

University Defence Research Centre (UDRC) In Signal Processing

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[O05] Cooperative Localisation: Distributed Optimisation with Hypothesis Testing

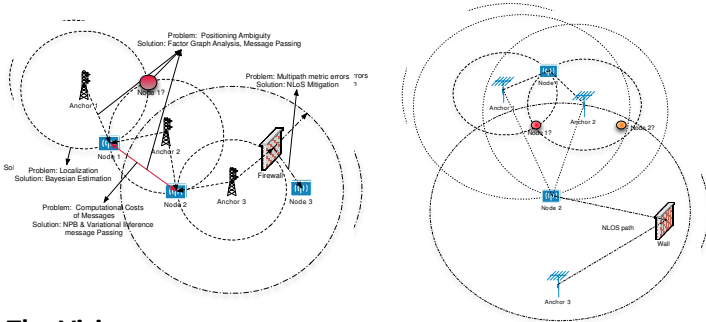
Theme: Detection Localisation and Tracking

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Project Objectives

- To devise **high-resolution localisation** algorithms by
 - Using **cooperation** to mitigate multipath fading and interference and help identify the LoS in the presence of delay paths
 - Exchanging information from one to another to remove ambiguity
 - Using **machine learning** techniques for LoS detection



The Vision

Our Objective: is to provide localisation which is required to be:

- Dynamic/intelligent
- High-resolution
- Distributed
- Robust (to uncertainty)
- Of affordable complexity

Current approaches: Do not consider very high noise, or unevenly distributed anchors.

Technical Work

- A Bayesian Framework is developed to solve the problem
- Current approach considers a 3D environment with high multipath noise and NLoS communication between nodes.

How it Works

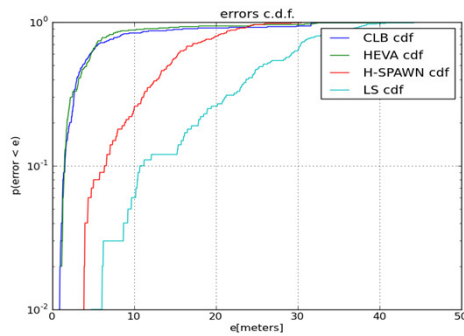
- Nodes share their localization pdf.
- Nodes measure distances between them.
- Nodes filter unusefull shared information
- Nodes self-localize on the MAP position estimate based on shared information and measurements taken

Novelty: Hybrid method, combining multiple techniques in order to achieve near optimal results even in high noise scenario.

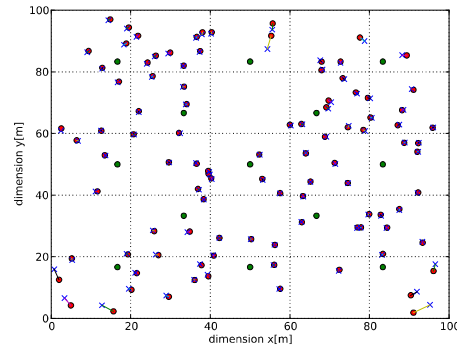
Summary

Hybrid Ellipsoid Variational Algorithm (HEVA) developed using:

- Cooperation using Message Passing.
- Non Parametric Belief Propagation
- Variational Bayes
- NLoS selective information filtering



CDF of Localization Error, comparison between various methods. HEVA closely follows the Cramer Lower Bound



Localization of a 100 nodes in a 100m² grid. Only xy axis shown for clarity.

Exploitation & military relevance

- Localisation in GPS denied environments
 - Indoors
 - Urban canyons
 - Caves
 - Etc.
- Search and Rescue Missions
- Movement Coordination and Logistics



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