Opportunity Title: Distributed High Frequency Over-The-Horizon Radar Fellowship
Opportunity Reference Code: ICPD-2024-37

Organization Office of the Director of National Intelligence (ODNI)

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Complete your application – Enter the rest of the information required for the IC Postdoc Program Research Opportunity. The application itself contains detailed instructions for each one of these components: availability, citizenship, transcripts, dissertation abstract, publication and presentation plan, and information about your Research Advisor co-applicant.

Additional information about the IC Postdoctoral Research Fellowship Program is available on the program website located at: https://orise.orau.gov/icpostdoc/index.html.

If you have questions, send an email to ICPostdoc@orau.org. Please include the reference code for this opportunity in your email.

Application Deadline 2/28/2024 6:00:00 PM Eastern Time Zone

Description **Research Topic Description, including Problem Statement:**

Over-The-Horizon (OTH) radars operate in the High Frequency (HF) band (3–30 MHz) and exploit signal reflection from the ionosphere to detect and track airborne and surface targets at ranges an order of magnitude greater than is possible with conventional line-of-sight radars. More than half a century of international research and development in this area has resulted in the fielding of mature OTH radar systems capable of cost-effective early-warning surveillance over wide areas. In particular, the ability of OTH radar to persistently monitor remote geographical regions where microwave radar coverage is not feasible or convenient represents an important advantage of such systems. The high performance achieved by state-of-the-art operational OTH radar systems is the outcome of a great deal of theoretical and experimental research in the areas of ionospheric propagation modelling, hardware system design, intelligent resource management, and digital signal processing. The knowledge gained and shared through joint programs of international collaboration has played a key role in the deployment of successful OTH radar systems worldwide.

Current trends dictate that for several Intelligence Surveillance and Reconnaissance (ISR) applications, the requirement is to push the boundaries on distributed OTH radar. Conventional OTH radar use large transmitter antenna arrays (typically 100-200 meters long) and even larger receiver antenna arrays, extending to many kilometers. The arrays each comprise many antenna elements and evidently a conventional OTH radar cannot be considered to be mobile or easily relocatable. The transmitting and receiving systems are usually located 50 km to 100 km from each other to provide radio frequency (RF) isolation of the transmitter from the receiver. Although a conventional OTH radar is formally a bistatic radar, it can often be considered monostatic at typical detect and track ranges; consequently, a conventional OTH radar transmitter and receiver can only

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measure the speed of a target along the look direction.

The scope of this research topic is to innovate next-generation and generation-after-next distributive OTH radars which would give added performance advantages for ISR applications by providing proposals which could advance theoretical and experimental research in the areas of ionospheric propagation modelling, hardware system design, intelligent resource management, and digital signal processing.

Example Approaches:

Distributed high frequency over-the-horizon radar system. The invention relates to the technical field of radar systems, radio physics, and the like, and, in particular, relates to a distributed high frequency over-the-horizon radar system. The distributed high frequency over-the-horizon radar system comprises a shore-based high frequency ground wave radar netted subsystem, a fixed/mobile ground wave over-the-horizon radar subsystem in other forms (float type, vehicle-mounted and shipboard ground wave radar), a high frequency sky wave emission subsystem, an environment guarantee subsystem, a control subsystem, and a data processing subsystem. The distributed high frequency over-the-horizon radar system can work in a ground wave netted and sky-ground wave hybrid netted mode, by virtue of distributed ground wave radar netted and sky-ground wave integrated netted detection, breaks through the limit that the conventional ground wave radar only can be distributed along coastlines, obtains more comprehensive physical quantity information at the original signal level by organic integration and mutual complementation multiple work modes, can improve accuracy of detection on wind, wave and current to a greater extent, greatly improves detection range of the high frequency radar system, and realizes far-shore ocean dynamics elements detection and near-shore fine detection.

Research Paper - the article raises the problem of fine tuning over-the-horizon radars with relevant information about the parameters of the ionosphere. To improve the accuracy of the radar, it is proposed to create a system of remote positions, which are ionosondes of vertical and inclined sensing. The results of the operation of such ionosondes serve to adjust the global model of the ionosphere. Thus, the quality of the radar is significantly improved, allowing us to more accurately determine the coordinates of air targets.

Relevance to the Intelligence Community:

The knowledge gained and shared through joint programs of international collaboration has played a key role in the deployment of successful OTH radar systems worldwide.

Key Words: HF Radar, Ionosphere, Data Assimilation, Inverse Problems, Signal Processing, Multistatic, Distributed RF, MIMO, Beyond-Line-Of-Sight, Over-The-Horizon Radar, OTH

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Qualifications

Postdoc Eligibility

- U.S. citizens only
- Ph.D. in a relevant field must be completed before beginning the appointment and within five years of the appointment start date
- Proposal must be associated with an accredited U.S. university, college, or U.S. government laboratory
- Eligible candidates may only receive one award from the IC Postdoctoral Research Fellowship Program

Research Advisor Eligibility

- Must be an employee of an accredited U.S. university, college or U.S. government laboratory
- Are not required to be U.S. citizens

Eligibility Requirements

- **Citizenship:** U.S. Citizen Only
- **Degree:** Doctoral Degree.
- **Discipline(s):**
  - **Chemistry and Materials Sciences** (12)
  - **Communications and Graphics Design** (3)
  - **Computer, Information, and Data Sciences** (17)
  - **Earth and Geosciences** (21)
  - **Engineering** (27)
  - **Environmental and Marine Sciences** (14)
  - **Life Health and Medical Sciences** (45)
  - **Mathematics and Statistics** (11)
  - **Other Non-Science & Engineering** (2)
  - **Physics** (16)
  - **Science & Engineering-related** (1)
  - **Social and Behavioral Sciences** (30)