Opportunity Title: Research of Mathematical Approaches to Cyber Physical System Security
Opportunity Reference Code: ARL-R-CISD-7114089873

Organization DEVCOM Army Research Laboratory

Reference Code ARL-R-CISD-7114089873

Description **About the Research**

Cyber Physical Systems (CPSs) are embedded systems that consist of computing elements and physical processes. Of particular interests are the security of Internet of Things (IoT), sensors networks, wearable devices, mobile phones, robots, autonomous vehicles, and smart cities. These IoT devices are most often designed without considering security. Unprotected IoT devices can be used as “stepping stones” by attackers to launch more sophisticated attacks such as advanced persistent threats (APTs). A later stage of APT is the “lateral movement” stage, where attackers use benign computer features to move step-by-step deeper into the network in a stealthy manner.

Emphasis is placed on research related to new techniques for the prediction, prevention, detection, resilience, survival and recovery from IoT attack. This effort pursues mathematical excellence in the following relevant areas which impact IoT cybersecurity: APT; cyber deception; IoT defense-in-depth; and end-to-end determination of security assurance. Theoretical constructs or mathematical abstractions provide a rigorous scientific basis for cyber security because they allow for reasoning quantitatively about cyber-attacks. This opportunity involves the use of several mathematical approaches, including game theory to capture the strategic behavior of malicious adversaries and automatically formulate the optimum policies; graph theory to build and formalize attack-graphs; and adversarial machine learning for adaptation to dynamic change in operating scenario. Limited rationality, incomplete information, imperfect monitoring in distributed networks are among the challenges to be considered.

ARL Advisor: Charles Kamhoua

ARL Advisor Email: charles.a.kamhoua.civ@army.mil

About CISD

The Computational and Information Sciences Directorate (CISD) conducts research in a variety of disciplines relevant to achieving and implementing the so-called digital battlefield. Problems address the sensing, distribution, analysis, and display of information in the modern battle space. CISD research focuses on four major areas: communications, atmospheric modeling, battlefield visualization, and computing

About ARL-RAP

The Army Research Laboratory Research Associateship Program (ARL-RAP) is designed to significantly increase the involvement of creative and highly trained scientists and engineers from academia and industry in scientific and technical areas of interest and relevance to the Army. Scientists and Engineers at the CCDC Army Research Laboratory (ARL) help shape and execute the Army's program for meeting the challenge of

Opportunity Title: Research of Mathematical Approaches to Cyber Physical System Security
Opportunity Reference Code: ARL-R-CISD-7114089873

developing technologies that will support Army forces in meeting future operational needs by pursuing scientific research and technological developments in diverse fields such as: applied mathematics, atmospheric characterization, simulation and human modeling, digital/optical signal processing, nanotechnology, material science and technology, multifunctional technology, combustion processes, propulsion and flight physics, communication and networking, and computational and information sciences.

A complete application includes:

- **Curriculum Vitae or Resume**
- **Three References Forms**
  - An email with a link to the reference form will be available in Zintellect to the applicant upon completion of the on-line application. Please send this email to persons you have selected to complete a reference.
  - References should be from persons familiar with your educational and professional qualifications (include your thesis or dissertation advisor, if applicable)
- **Transcripts**
  - Transcript verifying receipt of degree must be submitted with the application. Student/unofficial copy is acceptable

If selected by an advisor the participant will also be required to write a **research proposal** to submit to the ARL-RAP review panel for :

- Research topic should relate to a specific opportunity at ARL (see Research Areas)
- The objective of the research topic should be clear and have a defined outcome
- Explain the direction you plan to pursue
- Include expected period for completing the study
- Include a brief background such as preparation and motivation for the research
- References of published efforts may be used to improve the proposal

A link to upload the proposal will be provided to the applicant once the advisor has made their selection.

Questions about this opportunity? Please email ARLFellowship@orau.or

Eligibility Requirements

- **Degree:** Any degree .
- **Academic Level(s):** Any academic level.
- **Discipline(s):**
  - **Computer, Information, and Data Sciences** (16 👁)
  - **Engineering** (27 👁)
  - **Mathematics and Statistics** (10 👁)
  - **Physics** (16 👁)
  - **Science & Engineering-related** (1 👁)
- **Age:** Must be 18 years of age

Opportunity Title: Research of Mathematical Approaches to Cyber Physical System Security
Opportunity Reference Code: ARL-R-CISD-7114089873