

Opportunity Title: Energy Boost Approaches
Opportunity Reference Code: ICPD-2020-06

Organization Office of the Director of National Intelligence (ODNI)

Reference Code ICPD-2020-06

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:**

Autonomous millimeter scale robots will be a powerfully effective and low cost tool with broad application. However, numerous challenges must first be solved, including mobility, energy, sensing, communication, and control. Moreover, these challenges must be solved simultaneously for microrobots to work effectively on a specific problem. Microrobotics is an intensively interdisciplinary problem. The Intelligence Community (IC) Postdoctoral Fellowship Program has funded research to continue innovative research on the "Design and Control of Heterogeneous Microrobot Swarms" based on aerial microrobot platforms, which use electrohydrodynamic (EHD) thrust to fly silently, and with no moving parts. This research takes a unique approach to overcome thrust-to-weight challenges that trouble microrobotic development. True to the interdisciplinary nature of the field, initial success highlights the need for concurrent research and improvement in energy applications, specifically improved performance in DC-DC voltage conversion. These EHD- and other dielectric elastomer-, electrostatic-, or piezo-based microrobotic actuators all require high power density, miniaturized, and high voltage ratio converters that sit in a unique design space outside the typical purview of high performance power electronics.

Example Approaches:

The inherent trade-offs between operating frequency, the number of voltage multiplier stages, and the availability of suitable high-voltage diodes and high-frequency magnetic material are limiting the achievable specific power of state-of-the-art high voltage converters and slowing down the progress of many exciting fields. While commercially available solutions may have specific powers suitable for larger and/or grounded robots, they are unsuitable for centimeter- and millimeter- scale robotics. There is potential for high impact work studying both new circuit topologies (e.g., high frequency switching resonant circuits) and new devices to populate them (e.g., high performance GaN power transistors and high-Q MEMS inductors).

A nanotech approach would require additional basic research but represents the appropriate applicable scale to microbotics and a variety of different approaches. Energy harvesting, via nanoscale machines (a mesoscopic ratchet to collect dissipated heat energy demonstrated in work led by French researchers Roche and Rolleau), or development of thermal effusive materials



ORISE GO

The ORISE GO mobile app helps you stay engaged, connected and informed during your ORISE experience – from application, to offer, through your appointment and even as an ORISE alum!

Visit ORISE GO

GET IT ON Google Play

Download on the App Store

Opportunity Title: Energy Boost Approaches
Opportunity Reference Code: ICPD-2020-06

(Cottrill, MIT); the creation of new super capacitating electrolytic surfaces (T.Allan Hatton, MIT and J.Eastoe Uni Bristol); or an entirely new class of bio-batteries (S.Heilshorn, Stanford). These approaches, and many others, illustrate the potential for nanoscale energy production.

Relevance to the Intelligence Community:

Mircrorobotics represent a promising new future technological wave capable of meeting persistent monitoring and surveillance requirements against priority issues at low costs, but only if several vexing technical problems—including, mobility, sensing, communication and control—can be resolved. Progress in these areas would improve the IC’s ability to monitor, warn, and provide senior leaders the decision space to address numerous dangerous and destabilizing issues.

Key Words: DC Converter, Microrobotics, Electrohydrodynamic, EHD, Energy Harvesting, Battery, Bio-Batteries, Robotics










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](#) )