Motivation

- Large "effective apertures" can be synthesized using multiple, loosely coordinated and synchronized arrays.
- Capturing information using steerable antenna arrays from multiple perspectives can be exploited to improve localization accuracy & resolution.

Objective: Distributed imaging with multiple large aperture radar arrays for sensing & perception systems.

Challenges

1. Grating Lobes: Aliasing effect arises due to under-sampling in the spatial domain.
2. Complications in fusion of information from distributed sensors, e.g., target association.
3. Interference between multiple platforms.

Our Approach

- Design large baseline array to form sharp directional beams for tracking.
- Develop spatiotemporal signaling schemes and estimation algorithms for multiple steerable antenna arrays.
- Joint localization and imaging with multiple platforms.

Objective: Bayesian techniques for joint localization and imaging using multiple platforms.

Large Effective Aperture Design

- Designing large aperture radar arrays.
- Large "effective apertures" can be synthesized using multiple, loosely coordinated and synchronized arrays.
- Capturing information using steerable antenna arrays from multiple perspectives can be exploited to improve localization accuracy & resolution.

Objective: Distributed imaging with multiple large aperture radar arrays for sensing & perception systems.

Applications

- Situational awareness for cars:
  - Radar sensors mounted on front, back, side of car.
  - Inference engine fuses sensor data for high resolution mapping of vehicle's surrounding.

- Coordinated radar imaging using drones:
  - Each drone is equipped with multiple arrays.
  - Drones share information for navigation, imaging.

Multiple target Localization

Estimation Theoretic Analysis

- System modeled as linear sensor array to evaluate localization accuracy.
- Super-resolution algorithms achieve localization accuracy close to CRLB.
- Link budget and CRLB analysis provides Coverage area of radar array.

Target Association Problem

- Potential target locations (phantoms) are extracted from super-resolved range, doppler estimates. Phantoms consist of both true & ghost targets.
- True targets separation using prune & refine method:
  - Pruning: Less likely phantoms are discarded based on their likelihood.
  - Refinement: Remaining phantoms are refined using Gauss Newton algorithm.

Publications


Future Work

- Bayesian techniques for joint localization and imaging using multiple platforms.
- Design spatiotemporal waveforms for interference mitigation between platforms.
- Compressive information acquisition.

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