

# Muhammad Umair Khan, PhD.

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## Career Summary

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- **PhD in Secure Software Engineering** from **Queen's University (Canada)** and **Masters (Diplom) in Computational Logic** from **Dresden University of Technology (Germany)**.
- **13 years (10 years Post-Doctoral)** experience in **teaching** computer science to **undergraduate** and **graduate** students in Germany, Pakistan, and Canada.
- **8 years (part-time)** experience as a **research assistant** (secure software engineering) and **teaching assistant** (for graduate and undergraduate students) at Queen's University.
- Extensive experience in **technical report and paper writing, grant proposal writing, software security, secure software development, requirements and design techniques, and security vulnerability identification and analysis.**
- **2 years (5 months Post-Doctoral)** of experience in **analyzing, architecting, and designing** of software in research (Fraunhofer IESE and IVI, Germany) and industry (Ministry of Health, Ontario, Canada).
- Received, among other awards, **Ontario Graduate Scholarship, Queen Elizabeth II Scholarship for Science and Technology (twice), and R. Samuel McLaughlin Fellowship.**
- Received Natural Sciences and Engineering Research Council of Canada (NSERC) Engage Industry (previously ARD level 1), Centennial College ARIF, and **NSERC ARD Level 2 + Ontario Centers for Excellence + Industry Grants as principal investigator. Total research grant received as PI to date: \$ 392,000.**

## Education

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| <b>August 2014</b>   | Queen's University, Kingston, Canada.<br><b>Ph.D. in Computing (Thesis Area: Secure Software Engineering).</b>    |
| <b>December 2001</b> | Dresden University of Technology, Dresden, Germany.<br><b>Masters in Computational Logic (Diplom Informatik).</b> |
| <b>May 1999</b>      | National University of Computer and Emerging Sciences, Pakistan.<br><b>Bachelors in Computer Science.</b>         |

## Professional Experience

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| <b>Aug '21 – present</b> | <b>Assistant Professor, Alfaisal University, Riyadh, Saudi Arabia</b><br>Taught software engineering courses to undergraduate students. Chair of the department since Sep 2023.                      |
| <b>May '21 – Aug '21</b> | <b>Course Director, York University, Toronto, Canada</b><br>Delivered Theory of Computation and Requirement Engineering courses to undergraduate computer science students (Online/remote teaching). |

- Sep '20 – Apr '21 Faculty Member, Centennial College, Toronto, Canada.**  
Delivered lectures, assignments, tutorials, and exams for Operating Systems, Web Design, Computer and Network Security, Software Engineering, and Software Security courses.
- Aug '19 – Dec '20 Software Security Consultant, Centennial College, Toronto, Canada.**  
Provided consultation on security related issues on, among others, NSERC funded project on Wearable Interactive and Mobile Technology Access Center in Health (WIMTACH).
- Aug '19 – Aug '20 Assistant Professor, National University of Computer and Emerging Sciences (FAST NUCES), Lahore, Pakistan.**  
Taught computer science courses to undergraduate and graduate students. Supervising MS theses. Member of the Graduate Research Lab Committee.
- Aug '19 – Aug '20 Software Engineering Consultant, Power Information Technology Company, Ministry of Energy, Pakistan**  
Assisted with the overhauling of the current software systems using software engineering techniques and principles.
- Jan '17 – Aug '19 Assistant Professor, Riphah International University, Lahore.**  
Taught computer science courses to undergraduate and graduate students. Supervised MS theses. Member of Board of Studies, Board of Faculty, and Chairman of the IT committee. Head of department Jan 2017 to Aug 2018.
- May '18 – Jul' 19 Principal Investigator, Centennial College, Toronto, Canada  
NSERC-OCE-Prompt-Industrial grant (\$ 331,000)**  
Supervised the development of a test suite to verify the randomness of a true random number generator. Total grant amount was approximately \$881,000 split with Dr. Francois Gagnon of ETS Montreal. The project was “Co-development and Implementation of a Novel Random Number Generator Compliant with Federal Information Processing Standard 140-2 Level 2”.
- Jan '15 – Dec '16 Faculty Member, Centennial College, Toronto, Canada.**  
Delivered lectures, assignments, tutorials, and exams for Operating Systems, Web Design, Computer and Network Security, Software Engineering, and Software Security courses.
- May '16 – Aug '16 Principal Investigator, Centennial College, Toronto, Canada.  
Centennial ARIF grant (\$ 10,000)**  
Investigated the possibility to enable non-component-based software to be self-monitoring using the previously proposed approach for component-based software.
- Dec '15 – May '16 Principal Investigator, Centennial College, Toronto, Canada.  
NSERC ARD Level 1 grant (\$ 51,000)**  
Worked on a Natural Sciences and Engineering Research Council of Canada funded industrial applied research project to make smart phones more secure.
- May '15 – Aug '15 Faculty Member, Sheridan College, Oakville, Canada.  
(Part-time)**  
Delivered lectures, assignments, tutorials, and exams for Data Structures and Threat Analysis & Risk Assessment courses.

- Aug '14 – Dec '14 Senior Systems Analyst, Ministry of Health, Ontario, Canada.**  
Organized meetings with different stakeholders to gather enhancement requirements. Translated the stakeholders' goals into system design and data models. Analyzed and proposed enhancements for the multi-application based online health management system of the ministry. Developed and managed the development process to effectively achieve the stated goals of the project. Developed, enhanced, and disseminated requirements and design documents and development guidelines.
- Sep '06 – Aug '14 (Part-time) Queen's University, Canada.**  
**Teaching Assistant** for multiple undergraduate courses (software engineering, theory of automata, formal methods in software engineering, human computer interaction, and distributed systems).  
**Research Assistant** in Software Engineering and Security. Employed, analyzed, and improved secure software development life cycle processes, security requirements methodologies, secure design and architecture concepts, and security monitoring techniques. Enhanced the design of software components to include specification-based security monitors.
- Aug '05 – Jul '06 National University of Computer and Emerging Sciences, Pakistan.**  
**Lecturer:** Independently developed and taught Theory of Automata, Operating systems, and Software Engineering courses.  
**Advisor and Final-Year Project Coordinator:** Supervised the design and development of 13 undergraduate final year student software projects each spanning around 10-12 months and involving multiple students.  
**Head, IT Computer Labs Committee:** Developed policies and proposed enhancements to the students' computer facilities.
- Sep '04 – Feb '05 Fraunhofer Institute of Experimental Software Engineering (IESE), Kaiserslautern, Germany.**  
**Project Analyst:** Analyzed multiple software projects for consistency with component-based software development principles.
- Mar '02 – Dec '03 TU Kaiserslautern, Germany.**  
**Teaching Associate:** Prepared lectures, assignments, tutorials, and examinations for software engineering courses and seminars. Delivered tutorials and conducted examinations. Also advised undergraduate students on their final year projects.  
**Research Associate:** Designed and developed tools for building a connected and networked system for smart homes. Also designed, developed, and tested a tool for enacting business process models.
- Jan '01 – Dec '01 Fraunhofer Institute for Transportation and Infrastructure Systems (IVI), Dresden, Germany.**  
**Software System Architect:** Developed the architecture and design of a system to guide an automatic vehicle. This system was verified for different safety and liveness properties using UML and OCL.

### **Publications (In-Progress)**

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24. **M. U. Khan**, "Using UML-SR to Trace Security Requirements in Software Development Lifecycle Phases".

23. M. Yaqoob and **M. U. Khan**, “Model Checking Security Requirements Specified in TLA+ and TLA”.
22. A. Javed, **M. U. Khan**, and M. J. Saeed, “Efficient Object Tracking Using Delayed Transmission over the Network”.
21. S. Nawaz and **M. U. Khan**, “Testing Security Vulnerabilities in Web Applications”.

**Publications (Refereed) (Total = 14)**

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20. M. Mohsin and **M. U. Khan**, “UML-SR: A Novel UML Based Security Requirements Specification Language,” In *Proceedings of the 19<sup>th</sup> IEEE International Conference on Software Quality, Reliability, and Security*, Sofia, Bulgaria, July 22-26, 2019 **IEEE CS Press**, pp. 342-349. <https://ieeexplore.ieee.org/document/8854704>
19. **M. U. Khan**, F. Chowdary, Z. Jahangir, & F. Ofougwuka, “Secure Communication Protocol for Bluetooth Devices over Short Distances,” *ICST Institute for Computer Sciences, Social-Informatics and Telecommunications Engineering, 2018*, R. Mehmood et al. (Eds): SCITA 2017, LNICST 224, pp. 74-85. [https://doi.org/10.1007/978-3-319-94180-6\\_9](https://doi.org/10.1007/978-3-319-94180-6_9) **Springer**.
18. S. Rehman and **M. U. Khan**, “Security and Reliability Requirements for a Virtual Classroom,” *Procedia Computer Science*, 2016, **Elsevier**, volume 94, pages 447-452. <https://doi.org/10.1016/j.procs.2016.08.069>
17. S. Rehman and **M. U. Khan**, “A Reliable and Secure Virtualized Clinical Assistance Tool for Doctors and Patients,” *Procedia Computer Science*, 2016, **Elsevier**, volume 94, pages 441-446. <https://doi.org/10.1016/j.procs.2016.08.068>
16. **M. U. Khan**, “Representing Security Specifications in UML State Machine Diagrams,” *Procedia Computer Science*, 2015, **Elsevier**, volume 56, pages 453-458. <https://doi.org/10.1016/j.procs.2015.07.235>
15. **M. U. Khan** & M. Zulkernine, “A Hybrid Monitoring of Software Design-Level Specifications,” In *Proceedings of the International Conference on Quality Software (QSIC'14)*, Dallas, Texas, USA, 2014, **IEEE CS Press**, pp. 111-116. <https://doi.org/10.1109/QSIC.2014.14>
14. **M. U. Khan** & M. Zulkernine, “Building Components with Embedded Security Monitors,” In *Proceedings of the 2<sup>nd</sup> ACM SigSoft International Symposium on Architecting Critical Systems (ISARCS)*, Boulder, Colorado, USA, 2011, **ACM Press**, pp. 133-142. <https://doi.org/10.1145/2000259.2000282>
13. **M. U. Khan** & M. Zulkernine, “Activity and Artifact Views of a Secure Software Development Process,” In *Proceedings of the International Conference on Computational Science and Engineering*, Vancouver, Canada, 2009, **IEEE CS Press**, vol. 3, pp. 399-404. <https://doi.org/10.1109/CSE.2009.383>
12. **M. U. Khan** & M. Zulkernine, “On Selecting Appropriate Development Processes and Requirements Engineering Methods for Secure Software,” In *Proceedings of the 33<sup>rd</sup> Annual IEEE International Computer Software and Applications Conference (COMPSAC '09)*, Seattle, Washington, USA, 2009, **IEEE CS Press**, vol. 2, pp.353-358. <https://doi.org/10.1109/COMPSAC.2009.206>

11. **M. U. Khan** and M. Zulkernine, “Quantifying Security in Secure Software Development Phases,” In *Proceedings of the 33<sup>rd</sup> Annual IEEE International Computer Software and Applications Conference (COMPSAC '08)*, Turku, Finland, 2008, **IEEE CS Press**, pp. 955-960. <https://doi.org/10.1109/COMPSAC.2008.173>
10. M. Zulkernine, M. Graves, & **M. U. Khan**, “Integrating Software Specification into Intrusion Detection,” *International Journal of Information Security*, **Springer**, 2007, vol. 6, no. 5, pp. 345-357. <https://doi.org/10.1007/s10207-007-0023-0> .
9. J. Li, R. Conradi, O. P. N. Slyngstad, C. Bunse, **M. U. Khan**, M. Torchiano, and M. Morisio, “An Empirical Study on Off-the-Shelf Component Usage in Industrial Projects,” *Lecture Notes in Computer Science*, **Springer**, volume 3547, pages 54 – 68. [https://doi.org/10.1007/11497455\\_7](https://doi.org/10.1007/11497455_7)
8. J. Li, R. Conradi, O. P. N. Slyngstad, C. Bunse, **M. U. Khan**, M. Torchiano, and M. Morisio, “Validation of New Theses on Off-the-Shelf Component Based Development,” In *Proceedings of the 11<sup>th</sup> IEEE International Software Metrics Symposium (METRICS'05)*, Como, Italy, 2005, **IEEE CS Press**, volume 00, page 26 (10 Pages). <https://doi.org/10.1109/METRICS.2005.53>
7. J. Li, R. Conradi, O. P. N. Slyngstad, C. Bunse, **M. U. Khan**, M. Torchiano, and M. Morisio, “Barriers to Disseminating off-the-shelf Based Development Theories to IT Industry,” In *Proceedings of the 2<sup>nd</sup> International Workshop on Models and Processes for the Evaluation of Off-the-shelf components (MPEC '05)*, Louis, Missouri, USA, **ACM SIGSOFT Software Engineering Notes**, 2005, **ACM Press**, volume 30, number 4, pages 1-4. <https://doi.org/10.1145/1082948.1082953>

#### **Publications (Theses and Technical Reports)**

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6. **M. U. Khan**, “Building Components with Embedded Specification-based Security Monitors” PhD Thesis, Schools of Computing, Queen’s University, Canada, 2014. Available at <http://hdl.handle.net/1974/12423>
5. **M. U. Khan** and M. Zulkernine, “A Survey on Requirements and Design Methods for Secure Software Development,” Technical Report 2009-562, School of Computing, Queen’s University, Canada, 2009. Available at <http://research.cs.queensu.ca/TechReports/Reports/2009-562.pdf>
4. **M. U. Khan**, “Replication of Basili and Selby 1987 Experiment,” SFB 501 Technical Report TR 09/03, Department of Computer Science, University of Kaiserslautern, Germany. Also published as ESERNET experiment EXP-42, 2003.
3. **M. U. Khan**, “Process Modeling for Glockenspiel,” SFB 501 Technical Report TR 10/03, Department of Computer Science, University of Kaiserslautern, Germany, 2003.
2. **M. U. Khan**, “Object Oriented Modeling of a System for Automated Vehicle Guidance,” Master’s Thesis, Department of Computer Science, Dresden University of Technology, Germany, 2001. Available at <http://publica.fraunhofer.de/documents/B-75803.html>.
1. **M. U. Khan**, “Improving the Quality of Requirement Specifications,” Bachelor’s Final Year Project, Department of Computer Science, National University of Computers and Emerging Sciences, Lahore, Pakistan.

### **Additional Conference Presentations**

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1. **M. U. Khan**, “Components with Embedded Specification-Based Security Monitors”, Consortium for Software Engineering Research (CSER), November 2012, Toronto, Canada.
2. **M. U. Khan**, “Components with Embedded Specification-Based Security Monitors”, Delivering Ultra-Large Scale Services (ULySSes) Meeting, June 2013, London, Canada.
3. **M. U. Khan**, “Co-development and Implementation of a Novel Random Number Generator Compliant with Federal Information Processing Standard 140-2 Level 2”, RISES conference, June 2019, Toronto, Canada.

### **MS Thesis supervised**

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1. UML-SR A Novel UML Based Security Requirements Specification Language by Muhammad Mohsin at Riphah International University
2. Effectively Testing Security Vulnerabilities in Web Applications by Shah Nawaz at Riphah International University
3. Ensuring Data Availability by Delayed Transmission Over the Network by Ali Javeed at Riphah International University
4. Model Checking Security Requirements Specified in TLA+ and TLA by Malaika Yaqoob at Riphah International University
5. Analysis of Open Source Design for Secure Design Guidelines by Durr e Najaf at FAST NUCES
6. Detecting and Preventing Attacks from Disguised Network Addresses by Moshin Qurban at FAST NUCES
7. Security Issues in Single Sign-On Authentication by Mah Rukh at FAST NUCES
8. Web Application Security Requirements by Sana Ashraf at FAST NUCES

### **Awards and Grants**

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1. 2018 – 2020 **ARD level 2** from National Scientific and Engineering Research Council (**NSERC**) in conjunction with **OCE** (Ontario), **PROMPT** (Quebec) and Cybersecurity Umbrella. Total grant amount: \$ 331,000.
2. 2016 – 2016 Applied Research and Innovation Fund (ARIF), Centennial College. Total grant amount: \$ 10,000.
3. 2015 – 2016 **NSERC ARD Level 1**, Industrial Research Project, Principal Investigator at Centennial College, Toronto, Canada. Total grant amount: \$ 51,000.
4. 2010 – 2011 Ontario Graduate Scholarship (**OGS**) at Queen’s University, Canada.
5. 2009 – 2010 Queen Elizabeth II Scholarship at Queen’s University, Canada.
6. 2008 – 2009 Queen Elizabeth II Scholarship at Queen’s University, Canada.
7. 2007 – 2008 R. S. McLaughlin Award at Queen’s University, Canada.
8. 2007 – 2008 Queen’s Graduate Award at Queen’s University, Canada.
9. 2006 – 2007 Queen’s Graduate Award at Queen’s University, Canada.
10. 2001 – 2002 International Quality Network Student Grant at Dresden University of Technology, Dresden, Germany.

### **Professional Activities**

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1. Member of the SE Department Research Committee, SE Department Curriculum Committee, SE Department Council, SE Department Hiring Committee, and the College of Engineering Council.

2. Member Graduate Research Lab Committee, National University of Computer and Emerging Sciences (2019/20)
3. Co-Chair – International Workshop on Enterprise Web Application Dependability, Gran Canaria, Spain, August 2018.
4. Chair – International Workshop on Enterprise Web Application Dependability, Leuven, Belgium, July 2017.
5. PC Member – International Workshop on Enterprise Web Application Dependability, Montreal Canada, August, 2016.
6. PC Member – International Workshop on Enterprise Web Application Dependability, Belfort France, August 17<sup>th</sup> – 20<sup>th</sup>, 2015.
7. Program Development Committee Member – Graduate Program in Cyber Security, Centennial College, Toronto, Canada.
8. Reviewer for multiple journals and conferences (e.g., COMPSAC, HASE, QSIC, MobiSPC, REEN).
9. Member of department’s ethics committee at Queen’s University.
10. Head of IT committee at National University of Computer and Emerging Sciences (2005/06).

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#### **Graduate Courses Taught at FAST National University, Pakistan**

*Spring 2020:* Requirements Engineering

*Fall 2019:* Software Process Management and Metrics

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#### **Graduate Courses Taught at Riphah International University, Pakistan**

*Spring 2017, 2018, 2019:* Secure Software Engineering

*Fall 2017, 2018:* Advanced Software Engineering

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#### **Undergraduate Courses Taught at Alfaisal University, Riyadh, Saudi Arabia**

*Spring 2024:* Ethical Hacking, Secure Software Engineering

*Fall 2023:* Software Design and Architecture, Cryptography, Network Security

*Spring 2023:* Ethical Hacking, Requirements Engineering, Introduction to Cybersecurity

*Fall 2022:* Software Design and Architecture, Cryptography, Network Security

*Spring 2022:* Cryptography, Ethical Hacking, Introduction to Cybersecurity

*Fall 2021:* Network Security, Programming for Engineers

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#### **Undergraduate Courses Taught at York University, Toronto, Canada (Online Teaching)**

Requirements Engineering, Theory of Computation

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#### **Undergraduate Courses Taught at FAST National University, Pakistan**

*Spring 2020:* Network Security

*Fall 2019:* Object Oriented Analysis and Design

*Spring 2006:* Software Engineering, Theory of Automata, Operating Systems.

*Fall 2005:* Software Engineering.

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#### **Undergraduate Courses Taught at Riphah International University, Pakistan**

*Spring 2019:* Data Structures, Introduction to Computing

*Fall 2018:* Software Requirements Engineering, Database Systems

*Spring 2018:* Software Construction

*Fall 2017:* Introduction to Computing, Software Engineering  
*Spring 2017:* Discrete Mathematics

### **Tutorials for Undergraduate Courses at TU Kaiserslautern, Germany**

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*Summer 2003:* Software Engineering & Software Process Measurement.

*Summer & Winter 2002:* Software Engineering.

### **Undergraduate/Diploma Courses Taught at Centennial College, Canada**

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*Winter 2021:* Computer Forensics & Network Security

*Fall 2020:* Software Security

*Winter 2016:* Operating Systems, Object-Oriented Software Engineering, Computer and Network Security, & Software Testing and Quality Assurance.

*Fall 2015:* Web Design, Operating Systems, and Software Security.

*Summer 2015:* Security Threats and Risk Assessment & Data Structures and Algorithm Development in C. Object-Oriented Software Engineering & Operating Systems.

*Winter 2015:* Operating Systems.

### **Undergraduate/Diploma Courses Taught at Sheridan College, Canada**

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*Summer 2015:* Security Threats and Risk Assessment & Data Structures and Algorithm Development in C.

### **Graduate-Level Courses Studied (Queen's University and TU Dresden)**

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Software Reliability and Security, Computer and Network security, Verification of Software Systems, Software Reengineering, Formal Specifications of Software Systems, Implementation of Imperative Programming Languages, Computational Logic, Foundations of Cognitive Robotics, Foundations of Logic and Constraint Programming, Deduction Systems.

### **Tools and technologies used**

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C/C++, Prolog, SQL, WAS, ClearCase, MS SDL, AEIGS, CLASP, TSP-Secure, McGraw's Touchpoints, UML, OCL, Z, B,  $i^*$ , TLA+, CCS, SMV, NuSMV, Spin, Pi Calculus.

### **References**

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Prof. Dr. Muhammad Zulkernine (PhD Supervisor)  
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