Localization With Mobile Anchor Points in Wireless Sensor Network

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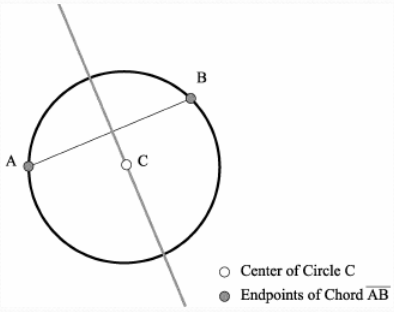
introduction

- range free scheme
- utilizes mobile anchor points that moves around sensing area
- localization using perpendicular bisector of a chord conjecture

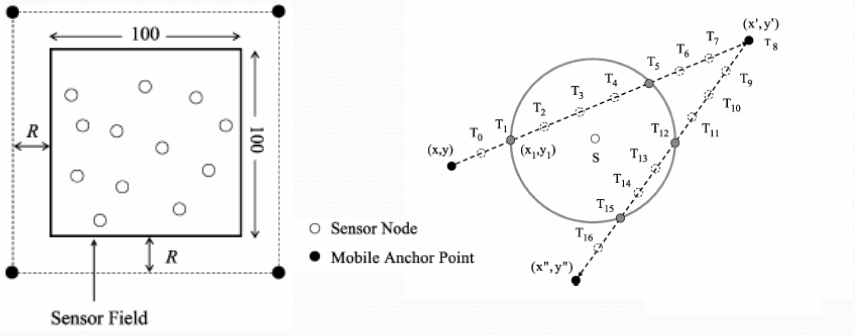


overview

- mobile anchor points
- how the method works
- enhancements
- simulation results
- conclusions

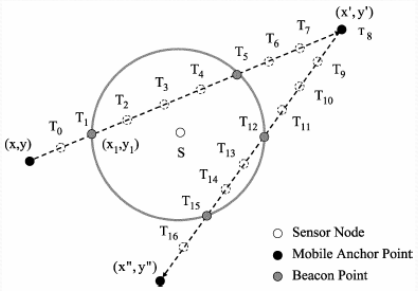
mobile anchor points

- have a GPS system
- able to move anywhere in sensor area
- periodically broadcast beacon messages
- beacon messages contain coordinate information



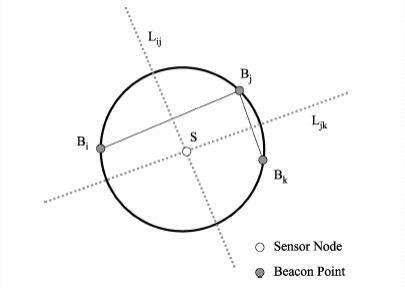
how the method works

- sensor node S will have a circle communication area
- mobile anchor points (*MAP*) move (randomly) and broadcast beacon messages with interval T
- beacon messages are stored by sensor node in a list
- the list is constantly renewed until the last beacon messages detected
- the first and the last beacon messages detected → *beacon points*



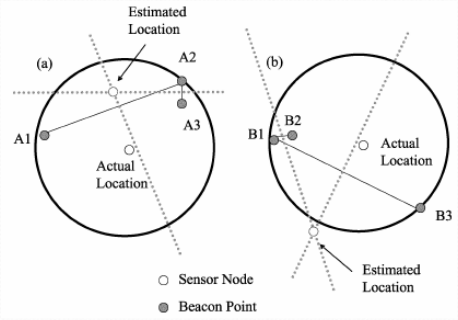
how the method works

- three beacon points are selected
- two different chords are generated
- two corresponding perpendicular bisector of a chord will be generated
- the intersection of both corresponding perpendicular line (S) will be the sensor node's location (centre of the circle)



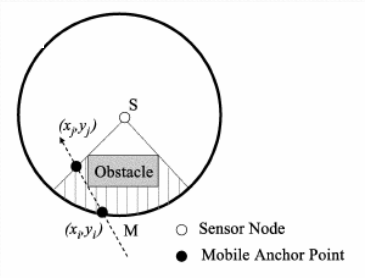
enhancements

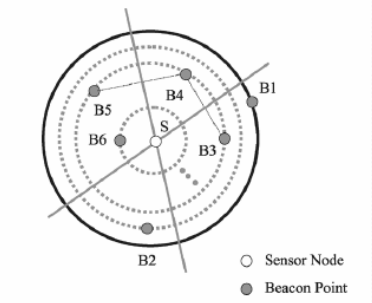
- beacon scheduling
  - prevents collision of beacon messages from different mobile anchor points
  - beacon messages interval are jittered (randomized)
  - chord selection
  - collision or inappropriate interval of beacon messages
    → incorrect beacon points → localization error
  - a minimum threshold value for the chord's length is introduced



enhancements

- obstacle tolerance
  - concentric (inner) circles are implemented
  - beacon points that have similar signal strength are assumed to be in the same circle





simulation

metrics

- Average location error

$$= \frac{\Sigma\ location\ error}{\#\ sensor\ nodes}$$

- Average execution time

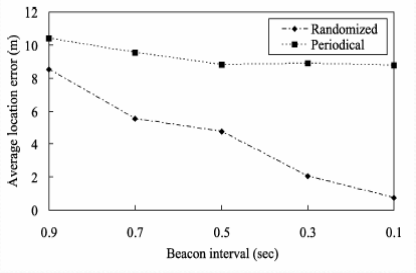
$$= \frac{\Sigma\ exec.time}{\#\ sensor\ nodes}$$

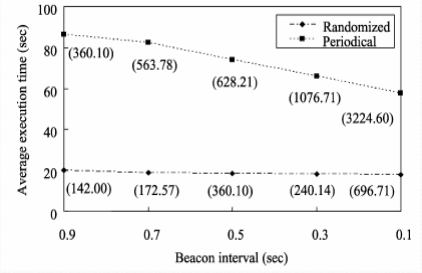
- Beacon overhead

$$= \frac{\Sigma\ beacon\ messages}{\#\ mobile\ anchor\ points}$$

simulation results

- periodical vs. randomized beacon scheduling
  - improves localization accuracy
  - decreased the execution time
  - requires less beacon messages





simulation results

- longer chord enhance the performance of localization scheme
- the appropriate chord length's threshold is about 30% - 40% of sensor node's radio range
- the method requires less execution time and beacon messages then the centroid and constraint methods
- for obstacle tolerance, average location error can be reduced with more reference beacon points

conclusions

- mobile anchor points localization method:
  - range free
  - perpendicular bisector of a chord method is used
  - anchor points are mobile
  - no interactions between neighboring nodes
- able to tolerate radio irregularity due to obstacles
- better performance compared to other range-free approach (constraint and centroid methods)

conclusions

- chord length's threshold value could be changed depending on the requirements
- not applicable in every terrain/area
- sensor nodes communication area is not a perfect circle
  - more than three beacon points could be implemented
  - more execution time and beacon messages