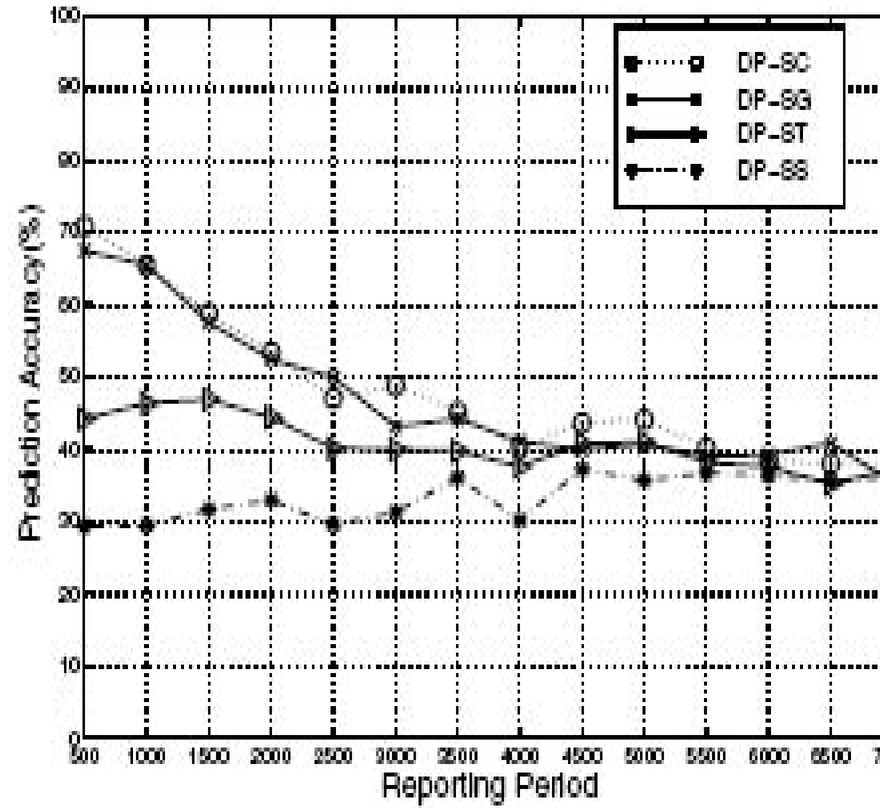
- granularity effect:影響SS,ST而增加其accuracy

Performance Evaluation (cont)

- reporting period



(a) Total Energy Consumption



(b) Prediction Accuracy

Conclusion and Future work

- The paper addressed the energy conservation in the reporting operations.
  - Location model decides the granularity
  - Predication model decides how to predict the objects by history

Conclusion and Future work

- Result shows four lessons:
  - Minimizing the energy usage
  - Stable energy savings
  - Granularity effect
  - The longer reporting period improves the accuracy for high granular location models.

Conclusion and Future work

- Future lessons:
  - Sensor detection errors
  - Network communication collisions
  - PES + DPR