Dynamic Automatic Calibration of Coherent Radar UAV Swarm Arrays

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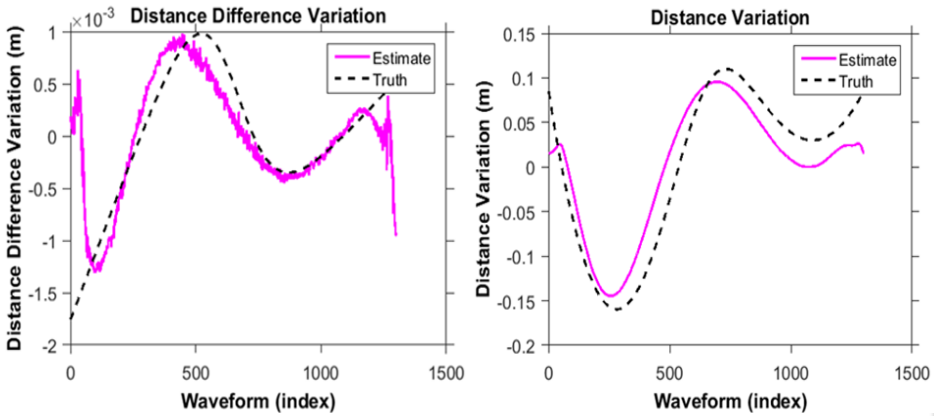

Results of estimating the distance difference variation (left panel) and the distance variation (right panel). These methods are based upon phase estimation methods which offer to generate the required sub-wavelength estimates of the distances between given radar UAV and that of other UAVs within the swarm array.

Proposed Methodology

- The proposed paradigm envisions a scenario in which each UAV radar collects skin returns from the other UAVs of the swarm in order to extract range profiles which include all of the UAVs of the swarm.
- It is possible to resolve multiple target tracking ambiguities by equipping each UAV with a GPS receiver, but resulting UAV locations are not sufficient in using the swarm as one large coherent radar array.
- Automatic phase estimation methods will be adapted to correct for the atmospherically induced and dynamically changing bias errors in the range profiles collected by each swarm UAV.
- Then, the bias-compensated range profiles can be used to solve to yield precisely accurate positions of each of the UAV platforms required for the coherent radar array to perform its various critical DoD missions.

Background and Deliverables

- Background:
  - There exist errors in the platform position due to atmospheric turbulence along the path of the radar's trajectory of a synthetic aperture array.
  - Recent research by the PI has revealed that phase-based distance estimation methods can be applied to the radar return data.
  - The proposed work offers to apply similar distance estimation and compensation techniques to the problem of calibrating a swarm array.
- Deliverables:
  - Final report containing a description of the resulting techniques for generating and maintaining a dynamically calibrated array of UAVs.
  - Source files for important engineering codes can be included as well.

Objectives

- The objective of this proposed work effort is to develop the mathematical techniques and signal processing necessary to enable a swarm of UAVs that are configured with active radar payloads to be able to perform dynamic automatic calibration in order to obtain a coherent radar array.
- The primary impediment in maintaining a coherent radar array of swarm UAVs is the locally-varying atmospheric turbulence which is expected to induce statistical fluctuations in the true ephemeris position of each individual UAV radar platform.
- The functionality of a coherent radar array requires that these independent UAV ephemeris fluctuations to be estimated accurately so that resulting calibration errors can be removed.

NPS

FY19 Call for Proposals

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