

**Opportunity Title:** Nontraditional Distributed Aperture Coherent

Imaging/Sensing

**Opportunity Reference Code:** ICPD-2021-02



**Organization** Office of the Director of National Intelligence (ODNI)

**Reference Code** ICPD-2021-02

**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](mailto:ICPostdoc@orau.org). Please include the reference code for this opportunity in your email.

**Application Deadline** 2/26/2021 6:00:00 PM Eastern Time Zone

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

Coherent aperture synthesis has been used in imaging techniques such as Synthetic Aperture Radar (SAR) and digital holography for more than 40 years and is frequently employed in both the Air and Space domains. Additionally, many algorithms and techniques exist which incorporate sensor data composed of overlapping/redundant information in order to render an improved image or extract additional useful information about the target. As a shift toward having numerous, independent/distributed sensors present over the same region of interest occurs, it is incumbent upon us to understand how best to exploit all data collected over many possibly sparse, nonuniformly distributed sensors having different look angles and distances relative to the target region. This topic supports efforts which seek to explore and understand novel methods for coherent field data combination/exploitation and contextualizes these methods in terms of the fundamental physics (wave-optics), statistics, and/or information theory. The ideal end state is the development of techniques and their associated mathematical framework which appreciate the fundamental limitations of combining coherent field data as a function of some or all of the aforementioned free parameters, e.g. nonuniform sensor distribution, sparsity, variable/random look angles, and varying distances to the target. Which sensor geometries result in the most information gain in the combined data? What effects do sparsity and nonuniformity of sensor placement have on the end result? What other meaningful data can we extract from regions with insufficient data to form a useful image?

**Example Approaches:**

Potential approaches/problems:

- Framework for distributed sensors at a number of discrete altitudes—space-based + mid/high altitude + ground-adjacent sensors with common laser illuminator.
- Random ground-adjacent sensor swarms with overhead/off-angle laser illumination.
- Sparsely distributed satellite constellations.
- 3D-360 target imaging using distributed coherent lidar systems.

**Relevance to the Intelligence Community:**

The Intelligence Community relies on overhead and airborne assets to image/sense remote targets. Leveraging multiple distributed imaging/sensor systems simultaneously to accomplish a common imaging/sensing goal would enable cheaper imaging asset networks through economies of scale and decrease mission impact in the event of asset loss/destruction. The development of low-cost, distributed imaging systems also will enable rapid off-the-shelf capability deployment of additional assets in contingency scenarios where existing assets have either been rendered nonfunctional or do not have ample time to support all mission requirements. Moreover, being able to improve existing assets through the deployment of augmentee sensors would enable enhanced resolution, field-of-view, signal to noise ratio (SNR), and target detection, as well as potentially extending the lifecycle of outdated overhead assets which lack necessary system specifications to complete certain missions.

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**Key Words:** Aperture Synthesis, Digital Holography, 3D Imaging, Coherent LIDAR, Riemannian Geometry, Range Imaging, Bayesian Estimation, Swarm Imaging, Small Satellite Constellations, Multistatic Sensors, Distributed Apertures, Inferential Data Exploitation, Cramer-Rao Analysis, Distributed/Conformal Apertures, Multiple View Geometry, Wave Optics

## 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 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):**
  - **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-S&E** (2 )
  - **Other Physical Sciences** (12 )
  - **Other S&E-Related** (1 )
  - **Physics** (16 )
  - **Social and Behavioral Sciences** (27 )