

Opportunity Title: Cognitive Electronic Warfare

Opportunity Reference Code: ICPD-2022-03

Organization Office of the Director of National Intelligence (ODNI)

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How to Apply **Create and release your Profile on Zintellect** – Postdoctoral applicants must create an account and complete a profile in the on-line application system. **Please note: your resume/CV may not exceed 2 pages.**

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 2/28/2022 6:00:00 PM Eastern Time Zone

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

The next generation of radars and jammers have to be able to both reliably and accurately identify and discern different radio frequency (RF) signals and adapt to a complex and contested environment to achieve mission success. The current manual and time intensive process of collecting, cataloguing, identifying, updating the Electronic Warfare Integrated Reprogramming Database (EWIRD), and loading individual platforms with a subset of this incomplete database is insufficient to the task required even today. Electronic warfare has to be cognitively adaptive to its environment; capable of instantaneously collecting, identifying, and prioritizing threat signals, and then adapting its own output to survive and conduct its mission.

Example Approaches:

The idea of a cognitive radar was first introduced by S. Haykin in 2006 and was defined as a closed loop system composed of a transmitter, the environment, and receiver. In nature, such a system has evolved in bat's echolocation and dolphin's sonar locating ability to adjust the duration and repetition frequency of their own pulse burst emissions. Progress towards cognitive adaptation has also been made in both passive and active radar technology, and jammers (Georgia Tech's "Angry Kitten" program). Cognitive electronic warfare sensors must embody four characteristics:

- Adaptivity: it must tolerate unpredictability and learn as



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information changes. It must also be able to adjust capabilities and its own wave form transmissions as goals and requirements evolve.

- Mindful: it must “remember” previous experiences and interactions.
- Contextual: it must understand, identify, and extract contextual elements, drawing upon multiple sources of information, such as a preprogrammed environmental database and real time received input.
- Intelligent: it must possess a decision-making mechanism, exploiting the closed loop feedback between transmitter and receiver.

Each of these characteristics are potential areas for fruitful research. Especially challenging problem areas related to the above characteristics include the ability to produce in real-time reconfigurable circuits and wave forms appropriate to the environment (adaptivity, intelligent); dynamic spectrum reallocation for transmitting (intelligent); signal processing algorithm optimization for real-time radar channel estimation differentiating between clutter, interference, and targets (mindful, contextual); machine learning for radio frequency pattern recognition (mindful, contextual); and a scheduler that can optimize energy and processing resources (adaptivity, contextual, intelligent). These are just some of the higher order challenges to advancing this technology.

Relevance to the Intelligence Community:

Intelligence Mission Data is defined as providing essential data to build system models, develop algorithms, optimize sensor design, conduct system testing and evaluation, and validate sensor functionality in intelligence data dependent weapon systems, according to the Defense Acquisition University. Currently, this is a manual, error prone, and man-hour, time intensive process. Developing cognitive electronic weapon jammers and radars that can autonomously and on-mission sense and adapt to their environments would significantly reduce resources dedicated to this mission, increase data fidelity against a rapidly expanding information set, and greatly enhance mission performance and success.

Key Words: Radar; Jamming; Intelligence Mission Data; IMD; Passive Radar; Active Radar; Cognitive Radar; Cognitive Jamming; Machine Learning; Electronic Warfare; Electromagnetic Spectrum

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 application deadline
- Proposal must be associated with an accredited U.S. university, college, or

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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.
- **Academic Level(s):** Postdoctoral.
- **Discipline(s):**
 - **Chemistry and Materials Sciences** (12 )
 - **Communications and Graphics Design** (2 )
 - **Computer, Information, and Data Sciences** (16 )
 - **Earth and Geosciences** (21 )
 - **Engineering** (27 )
 - **Environmental and Marine Sciences** (14 )
 - **Life Health and Medical Sciences** (45 )
 - **Mathematics and Statistics** (10 )
 - **Other Non-Science & Engineering** (2 )
 - **Physics** (16 )
 - **Science & Engineering-related** (1 )
 - **Social and Behavioral Sciences** (27 )