

**Opportunity Title:** Mathematical Challenges in Potential Field Modeling

**Opportunity Reference Code:** ICPD-2020-25

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

**Reference Code** ICPD-2020-25

**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.ou.edu/icpostdoc/index.html>.

If you have questions, send an email to [ICPostdoc@ou.edu](mailto:ICPostdoc@ou.edu). 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:**

Modeling of geopotential fields – gravity and magnetics – on a global scale is performed most effectively using spherical and ellipsoidal harmonics. As the accuracy and resolution of these models improve, one is faced with both theoretical (formulation) and practical (implementation) challenges. The most prominent of these challenges are: (a) the analytical continuation of data acquired at randomly scattered locations to a mathematically convenient surface (e.g., an ellipsoid of revolution); and (b) the propagation of the errors of these data to the quantities derived from the estimated model parameters. Solving these problems with rigor and efficiency will significantly advance the state-of-the-art of geopotential model development and use.

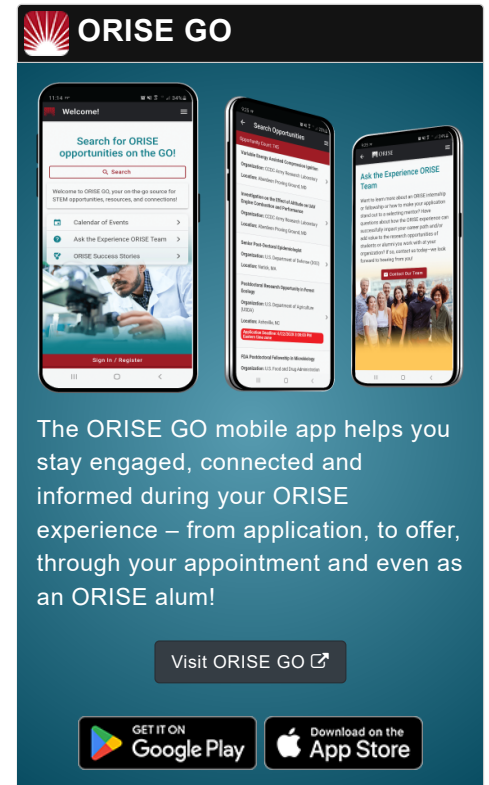
The successful Postdoc candidate will study, develop, and demonstrate the efficacy of alternative techniques for analytical continuation, error propagation, or both.

**Example Approaches:**

Analytical (downward or upward) continuation using iterative solution of Poisson's equation, with or without the assumption of linear correlation between elevations and free-air gravity anomalies, spherical or ellipsoidal harmonic gradient computations, and least squares collocation. Impact of the various analytical continuation techniques on the error properties of the data.

**Relevance to the Intelligence Community:**

In the absence of Global Navigation Satellite Systems (GNSS), accurate navigation can be accomplished using inertial systems or techniques employing crustal magnetic field information. Both of these technologies rely on the use of



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mathematical models describing the Earth's gravitational and magnetic fields. Thus, any improvements in error propagation and accuracy assessment will improve the fidelity of the resulting navigational system. The goal of this work is to improve efficiency and rigor in the development of future Earth Gravitational Models (EGMs) and Enhanced Magnetic Models (EMMs) and to improve the error characterization of these models.

**References:**

1. Pavlis, N. K., Holmes, S. A., Kenyon, S. C., & Factor, J. K. (2012). The development and evaluation of the Earth Gravitational Model 2008 (EGM2008). *Journal of Geophysical Research: Solid Earth*, 117(B4), n/a-n/a. doi:10.1029/2011jb008916
2. Maus, S. (2010). An ellipsoidal harmonic representation of Earth's lithospheric magnetic field to degree and order 720. *Geochemistry, Geophysics, Geosystems*, 11(6), n/a-n/a. doi:10.1029/2010gc003026

**Key Words:** Spherical Harmonics, Ellipsoidal Harmonics, Analytical Continuation, Uncertainty Quantification, Elliptic PDES, Poisson Equation

## 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 )