Opportunity Title: Three dimensional (3D) rendering of multiple two dimensional (2D) images for component recognition.
Opportunity Reference Code: IC-18-01

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://orau.org/icpostdoc/.

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

Application Deadline 3/12/2018 11:59:00 PM Eastern Time Zone

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

- Two dimensional (2D) images are an efficient and cost effective source of data for analyzing printed circuit boards, however three dimensional (3D) images are required to process the detail of the boards.It is possible to process 2D images into a 3D model, but current methods do not provide sufficient dimensional or color accuracy.
- For example, current X/Y/Z dimensional accuracy is 350 microns, while resolution of ~100 microns is needed. In addition, highly reflective and dark surface are problematic with current methods and the ability to resolve/tolerate metallic/reflective features is needed. True color is not necessary but color accuracy probably would be needed to aid thresholding for differentiation of PBC objects/features. Accuracy is most important so long scan times (hours), to support stitching if necessary, is reasonable.
- This research involves the creation of three-dimensional models from a set of images to facilitate automated component recognition on printed circuit boards (PCB).When using current processes, photo images originate as projections of a 3D scene onto a 2D plane resulting in a loss of depth.With multiple images, the depth can be calculated with triangulation and other iterative algorithms.Multiple iteration steps should allow for a better reconstruction at the cost of a higher computation time.

Example Approaches:

- Research could focus on optics, algorithms, or both. This effort could

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examine the possibility of the construction of a simple camera platform to take multiple images of a printed circuit board.An example of a platform might have a rotatable base supporting 8+ 45 degree images of the board.

- Part of the research may focus on acquisition of a large image data set, which is critical to this effort but may also support the evaluation of the algorithms and support future research and refinement of the techniques.
- A statistical iterative image reconstruction algorithm could be investigated.An object model could be developed that expresses the unknown continuous-space function that is to be reconstructed in terms of a finite series with unknown coefficients that could be estimated from the data.A system model could be developed that relates the unknown object to the "ideal" measurements that would be recorded in the absence of measurement noise.A statistical model could then be developed that describes how the noisy measurements vary around their ideal values. A cost function could then be developed that is to be minimized to estimate the image coefficient vector. Finally, an algorithm could be developed for minimizing the cost function, including some initial estimate of the image and some stopping criterion for terminating the iterations.
- Possible approach: Machine learning could be applied to the data set to derive 3D images from the 2D images.Machine learning allows for the derivation of an algorithm without being explicitly programmed by learning from the data and making predictions.The machine learning may be supervised or unsupervised, where supervised learning would require the data set to have the ground truth (the expected resulting 3D image for each set of 2D images).

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 👁)

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