Opportunity Title: Novel Mathematical Approaches to Understanding Complex Systems

Opportunity Reference Code: ICPD-2023-15

Organization	Office of the Director of National Intelligence (ODNI)
Reference Code	ICPD-2023-15

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.
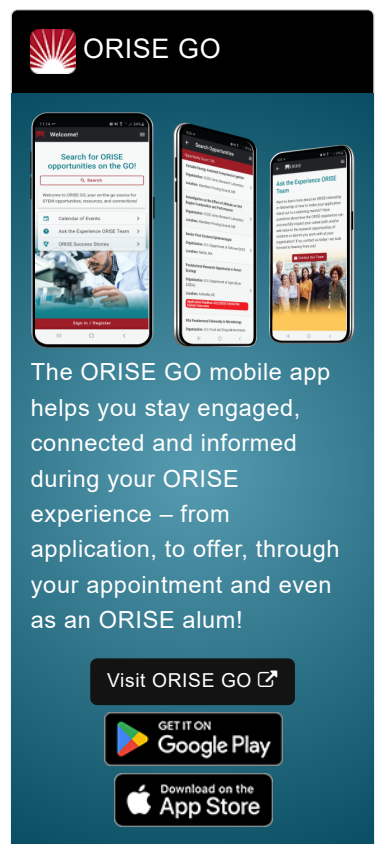
Application Deadline 2/28/2023 6:00:00 PM Eastern Time Zone

Description

Research Topic Description, including Problem Statement:

Complex systems are ubiquitous in many observed phenomena, including ecological systems, social networks, economies, and political systems. As "complex" is an overused term we will further define complex systems as adaptive networks. To better understand these phenomena, it is critical to develop novel mathematical approaches for analyzing the topologies, critical points, and statistics of complex systems. Understanding complexity and the mathematical underpinnings of complex systems is critical to understanding phenomena that are of interest to the Intelligence Community, including social networks, open-source coding ecosystems (e.g., GitHub, PyPI), and socio-economic systems. Complex systems differ from other types of systems in that they are often robust (i.e., can endure stress), or antifragile (i.e., become more robust under stress). Complex systems can also undergo phase changes under certain conditions, where the topology of the system reconfigures to a new optimal state. Relevant examples include economic transitions, or social unrest that leads to regime change. For example, can novel mathematical approaches determine if there is topological invariance that exists within population systems or even computer networks that can limit the feasible outcomes any policy can achieve? Can we identify how local effects propagate through the networks causing other adaptions which will result in phase changes leading to a new emergent or global behavior?

**Example Approaches:**

Explore novel statistical indicators of complexity; Develop novel topological approaches to understanding complex systems; Examine mathematical models of stability and their applications to complex systems; Apply agent-based modeling or similar approaches to complex systems; Develop algorithms to predict phase changes, robustness, resilience, or antifragility in complex systems.

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Relevance to the Intelligence Community (IC):

Develop/enhance capabilities to collect, process, and analyze information on integrated systems to develop models of complex systems of systems.

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

Key Words: #Topology, #Complexity, #Stability, #Modeling, #Hypergraphs, #Statistics, #Agent-Based Modeling, #Algebraic Topology, #Algebraic Geometry, #Artificial Intelligence

Eligibility Requirements

- **Citizenship:** U.S. Citizen Only
- **Degree:** Doctoral Degree.
- **Discipline(s):**
  - **Chemistry and Materials Sciences** (12 👁)
  - **Communications and Graphics Design** (5 👁)
  - **Computer, Information, and Data Sciences** (17 👁)
  - **Earth and Geosciences** (21 👁)
  - **Engineering** (27 👁)
  - **Environmental and Marine Sciences** (14 👁)
  - **Life Health and Medical Sciences** (48 👁)
  - **Mathematics and Statistics** (11 👁)
  - **Other Non-Science & Engineering** (2 👁)
  - **Physics** (16 👁)
  - **Science & Engineering-related** (1 👁)
  - **Social and Behavioral Sciences** (29 👁)