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Optimization of Wireless Locating in Complex Environments by Placement of Anchor Nodes With Evolutionary Algorithms

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Task: Radio locating in complex environments

Goal: Tracking of mobile entities on ship's decks

- Personell
- Buoys, containers, anchor weights

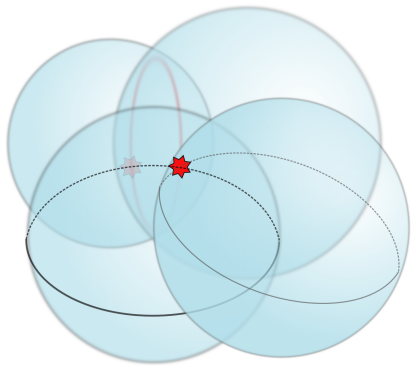
Toolkit: Wireless sensor network

1. Fixed position anchors nodes
2. Self-locating mobile sensor nodes
3. Gateway node to plant network

Challenge: Keep up the precision

Locating with multilateration

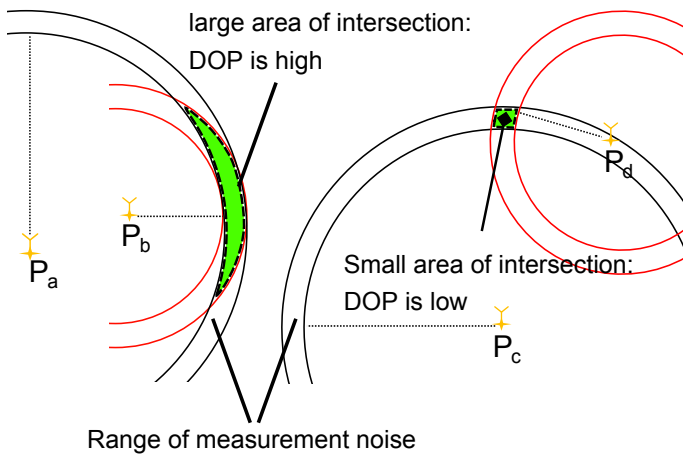
1. Distances measurements to known fixed anchor points
2. Estimation of own position in space



Multilateration

Several sources of systematic errors

- Measurement noise
- Dillution of Precision (DOP)
- Non line of sight measurements because of obstacles (NLOS)



Dillution of Precision

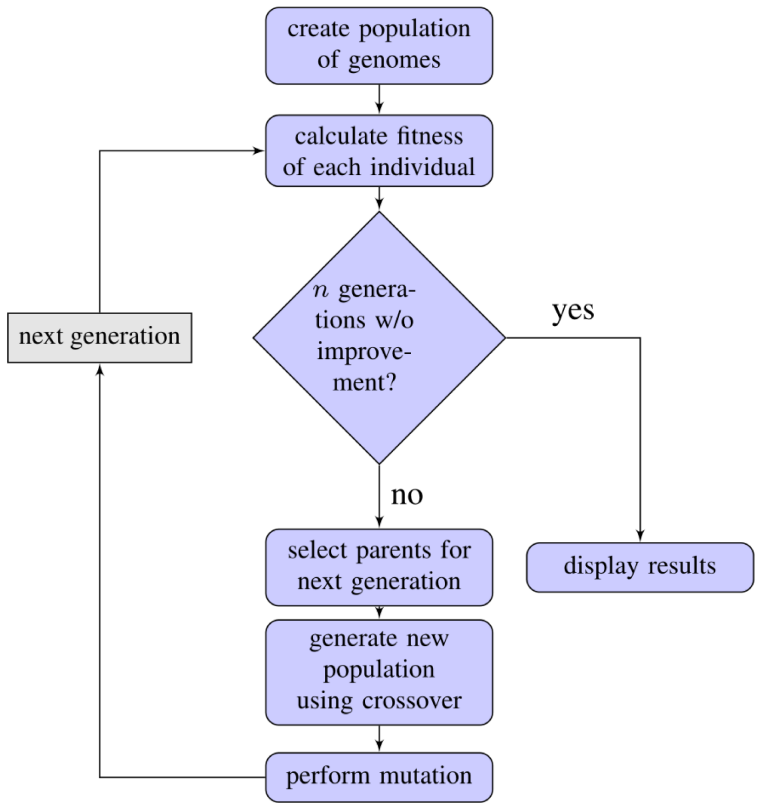
Solution : Evolutionary Algortihm

Qualtiy of solutions is easy to asses

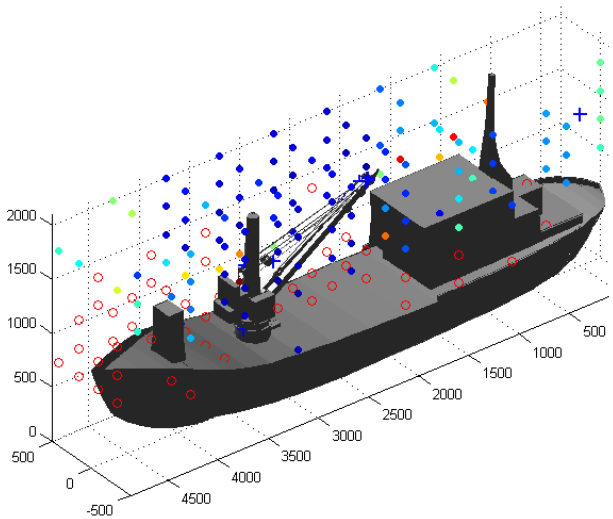
- Geometry: Low DOP-Values are good
- Visibility: At least four anchors required, more are better
- Cost: The fewer anchors used, the better

Good solutions are difficult to generate ad hoc

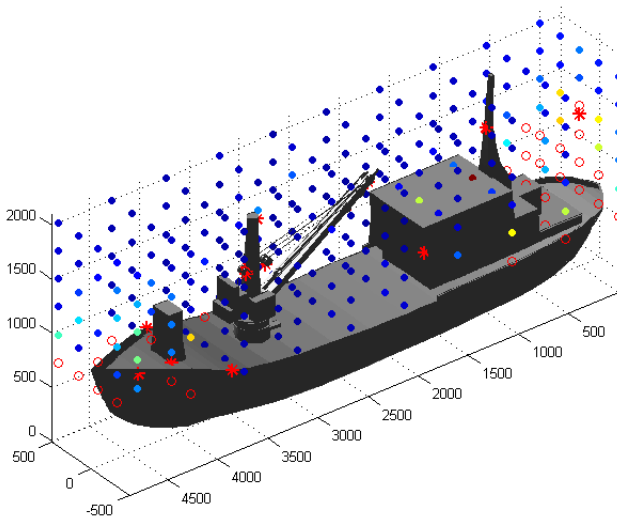
- Let the computer search!
- Employ biological principle of evolutionary optimization



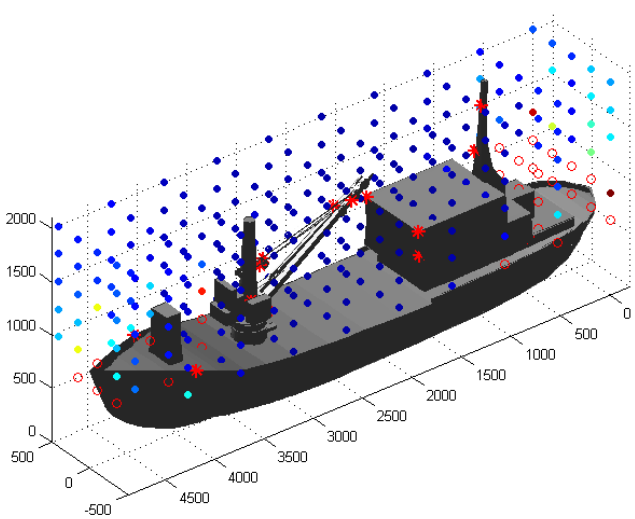
Results of optimization over 50 Generations



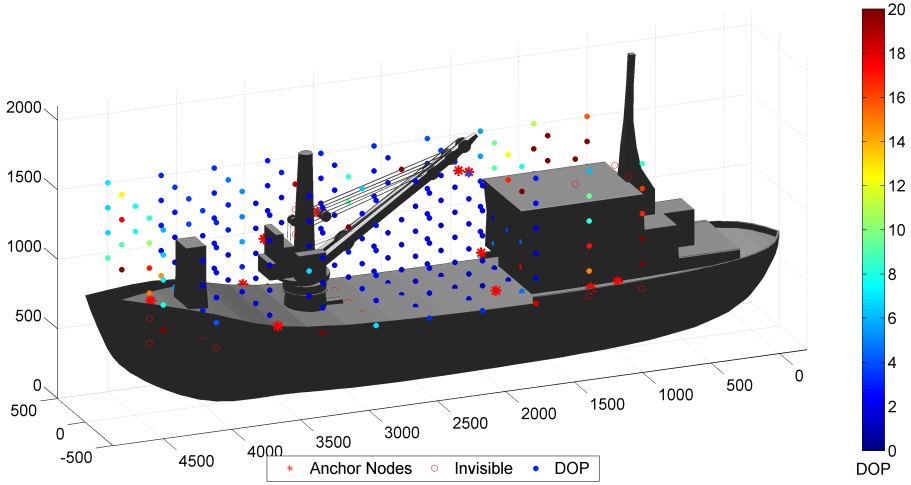
(a) Generation 1



(b) Generation 5



(c) Generation 47



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