Department of the Navy SBIR/STTR Transition Program

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Topic # N161-054

Passive Characterization of the Refractivity Environment and Temperature and Water Vapor Vertical Distributions Afloat

Dakota Ridge R & D

WHO

SYSCOM: ONR

Sponsoring Program: Division 322 Ocean, Atmosphere and Space Research Division

Transition Target: Real-Time Spectrum Operations (RTSO), PEO-IWS1, PEO-IWS2, PEO-IWS5

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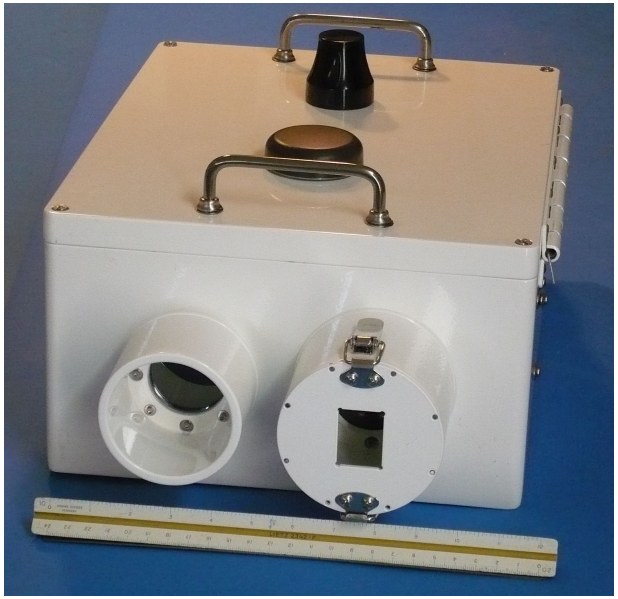
Other transition opportunities: Electromagnetic Warfare Battlespace Management, Future Me, Mk 20 Electro-Optical Sensor System, Maritime EMW Environmental Sensing. Battle scene weather, air operations, domestic atmospheric profiling for weather nowcasting, forecasting, trending, numeric weather models input

Notes: Pictured at right is the prototype passive autonomous low SWAP-C, <1 cu.ft. high-fidelity meteorological Temperature, relative humidity, and refractivity profiler 12 x 7 x 15 inches, 15 kg, 30 watts, No emissions, impervious to RFI.



WHAT

Operational Need and Improvement: The Navy seeks methods to characterize and predict the performance of radar, electronic warfare, laser, and communicators systems. Current present weather and forecast conditions and refractivity and electromagnetic/electro-optical (EM/EO) ducting characterizations afloat are obtained through numeric weather modeling, radiosondes, and RADAR sea clutter return. This passive long-wave infrared (LWIR) system being developed provides higher skill and performance battlespace EM/EO characterization and management. It also provides rapid sequence temperature, water vapor, and refractivity vertical profiles for weather.

Specifications Required: Very rapid (1 second) cycle time. Information is inverted mathematically into high vertical resolution tropospheric structure of temperature, relative humidity (RH), and refractivity to 10 km. The profile information obtained can be utilized to model the refractivity environment and evaporation duct in all EM wavebands, from low-frequency radio through ultraviolet. Simple implementation, Ethernet connection outputting Navy-defined results and for control, can be mounted on deck or superstructure. Hermetic and very low simple maintenance, low cost, compact, no expendables. Self-calibrating.

Technology Developed: Passive characterization of refractive effects upon visible, IR, and radio/RADAR electromagnetic propagation through passive relatively inexpensive IR camera observations is enabled with the apparatus and methods being developed. Passive remote sensing of profiles, structure, and gradients of refractivity, temperature, and water vapor in the troposphere are obtained through high thermal resolution and accuracy images of the atmosphere from the horizon upward. The methodology proposed herein is a new approach and utilizes heretofore unused infrared camera observations to obtain said tropospheric structures. The system augments or replaces existing active systems.

Warfighter Value: Atmospheric turbulence can distort and diminish the sensitivity of measurements of electromagnetic (EM) and Electro-Optic (EO) sensors. The Surface Navy has an interest in predicting EM and EO propagation and visibility from surface ships to support the prediction of radar, electronic warfare, laser, and communications systems performance. This passive IR imaging system produces the measurement of atmospheric profiles of temperature, water vapor, and refractivity. All three of these parameters affect EM/EO propagation. The temperature and relative humidity profiles serve weather nowcasting, forecasting, and trending, and also enable calculation of refractivity profiles in all wavebands.

WHEN

Contract Number: N68335-18-C-0261 **Ending on:** May 7, 2020

Milestone	Risk Level	Measure of Success	Ending TRL	Date
Phase I contract completed	Low	Modeling and design accomplished	TRL 3	2nd QTR FY17
Oceanic sea trials on R/V Sally Ride	Low	Successful sea trials	TRL 5	1st QTR FY18
Phase I Option completed	Low	SOW successfully completed	TRL 6	1st QTR FY18
Phase II contract	Low		TRL 6	3rd QTR FY18
Phase II contract 1 year of 2 year contract	Low	partial completion of SOW	TRL 6	3rd QTR FY19
End Phase II, begin phase II Option if exercised	Low	Demonstrated performance in representative environment	TRL7 after Option	TBD

HOW

Projected Business Model: Dakota Ridge intends to bring the system to a marine worthy high TRL level while partnering with an Aerospace or Defense Contractor to oversee the design and fabrication and user interface late in the contract effort. This is to facilitate and streamline possible procurement. Dakota Ridge will produce a limited number of units for performance evaluation and field trials. The intent is to enter into technology and patent and other rights agreement with the Contractor to manufacture and deliver to the Navy and possibly other elements of the DoD. Dakota Ridge will enter into a transition consulting agreement with the Contractor to convey overall knowledge. Conversations have begun with Ball Aerospace and Lockheed Martin. The system will provide a simple, yet comprehensive, graphical user interface (GUI) for the low-skill user.

Company Objectives: Dakota Ridge will retain commercial rights to manufacture and market a non-Navy model for the commercial and government markets in meteorological measurements for weather nowcasting and forecasting. In 25 years as a principal in Radiometrics Corporation, PI has designed, patented, produced, and manufactured over $30 million in passive microwave tropospheric profilers and knows the markets and customers. Field trials and demonstration are planned in Phase II. Commercial production is relatively simple. A work force of 10 can produce over 60 units/year.

Potential Commercial Applications: This system provides rapid (<1 second cycle time) passive autonomous remote sensing of the tropospheric thermodynamic parameters (T and RH) for meteorology, weather research, nowcasting and forecasting, for air quality (pollutant trapping and transport and scouring), wind energy (theta-E for air flow laminarity), aviation weather. It can also measure true sea surface temperature for climate modeling and other applications. Concurrent IR and visible images are captured, as well as surface meteorology. The system can also provide IR surveillance.

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