Umair Mughal

Assistant Professor
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Educational Background

Tennessee Technological University — Tennessee, USA
Ph.D. in Computer Science and Engineering — 2021 – 2024
- Dissertation Title: *AI-Assisted Intrusion Detection System for Swarms of Unmanned Aerial Vehicles*
- Advisor: Prof. Muhammad Ismail, Director of CEROC

INHA University — Incheon, South Korea
M.S. in Electrical and Computer Engineering — 2018 – 2020
- Dissertation Title: *UAVs Path Planning by Particle Swarm Optimization based on Visual-SLAM Algorithm*
- Advisor: Prof. KyungHi Chang, Fellow of IEEE

University of Engineering and Technology — Peshawar, Pakistan
B.Sc. in Electrical Engineering — 2011 - 2015

Research Interests

- Intersection of Cybersecurity, Machine learning, and Data Science
- Cellular Vehicle-to-Everything (C-V2X) technology security
- Application of Quantum information and LLM

Professional Experience

Assistant Professor (Tenure-Track) — Aug. 2024 - Present
School of Computer Science and Information Systems — Northwest Missouri State University, USA
- LLM-based penetration testing tool for unmanned aerial vehicles (UAVs).
- Quantum-based Security of connected and autonomous cars (CAVs) in 5G communications.

Graduate Research Assistant — 2021- 2024
Cybersecurity Education, Research and Outreach Centre (CEROC) — Tennessee Tech University, USA
- Machine learning pipeline: data collection & processing, feature engineering, model training, evaluation, & deployment.
- Developed cyber-physical testbed in unmanned aerial vehicles to support research and outreach in cybersecurity.
- Penetration testing on a live drone system by executing False data injection, Replay, Evil Twin, and DoS attacks.
- Developed Intrusion Detection System using deep neural network and graph neural network.
- Open-sourced a dataset of UAV swarm, collected from a real-world drone system, on IEEE Dataport.

Research Scientist — 2020-2021
Oceanic IT Convergence Research Centre — Asan, South Korea
- Data analysis of underwater acoustic communication using machine learning for link adaptation and throughput.
- Collected underwater acoustic data in the Incheon Sea over 1km and 3km distances between Tx and Rx.
- Designed algorithms for autonomous underwater vehicle's (AUV) and embedded them to the AUV.

Graduate Research Assistant — 2018-2020
Mobile Telecommunication Research Laboratory — Inha University, South Korea
- Developed cellular vehicle-to-everything (C-V2X) simulator according to 3GPP Rel. 14 & 15.
- Modeled V2X sidelink & PC5 interface (V2V, V2I), 5G-NR, and DSRC communication in vehicular environments
- Implemented Simultaneous Localization and Mapping (SLAM) technology for UAV navigation.

Lab Engineer — 2017-2018
Qurtuba University of Sciences and Technology — Dera Ismail Khan, Pakistan
- EE-391: Communication Systems
- EE-493: Computer Networks
- EE-271: Object Oriented Programming & Data Structure in C++

Junior Operation Engineer — 2015-2017
Master Tiles & Ceramic Industries Limited — Punjab, Pakistan
- Ladder Logic programming for PLC-based control system in ceramic production plant.
- Worked closely on the operation and maintenance of the plant control system.

BSS Intern Engineer — June 2014 - September 2014
Alcatel-Lucent ltd. — Islamabad, Pakistan
- Worked at BSS-CMPak project in Operation and Maintenance department.
- Implements modifications for the BTS sites.

Grant Proposal

- Submitting a grant proposal within coalition of Northwest Missouri State University, Tennessee Technological University, and Florida State University to National Science Foundation under Secure and Trustworthy Cyberspace (NSF-SaTc) program, USA

- Cyber Defense funding award, Northwest Missouri State University, 2024 – Funded amount $5000.

Certifications

- Penetration Testing, Incident Response and Forensics, IBM Cybersecurity Analyst Professional Certificate (Coursera)
- Security Risks in AI and Machine Learning: Categorizing Attacks and Failure Modes (LinkedIn)
- Cisco Networking Foundations: Wireless Networks, Services, Security, and Virtualization (LinkedIn)
- Software Development for Unmanned System, Drone Programming (Udemy)
- Generative AI with Large Language Models (Coursera)
- GPT-4 Foundations: Building AI-powered Apps (LinkedIn)
- LangChain for LLM Application Development (Deeplearning.ai)

Teaching Experience

Northwest Missouri State University — Maryville, USA
Instructor (Assistant Professor) — Aug. 2024 - present

- CSIS 44481: Ethical Hacking (with 12 labs) - Spring 2025
  - With Industry partner CompTIA for Hands-on exercises.
- CSIS 44457: Applied Cryptography (with 8 labs) – Spring 2025
- CSIC 44386: Digital Forensics (with 10 labs) – Fall 2024
  - With Industry partner Cengage for Hands-on exercises.
- CSIS 44382: Secure Programming (with 7 labs) – Fall 2024
- CSIC 44356: Network Fundamentals (with 11 labs) – Fall 2024, Spring 2025
  - Developed 11 Labs with new equipment (GMKtec Mini PC, Cisco switch, Netgate 1100, etc.) from scratch.

Tennessee Tech University — Tennessee, USA
Teaching Assistant — 2022 – 2023

- CSC-2310: Object Oriented Programming/Design in Python - Spring 2023
- CSC-3410: Computer Org/Assembly Language Programming - Spring 2023
- CSC-3410: Computer Org/Assembly Language Programming - Fall 2022
- CSC-2310: Object Oriented Programming/Design in Java - Summer 2022

Inha University — Incheon, South Korea
Teaching Assistant — 2018 - 2020

- ECE: Advanced Wireless Communications - Spring 2020
- ECE: Circuit Analysis-II – Spring 2019
- ECE: Circuit Analysis-I- Fall 2018, Fall 2019

Qurtuba University — D-I-Khan, Pakistan
Lab-Instructor — 2016-2018

- EE-391: Communication Systems
- EE-493: Computer Networks
- EE-271: Object Oriented Programming & Data Structure in C++

Advising

- **Current M.S. Students**
  - **Mike Soare:** Reinforcement Learning to Attack Leader Drone in a Swarm
    - Co-advising with Dr. Ismail at Tennessee Tech University
- **Current Undergraduate Students**
  - Mason Sipe, Outreach Activities in Cybersecurity, Expected Graduation in Fall 2025.
  - Kai Crabb, GenAI for Software Security, Expected Graduation in Spring 2026.
  - Addison Rinehart, Outreach activities in cybersecurity, Expected Graduation in Spring 2026

- **Graduate M.Sc. Students**
  - John Richeson (Fall 2023): Developing Intrusion Detection System against Evasion Attacks on a UAV, Department of Computer Science, Tennessee Technological University, TN, USA.
  - Nafis Ahmed (Fall 2020): Path Planning of the Unmanned Aerial Vehicles, Department of Electrical and Computer Engineering, Inha University, Incheon, Korea.

Publications

Journal

1. **U. A. Mughal,** R. Atat and M. Ismail, " Robust Topology-aware Graph Neural Network-Based Intrusion Detection System for a Swarm of UAVs", in *IEEE Internet of Things* (2025). (IF = 8.2) (Under Review)

2. **U. A. Mughal,** R. Atat and M. Ismail, " Next-Gen Defense: an Architecture-Independent Sequential Ensemble Learning for Intrusion Detection in a Swarm of UAVs", in *IEEE Transactions on Intelligent Transportations Systems* (2025). (IF = 7.9) (Under Review)

3. **U. A. Mughal**, I. Ahmad, and C. Yuen, "Transformer-Based Intrusion Detection System for 5G-V2X Communication", in *IEEE Transactions on Consumer Electronics* (2025). (IF = 4.3) (Under Review)

4. I. Ahmad, R. Narmeen, **U.A. Mughal**, and M. Wen, "Quantum CNN for Detection and Identification of UAV-Enabled Non-Terrestrial Networks," in *IEEE Wireless Communication* (2025). (IF= 10.9) [Accepted]

5. I. Ahmad, R. Narmeen, **U. A. Mughal**, and K. H. Chang, " Optimizing Cell Association and Stability in Integrated Aerial-to-Ground Next-Generation Consumer Wireless Networks," in *IEEE Transactions on Consumer Electronics* (2024).Link (IF= 4.3)

6. **U. A. Mughal**, Y. Alkhrijah, and C. Yuen, "Deep Learning for Secure UAV-Assisted RIS Communication Networks", in *IEEE Internet of Thing Magazine* (2024).Link

7. S. C. Hassler, **U. A. Mughal**, and M. Ismail, "Cyber-Physical Intrusion Detection System for Unmanned Aerial Vehicles", in *IEEE Transactions on Intelligent Transportation Systems* (2023).Link (IF: 7.9) (code)

8. **U. A. Mughal**, J. Xiao, I. Ahmad, and K. H. Chang, "Cooperative Resource Management for Cellular V2I Communications in a Dense Urban Environment", in Elsevier *Vehicular Communications* 26 (2020): 100282.Link (IF=6.7) (code)

9. R. Narmeen, I. Ahmad, Z. Kaleem, **U. A. Mughal**, "Shortest Propagation Delay-Based Relay Selection for Underwater Acoustic Sensor Networks", in *IEEE Access*, vol. 9, pp. 37923-37935 (2021).Link (IF= 3.9) (code)

10. **U. A. Mughal** and K. H. Chang, "UAVs path planning by particle swarm optimization based on visual-SLAM algorithm", In Intelligent Unmanned Air Vehicles Communications for Public Safety Networks, pp. 169-197., *Springer Nature*, 2022.Link (code)

Conference

11. John Richeson, **U. A. Mughal**, A. Takiddin, and M. Ismail, "Ensemble Learning-Based Intrusion Detection System for Aerial Base Stations Against Adversarial Evasion Attacks", in *2025 IEEE International Conference on Communications (ICC-2025)*, Montreal, Canada. [Accepted]

12. I. Ahmad, R. Narmeen, **U.A. Mughal**, and M. Wen, "Securing the Skies: Intelligent Beamforming for UAV-RIS Communication", in *2025 IEEE International Conference on Communications (ICC-2025)*, Montreal, Canada. [Accepted]

13. **U. A. Mughal,** R. Atat and M. Ismail, "Graph Neural Network-based Intrusion Detection System for a Swarm of UAVs", in *2024 IEEE Military Communications Conference (MILCOM-2024),* Washington, DC, USA.Link

14. **U. A. Mughal**, M. Ismail and S. A. A. Rizvi, "Stealthy False Data Injection Attack on Unmanned Aerial Vehicles with Partial Knowledge", *2023 IEEE Conference on Communications and Network Security (CNS)*, Orlando, FL, USA, 2023, pp.1-9.Link (code)

15. **U. A. Mughal**, S. C. Hassler and M. Ismail, "Machine Learning-Based Intrusion Detection for Swarm of Unmanned Aerial Vehicles", *2023 IEEE Conference on Communications and Network Security (CNS)*, Orlando, FL, USA, 2023, pp. 1-9.Link (code)

16. Nafis Ahmad, **U. A. Mughal**, and KyungHi Chang, "3D Path Planning of Unmanned Aerial Vehicles", *in Proc. KICS*, Feb. 2020.Link

17. **U. A. Mughal**, I. Ahmad, and K. H. Chang, "Cellular V2X communications in unlicensed spectrum: Compatible coexistence with VANET in 5G systems", *in Proc. JCCI 2019: 29th Joint Communication and Information Conference*, May 2019.Link

18. **U. A. Mughal**, I. Ahmad, and K.H. Chang, "Virtual cells operation for 5G V2X communications", *in Proc. KICS*, Feb. 2019.Link

Software & Product

- **Developed C-V2X Simulator and delivers to Korea's MSIT (Ministry of Science, Information, and Technology)** Performance Analysis System Level Simulator in LTE-V2X Network Environment", *INHA University Industry-Academia Cooperation Foundation*, Program No. C-2019-024785, 2019-09-05. (simulator code)

- **Developed Link Adaptation Simulator and handed over to the Oceanic IT Convergence Research Centre, Korea** System Level Simulator for Link-Adaptation for Next-Generation Underwater Acoustic Communications Networks. (simulator code)

- **Developed Dataset executing cyber-attacks on an actual drone system and published it open sourced.** Cyber-Physical Dataset for UAVs Under Normal Operations and Cyber-attacks [Download on IEEE DataPort] (GitHub)

Skills in Software/Tools

- **Programming Languages:** Proficient in Python, Assembly, Shell Scripting, Java, and C/C++.
- **Machine Learning:** Keras, TensorFlow, Scikit-learn, Pandas,
- **Cybersecurity:** Scapy, Aircrack-ng, Nmap, Wireshark, Metasploit, Kali Linux
- **Development Tools**: Docker, Git, Jupyter Notebook, VS Code, VS Studio
- **Other**: Ardupilot, Arduino, Q-Groundcontrol, MATLAB
- **Cybersecurity Practices:** Threat Modeling, Intrusion Analysis, Penetration Testing, Forensics, Identity and Access Management (IAM), Cloud Security, and Malware Analysis.

Honors & Awards

Jungseok International Scholarship

- Funded M.S. studies at Inha University, South Korea

Tennessee Technological University

- Travel Fund, Centre for Energy Systems Research (CESR) (2023)
- Travel Fund, College of Engineering (2023)

KPK Government (Pakistan)

- Full Tuition Scholarship for Undergraduate Studies, KPK Government Talent Hunt Program
- Laptop Award for Best Performance, presented by Provincial Chief Minister Ameer Haider Khan Hoti

Services, Activities, and Professional Affiliations

Northwest Missouri State University Aug. - present

- Alternate Point of Contact, National Security Agency - Centre for Academic Excellence (NSA-CAE) since Sept. 2024
- Faculty advisor, Cyber Defense Club since Oct. 2024
- Affiliated Faculty, Center for Cybersecurity
- Faculty Advisor, Women in Cybersecurity (WiCyS) Conference since Sept. 2024
- Session host at Cyberpalooz – conducting practical cyber coding demos

Tennessee Technological University 2022- 2024

- AI-Assisted cybersecurity competition-2024, Led red and blue teams for offensive and defensive competitions
- Vice President, Computer Science Graduate Student Club (2022 – 2024)
- Member, Autonomous Vehicle Club (2022 – 2024)

Inha University (South Korea) 2018 – 2020

- Ambassador, International Graduate Student (2019 - 2020)
- Committee member, International Student Lounge (2019 - 2020)

Reviewer

- Reviewer, IEEE Transactions on Intelligent Transportation Systems
- Reviewer, IEEE Wireless Communications
- Reviewer, IEEE Internet of Things (IoT) Journal
- Reviewer, IEEE Transactions on Consumer Electronics
- Reviewer, Vehicular Communication, Elsevier Journal

Professional Membership

- Committee Member, ACM Workshop on Secure and Trustworthy Cyber-Physical Systems (SaT-CPS) Fall 2025 - present
- Member, IEEE Communication Society 2022 - present
- Registered Engineer, Pakistan Engineering Council, Accreditation No. ELECT/52138. 2015 - present

Talks and Meetings

- Graph Neural Network-based Intrusion Detection System for a Swarm of UAVs — October 2024
  IEEE Military Communication Conference (MILCOM-2024) — Washington DC, USA
- Stealthy False Data Injection Attack on Unmanned Aerial Vehicles — November 2023
  Computer Science Graduate Student Seminar, *Tennessee Technological University* — TN, USA
- Machine Learning-Based Intrusion Detection for Swarm of Unmanned Aerial Vehicles — October 2023
  IEEE Communications and Network Security Conference — FL, USA
- Stealthy False Data Injection Attack on Unmanned Aerial Vehicles with Partial Knowledge — October 2023
  IEEE Communications and Network Security Conference — FL, USA
- Invited Talk: Adversarial attacks on a drone Swarm with practical Demo — October 2023
  CEROC Advisory Board Committee, *Tennessee Technological University* — *TN, USA*
- Vulnerabilities and Drone Hijacking Demo — September 2022
  Cyber Discovery Day, *Tennessee Technological University* — TN, USA
- Technologies and cases for Cellular Vehicle-to-Everything (C-V2X) — April 2020
  Korea Telecom (KT) Corporation Research Centre — Seoul, Korea
- 5G-V2X for Intelligent Transportation Systems — February 2020
  Workshop, *Seoul National University* — Seoul, Korea
- 5G-V2X for Intelligent Transportation Systems — November 2019
  Information Technology Research Center (ITRC), *Ministry of Information Science and Technology* — Incheon, Korea
- Cellular V2X communications in unlicensed spectrum: Compatible coexistence with VANET in 5G systems — May 2019
  29th Joint Communication and Information Conference — Gangneung, Korea
- Virtual cells operation for 5G-V2X communications — February 2019
  Korea Communications Society Winter Conference — Yongpyeong, Korea

Reference

Reference will be provided upon request.