



CyberSEA
Research Lab
Carleton University



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Systems and Computer Engineering

Carleton University

1125 Colonel By Drive

Ottawa, ON K1S 5B6

November 15, 2023

Position Available: Ph.D. Candidate

Comprehensive Security Assurance Solutions for Software-Dependent Systems

The **Cyber Security Evaluation and Assurance (CyberSEA) Research Lab** at Carleton University is actively looking for graduate students at the Doctoral level to contribute to a funded research program starting in September 2024.

Project Description

There is an ever-growing need to assure the security of critical software-dependent systems, and the information that they use, store, and communicate, in the face of cyber-attacks and failures. As systems grow larger and more complex they become more susceptible to a variety of unforeseen security vulnerabilities. Security should therefore be considered at all stages of their development. The current approach of having security “bolted-on” to the systems that we build is not sufficient. Instead, we need to consider the increasingly critical security requirements for these systems and design them with security “baked-in” so that sufficient evidence to support security assurance claims can be generated and reasoned about alongside the system being developed.

The overall aim of this research program is to establish comprehensive security assurance solutions by enhancing security-by-design approaches for engineering secure software-dependent systems. More specifically, it aims to develop more incremental, modular, and compositional solutions for securing systems from the outset and for generating sufficient evidence of their built-in resilience to a range of cyber-attacks and failures. This requires the integration of formal (mathematically rigorous) methods and security-by-design approaches to provide verifiable evidence to support security assurance claims from early stages of system development. We will achieve this by:

- (1) Developing formal modeling and analysis frameworks with which we can provide mathematical proofs of assurance of security properties of software-dependent systems at early stages of development;
- (2) Establishing system-level security evaluation methods and techniques for understanding and mitigating the risks to system assets posed by identified security vulnerabilities; and
- (3) Advancing techniques to support the management, evaluation, and presentation of sufficient evidence for developing incremental security assurance cases.

Project Keywords:

- security evaluation
- security assurance
- security engineering
- security metrics
- threat modeling
- risk assessment
- security-by-design
- software engineering
- modeling & simulation
- formal methods
- data science

Duties and Responsibilities

As part of the Doctoral Program requirements, candidates will complete a dissertation on a topic aligned with the research mission of the CyberSEA Research Lab including but not limited to: cyber security evaluation and assurance, threat modeling, security-by-design, risk assessment and management, modelling and simulation for security, and/or formal methods or data-driven approaches for software and security engineering.

Related Literature References

- [1] M. Zeroual, B. Hamid, M. Adedjouma, and J. Jaskolka. [Towards logical specification of adversarial examples in machine learning](#). In *2022 IEEE International Conference on Trust, Security and Privacy in Computing and Communications, TrustCom 2022*, pages 1575–1580, Wuhan, China, 2022.
- [2] J. Jaskolka, B. Hamid, and S. Kokaly. [Software design trends supporting multi-concern assurance](#). *IEEE Software*, 39(4):22–26, July/August 2022.
- [3] A. Jawad and J. Jaskolka. [Analyzing the impact of cyberattacks on industrial control systems using timed automata](#). In *21st IEEE International Conference on Software Quality, Reliability, and Security, QRS 2021*, page 12, Hainan Island, China, 2021.
- [4] J. Samuel, J. Jaskolka, and G.O.M. Yee. [Analyzing structural security posture to evaluate system design decisions](#). In *21st IEEE International Conference on Software Quality, Reliability, and Security, QRS 2021*, page 12, Hainan Island, China, 2021.
- [5] Q. Rouland, B. Hamid, and J. Jaskolka. [Specification, detection, and treatment of STRIDE threats for software components: Modeling, formal methods, and tool support](#). *Journal of Systems Architecture*, 117:102073, 2021.
- [6] J. Jaskolka. [Recommendations for effective security assurance of software-dependent systems](#). In K. Arai, S. Kapoor, and R. Bhatia, editors, *Intelligent Computing, SAI 2020*, volume 1230 of *Advances in Intelligent Systems and Computing*, pages 511–531. Springer, Cham, July 2020.

Desired Skills/Qualifications

Suitable candidates will have a Master's degree in Software Engineering, Computer Science, or a related field. Ideal candidates will be self-motivated with an ability to work independently and to communicate effectively in a team environment. A background in computer security, software engineering processes and concepts, and software/system requirements, architecture, and design is highly desirable. Experience with formal methods, data science, and/or modeling & simulation is considered an asset.

All candidates must satisfy the [Minimum Admission Requirements for Doctoral Programs](#) at Carleton University. International candidates must also ensure that they satisfy the [English as a Second Language Requirements](#). In all cases, these requirements will be strictly enforced when evaluating an application for admission.

Funding

Successful candidates for this position will be *eligible for funding* in the form of a research assistantship. Specific funding details are determined at the time of offer and consider numerous factors such as academic standing, research potential, availability of funds, eligibility for teaching assistantship and/or scholarships, etc.

Host Research Institute Information

[Carleton University](#) is a public comprehensive university, founded in 1942, in Ottawa, Ontario, Canada. The research-intensive Faculty of Engineering and Design at Carleton University is recognized as one of Canada's leading institutions in the study and research of engineering, architecture, industrial design and information technology. Since the inception of engineering at Carleton in 1945, our experts have pushed the bounds of innovation and discovery. Carleton focuses on anticipating the needs of industry and society, and offers forward-thinking programs with real world application and produces research that is helping to shape our present and future. The [Department of Systems and Computer Engineering](#) is a recognized world-class institution in software engineering, computer systems engineering, communications engineering, and biomedical engineering. Together with the Department of Electronics, the Department of Systems and Computer Engineering constitutes one of the largest and most research-intensive centres for Electrical and Computer Engineering and Software Engineering education and research in Canada. The [Cyber Security Evaluation and Assurance \(CyberSEA\) Research Lab](#) conducts advanced academic research to develop systematic and rigorous approaches for evaluating and assuring the cyber security of software-dependent systems.

Further Information

For more information about Graduate Studies at [Carleton University](https://carleton.ca/sce/graduate-studies/) and the [Department of Systems and Computer Engineering](#), please visit: <https://carleton.ca/sce/graduate-studies/>. For more information about applying for Graduate Studies at Carleton University, please visit: <https://graduate.carleton.ca/apply-online/>. For more information about funding for Graduate Studies, please visit: <https://graduate.carleton.ca/financial-assistance/admissions-funding/>.

How to Apply

Interested applicants are to send a **CV** and **Statement of Interest** detailing your research interests, background, and experience **by email** to the CyberSEA Lab Director:

Jason Jaskolka, Ph.D., P.Eng.

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For more information about how to apply, please visit: <https://carleton.ca/cybersea/positions-available/>

Application Deadline

Applications will be reviewed as they arrive until a suitable candidate is found.