Localization Light-Seminar Summary

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Service Construction

- Motivation
  - What services/application need localization
  - Build it and they will come? (supply-side argument)
- Security
  - Unforeseen issues? (e.g. spam)
- Privacy
  - Mixed reactions

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Multi-Lateration Techniques

- Measure time directly from clocks in sender and receiver
  - GPS
- Time-difference of arrival between media (radio, ultrasound)
  - Medusa
  - Hazas/Ward
  - Cricket

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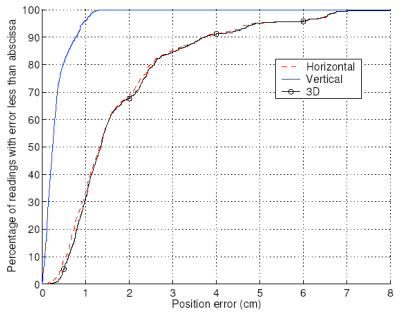
Sample Localization Accuracy



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Multi-Lateration

- Accurate distance measure from sender to receiver
- Line-of-sight to landmarks critical
  - Both for GPS, ultrasound
- Is this valid indoors?
  - How to obtain coverage in this case?
  - How hard is infrastructure?

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Sampling and Scene Analysis

- Observe properties of the spectrum
- Match properties to locations on a map
  - MS RADAR
    - Sampled points, signal space mapping
  - CMU Triangulation, Mapping, Interpolation
  - UMD Bayesian

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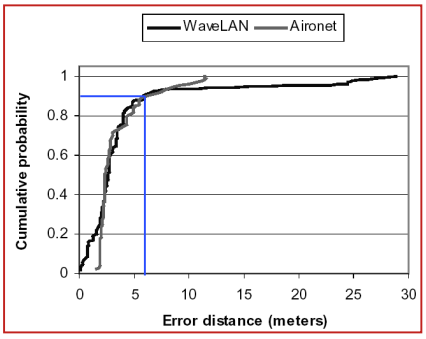
Normal RADAR accuracy



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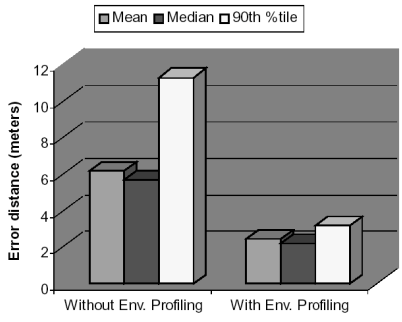
Enhanced RADAR Accuracy



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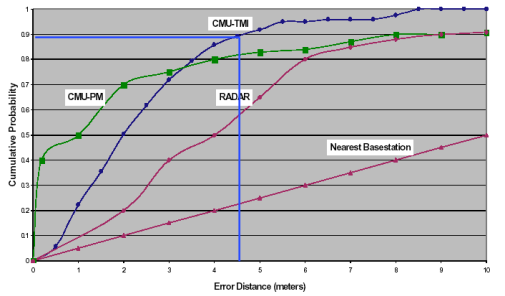
CMU TMI



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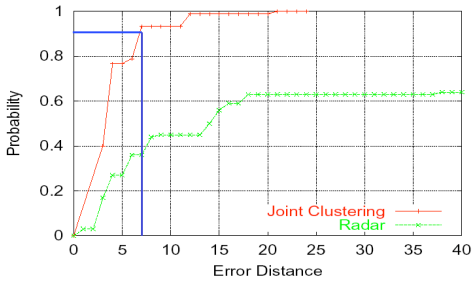
UMD Joint/Bayesian



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Sampling + Scene Analysis

- Pro: little added infrastructure
- Con: sampling
- Open issues:
  - AP density, placement
    - "auto sampling"?
  - Sampling density
  - Scene changes over time
  - Area/volume analysis vs. point analysis
  - Is 3-4m accuracy really the best possible?

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Add-hoc Approaches

- Ad-hoc positioning (APS)
  - Estimate range to landmarks using hop count or distance summaries
- Convex Hull Estimation
  - Constrain positions using systems of equations, use optimization to solve
- Point-in-Triangle
  - Node located in an enclosing triangle test, repeat to reduce location
- Multi-Dimensional Scaling
  - Map high dimension to low dimensional space

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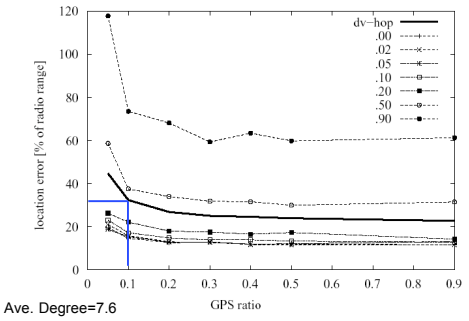
APS



Ave. Degree=7.6

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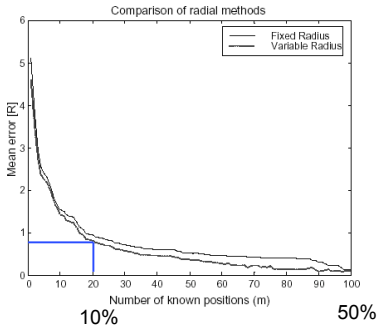
Convex Hull



10%

50%

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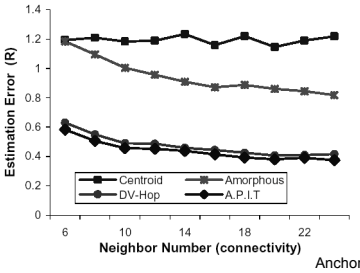
Approximate Point-in-Triangle



Anchor Percentage < 2%

B.DOI=0.2, ANR = 10, AH=16, Uniform

$AP=AH/(AH+ND*ANR^2)$.

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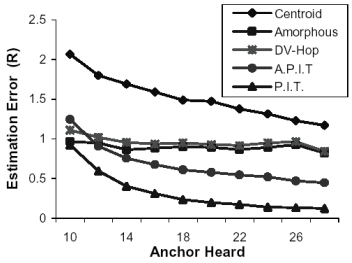
APIT (cont)



C. AH=10~28, DOI=0, ANR = 10, ND = 8, Random

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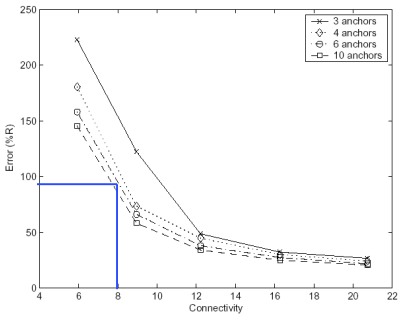
MDS: Connectivity only



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Ah-Hoc Summary

- Wide variation in approaches
- Not clear there is a “winner”
  - 40% of radio range good estimate
  - better possible with lots of excess resources, perfect information
- APS: simple, distributed, many messages
- Others: Centralized, complex

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