Opportunity Title: Fundamentals of Wave-Front Sensing: Design and Implementation
Opportunity Reference Code: ICPD-2020-19

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 2/28/2020 6:00:00 PM Eastern Time Zone

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

A wave-front sensor is a device for measuring the aberrations of an optical wave-front. To visualize the optical wave-front, first picture the ripples expanding from a disturbance on the surface of water. The contours of constant height define the "wave-front" of the ripples. Similarly, for the electromagnetic waves from a light source we can imagine surfaces of constant phase at a moment in time as the wave-front. If there is a perturbation on the surface of the water, say a floating twig, the ripples will become distorted. Just as with ripples, the optical wave-front can become distorted from perturbations in the air[1].

Satellites that provide overhead intelligence must deal with rapidly changing scenery and variable atmospheric conditions that affect image quality. Cameras that use short exposure times to prevent image blurring therefore limit the number of photons collected in a given integration and place a premium on sensitivity. The most common type of wave-front sensor is the industry standard Shack-Hartmann design that is at least two orders of magnitude less sensitive than a theoretical ideal device. It also suffers from systematic errors (branch points, hidden phase, scintillation bias, and others) that further degrade performance. Postdoc candidates are challenged to study the limitations of wave-front sensing imposed by the laws of physics and work with academic and intelligence community (IC) researchers to design, build, and test new types of wave-front sensors. The goal for these sensors is that they offer promise to out-perform current-generation devices by approaching the maximum sensitivity allowed by fundamental physics.

Example Approaches:

The industry standard is the Shack-Hartmann design – this faces the challenges stated above.

Relevance to the Intelligence Community:

Improved wave-front sensing options offer methods to improve image quality under conditions pertinent for many IC missions.

References:

Wavefront Sensing. (n.d.). Retrieved from

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https://www.northropgrumman.com/BusinessVentures/AOAXinetics/IntelligentOptics/Technology/Pages/WavefrontSensing.aspx

Key Words: Wavefront Sensors, Wave-Front Sensors, Sensing, Sensitivity, Branch Points, Hidden Phase, Scintillation Bias, Adaptive Optics, Deformable Mirror, Shack-Hartmann

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** (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)