Rotary-Wing UAS for Evaporation Duct Measurements Using mini-Dropsondes

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Consortium for Robotics and Unmanned Systems Education and Research

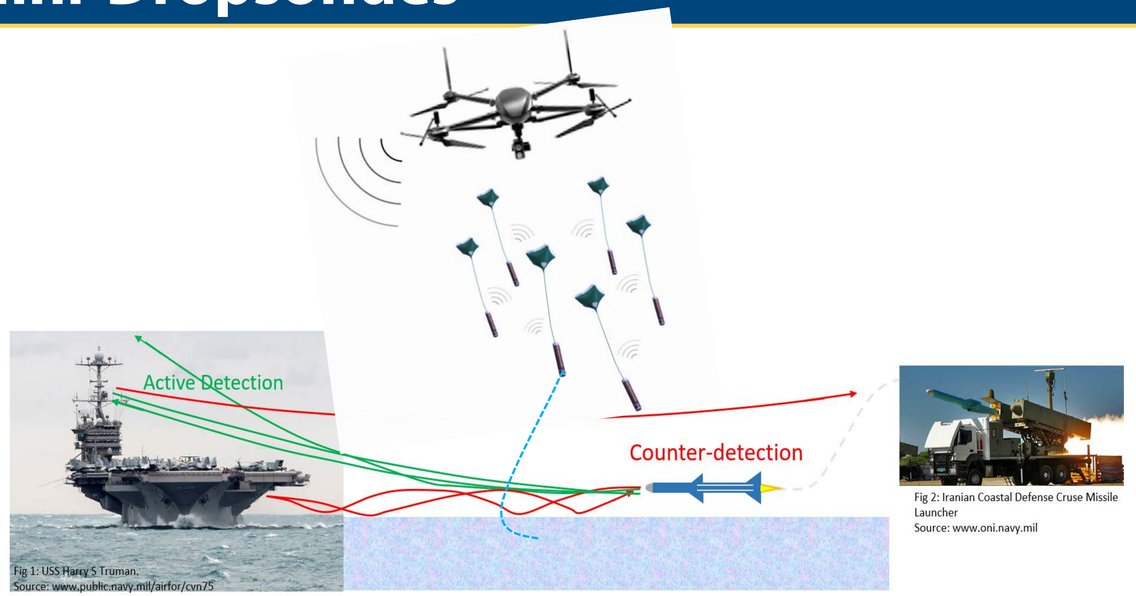

Fig 1: USS Harry S Truman.
Source: www.public.navy.mil/airfor/cvn75

Fig 2: Iranian Coastal Defense Cruse Missile Launcher
Source: www.oni.navy.mil

Illustration of radar detection and counter-detection geometry in the near-surface levels and the concept of UAS dropped mini-dropsondes to characterize the surface layer refractive conditions. The blue dash line shows the modified refractivity profile from the swarm of sensor packages deployed from the UAS.

Approach

- Explore the concept of using UAS for evaporation duct measurements in minimally disturbed environment
- Develop a sensor and data acquisition package that adequately responds to and is sensitive enough to the vertical variation of the temperature and humidity providing vertical gradients of the refractivity
- Develop sensor release mechanisms for deploying mini-Dropsondes from small UAS copters as a demonstration of capability for future use on the fleet with tactical UAS
- Adopt existing data telemetry techniques to transmit data from a swarm of simultaneously deployed mini-dropsondes to shipboard receiver in real time
- Test the mini-Dropsonde measurements and UAS release mechanisms overland and at-sea that will provide datasets for analysis and identifying potential issues and seeking for methods of correction
- Close collaboration with researcher in NRL-DC is planned to leverage their effort in sUAS meteorological sensing.

Deliverables

- Prototype of bio-degradable mini-Dropsonde with functional meteorological sensors
- Well-tested release mechanism system deployed on sUAS
- Data acquisition system and software for meteorological data retrieval
- Test dataset to characterize the performance of mini-Dropsonde sensors in regions of strong temperature and water vapor gradients
- M.S. thesis documenting sensor development, testing, field deployment, and results from data analyses.

Motivation and Objectives

- Evaporation ducts occur about 95% of the time over the ocean. They significantly impact naval operation near the surface such as radar detection of the anti-ship cruise missiles (ASCMs). The evaporation ducts are very difficult to model correctly using the current naval operational models. Large amount of data are needed to improve these models
- Ship-based measurements are inadequate for quantifying evaporation ducts because of the flow distortion and thermal effects of the ship. Measurements on the sUAS are also not ideal because the downwash from the UAS will introduce strong dynamic disturbance to the near-surface layer
- Our objective is thus to develop and deploy high a swarm of quality mini-dropsondes from a sUAS system to quantify evaporation ducts with sufficient statistics and in minimally disturbed marine atmospheric surface layer.

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FY20 Call for Proposals

Qing Wang
Meteorology Department
qwang@nps.edu; (831) 656-7716

Ryan Yamaguchi
Meteorology Department
ryamaguc@nps.edu; (831) 656-7645