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Opportunity Title: Optimal and Autonomous Control of Satellite Formations
Opportunity Reference Code: ICPD-2021-29

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 2/26/2021 6:00:00 PM Eastern Time Zone

Description

Research Topic Description, including Problem Statement:

Satellite formation flying offers two significant benefits: 1) graceful degradation: if one satellite in the formation fails, the remaining satellites may be able to continue collecting mission data, and 2) potential performance increases: distributed aperture sensing technology theoretically provides transformational improvements. However, in order to realize these benefits, one must be able to maintain the formation in the presence of dynamic perturbations. Classical control approaches involve targeting desired orbital elements or relative orbital elements, but these approaches assume that one knows what the desired elements are. If the orbital dynamics were perfectly known, this would not be an issue. However, there are still uncertainties in the gravity field and atmosphere, and more importantly, minor differences in satellite makeup and orientation; combined, these uncertainties introduce inefficiencies into formation control. Furthermore, if one satellite is lost from the formation, how does the formation optimally reconfigure itself? It is hypothesized that a better approach to achieving and maintaining satellite formations can be found. The goal of this research project is to review the state-of-the-art literature and explore methods to improve satellite formation control in the presence of dynamic model errors.

Example Approaches:

Instead of viewing formations in terms of orbital elements or element differences, one could cast the problem in terms of controlling relative orbital element rate differences. For example, if two satellites were flying in the same orbital plane separated by several degrees of mean anomaly, one would expect small perturbations, due to longitude-dependent gravity and drag effects, to slowly impact the mean anomaly difference. One could execute small maneuvers to maintain the target mean anomaly difference each time the separation distance changes beyond a tolerance value. Alternatively, one could change the reference semimajor axis by a small amount to offset the unmodeled dynamic perturbation. This second approach would require far fewer maneuvers. Less elegantly, one could also approach the problem from a machine-learning point of view.

Relevance to the Intelligence Community:

Satellite formation flying offers increased resilience and potentially improved intelligence, surveillance, and reconnaissance (ISR) data collection capabilities.

Key Words: Control Theory, Satellite Formation Flying, Satellites, Machine Learning, Space

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** (17)
  - **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)