Opportunity Title: Construction/Evaluation of a compressive imaging system from an Indium Gallium Arsenide photo sensor
Opportunity Reference Code: ICPD-2019-16

Organization Office of the Director of National Intelligence (ODNI)

Reference Code ICPD-2019-16

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 3/1/2019 6:00:00 PM Eastern Time Zone

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

- Compressive sensing is a signal processing technique that uses the expected sparsity of a signal in a certain basis to capture and reconstruct the information using fewer samples than that of the Nyquist rate. This method, however, can only be used when all of the data is available to be sampled and the basis functions projected in a given moment. Thus, compressive sensing lends itself to spatially or spectrally spread data, such as two-dimensional (2D) imaging applications, antenna arrays, or even multi-view through-the-wall radar reconstructions. Techniques have been proposed to use it for temporal signal data, using high-speed shifting cascaded digitizers, but the value of that approach is dubious. For imaging, the act of projecting the data on a basis function is done by simply applying a dynamic image mask in the system optics (using a micro-mirror array or filtering Liquid Crystal Display, LCD, matrix), and a single photosensor to integrate the resulting total light intensity. The use of a single photosensor can be a significant cost advantage, with or without compressive sensing, versus a matrix of high quality photosensors. Compressive sensing theory is currently being explored and evaluated as a means to enable various different measurement systems. The specific problem to be addressed here is the construction of a single pixel compressive imaging system using a single InGaAs photosensor designed to be as practical as possible, and the evaluation of the practicality for using the resulting system. The LCD image mask should be integrated into the photosensor such that the system only needs a single lens. Supporting the system, the optimal basis functions should be investigated such that real images are maximally sparse and compressibility is maximized. Also, compressive reconstruction of images should be improved to mitigate high frequency noise when solutions are not sparse. Also, reconstruction algorithms should be optimized for speed, and computer-identifiable indicators of image quality should be used to determine when a solution is acceptable. Beyond the imaging system, the practical value of using compressive sensing to improve the methods of other applications such as antenna arrays, through-the-wall radar, and quantum photon entanglement imaging should also be evaluated.

Example Approaches:

Opportunity Title: Construction/Evaluation of a compressive imaging system from an Indium Gallium Arsenide photo sensor
Opportunity Reference Code: ICPD-2019-16

- Construct a single pixel monochromic imaging system with compressive sensing and a single high quality InGaAs photosensor, including all hardware, optimized software algorithms, and optimal basis functions. The system should be constructed as small as possible, and as self-contained as possible, integrating the LCD filter with the photosensor and using only a single focusing lens.
- Research optimal basis functions for different types of real data (images of different types, non-uniform baseline antenna array data, modern urban frequency spectra and so forth.).
- Evaluate, both experimentally and theoretically, all practical considerations of the use of the imaging system, such as sensor noise tolerance, system size for different dynamic mask types, optimal dynamic masks performance, temporal tolerance and sampling rate for imaging objects in motion, processing time and power and so on.
- Evaluate the use of compressive sensing in the practical implementation of other proposed applications, such as through-the-wall radar imaging, antenna arrays, and quantum photon entanglement measurements.

Key Words:

Compressive sensing; sensing; photosensing; single-pixel imaging; through-the-wall radar; antenna arrays

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):**
  - **Chemistry and Materials Sciences** (12 👁)
  - **Communications and Graphics Design** (6 👁)
  - **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** (5 👁)
  - **Physics** (16 👁)
  - **Science & Engineering-related** (1 👁)

Opportunity Title: Construction/Evaluation of a compressive imaging system from an Indium Gallium Arsenide photo sensor
Opportunity Reference Code: ICPD-2019-16

- **Social and Behavioral Sciences** (28 👁)