Department of the Navy SBIR/STTR Transition Program

Distribution Statement A: Approved for public release, distribution is unlimited.
NAVAIR 2016-763

Topic # N141-003
Innovative Signal Processing Techniques for Mitigation of Wind Turbine Farm Interference in Airborne Radar Systems
Upstate Scientific

WHO

SYSCOM: NAVAIR

Sponsoring Program:

Transition Target: The Wind-farm Airborne Radar Processor (WARP) being developed in this project can be used as a part of the U.S. Navy's Airborne Early Warning Radar System.

TPOC:
(301)342-2277

Other transition opportunities: The WARP's algorithms and architecture address the more general problem of threat target detection in very difficult Anti-Acess/Aerial Denial (A2/AD) environments complicated by the presence of multiple obscuring signals, including dense civilian targets, electromagnetic interference/comms, and heterogeneous terrain, especially over littoral zone environments.

(Image Courtesy of the U.S. Navy: 150428-N-GR120-285, April 28, 2015, Mass Communication Specialist Seaman Anna Van Nuys/Released)

Notes: The WARP will be implemented on a High Performance Computing (HPC) platform that can easily be integrated into an existing radar system.

WHAT

Operational Need and Improvement: The number of wind-farms generating electrical power is increasing rapidly both within the United States and abroad. These systems are comprised of multiple wind turbines with rotating blades reaching heights of 500 feet. These turbine blades exhibit large reflectivity (radar cross section), and often occupy portions of the spatial domain and Doppler spectrum that airborne radar systems have to operate within, in order to detect and track mission critical targets. The U.S. Navy has a need to mitigate these adverse effects on their airborne radar systems.

Specifications Required: Develop innovative signal processing techniques for the mitigation of adverse effects on airborne radar systems resulting from the interference caused by the large radar cross section of a wind turbine combined with the Doppler frequency shift produced by its rotating blades which impacts the ability of a radar system to differentiate a wind turbine from an aircraft.

Technology Developed: Upstate Scientific is developing technology that will make it possible to significantly reduce the clutter produced by radar returns from wind turbines. The Wind-farm Airborne Radar Processor (WARP) is a multi-layered approach to unobtrusively mitigate the clutter returns from wind-farms. The WARP's unobtrusive nature is a result of its innovative signal processing technique that can operate transparently to the current fielded radar system. All that the WARP requires is existing digital I & Q data that can be tapped off from the radar, as well as outputs from the radar's track processor. Once the clutter has been reduced and desired targets are detected the information is injected back into the radar's data processing chain. The entire WARP's "technology insertion" can be implemented on a High Performance Computing (HPC) platform, in such a way as to be minimally intrusive to an existing radar system.

Warfighter Value: The WARP's algorithms and architecture isolate, separate, track, and suppress strong interfering returns from radar clutter, including stationary movers (wind turbines), that would otherwise obscure the weak radar reflections from modern threat targets that are essential for detection, track, identification and engagement. These capabilities enhance mission performance.

WHEN

Contract Number: N68335-16-C-0075 **Ending on:** December 7, 2018

Milestone	Risk Level	Measure of Success	Ending TRL	Date
Exercised key algorithms of the WARP using wind-farm simulation data	N/A	Sim Target Detected	4	July 2014
Integrate ANSYS HFSS modeling of E2D aircraft and antenna into simulated data	Low	Sim Target Detected	4	November 2016
WARP Simulation Implementation in MATLAB	Med	Sim Target Detected	5	December 2017
WARP implementation on a High Performance Computing platform	Med	Sim Target Detected	5	December 2018
Gather radar data in the vicinity of a wind-farm	High	Detect Target (Measured)	6	September 2017

HOW

Projected Business Model: Upstate Scientific brings a system of systems approach to the integration of our products with other existing and planned military and commercial systems. We develop advanced RF systems (radar, communications, passive sensors, etc.). We transition RF technology (T/R devices, antennas, waveforms, signal processing algorithms, processors) from concept and theory to system integration and production. Validation of system and subsystem performance is accomplished through laboratory measurements, field experiments and system demonstrations. Our systems address military missions, homeland security operations and commercial applications. Our approach focuses on:

- Performance in realistic environments (interference, clutter and countermeasures),
- Autonomous operation to minimize personnel required,
- Cost-effective automated production.

Our integrated approach considers all of these factors from cradle to grave.

Company Objectives: Upstate Scientific would like to meet with both prime and subcontractors as well as acquisition groups that would benefit from our clutter reduction techniques embedded in the WARP processor's innovative multi-layer architecture. In addition, Upstate Scientific is seeking additional funding to perform data collection exercises to expedite the movement of our clutter mitigation technology from Technology Readiness Level (TRL) 5 to TRL 7.

Potential Commercial Applications: There is a high potential for private sector use of the algorithms and architecture developed under this topic. Primary candidates for dual use of wind turbine farm mitigation technology are air traffic control and weather radar systems that must contend with the issue of interference resulting from the presence of wind turbines.

Contact: Dr. Vincent J. Amuso Sr., Chief Scientist
amuso@upstatescientific.com (585) 506-2405