



Muhammad Usman Khan

[Redacted contact information]

WORK EXPERIENCE

Post-Doctoral Researcher

National-Inter-University Consortium for Telecommunications (CNIT) [01/02/2024 – Current]

City: Cesena | Country: Italy

- Designed a deep learning model for active user detection in CF-mMIMO.
- Working on large language models (LLMs) for summarizing and analyzing news articles.
- Presented the work titled "Optimizing Power Control and Pilot Allocation in Cell-Free Massive MIMO via Deep Learning" at the IEEE International Symposium on Personal, Indoor and Mobile Radio Communications (PIMRC) in Valencia, Spain.
- Attended the IEEE RTSI (Research and Technologies for Society and Industry) conference in Lecco, Italy, where I presented another work titled "Blind User Activity Detection for Grant-Free Random Access in Cell-Free mMIMO Networks."

Projects

1. Blind User Activity Detection for Grant-Free Random Access in Cell-Free mMIMO Networks

Designed a deep neural network to estimate the activity status of the users in CF-mMIMO without the need for large-scale fading coefficient estimation.

2. News That Travels in Space and Time

Developing large language model (LLM) for geolocating and time-stamping historical news archives, enabling seamless exploration of content across spatial and temporal dimensions.

Researcher

National-Inter-University Consortium for Telecommunications (CNIT) [01/01/2022 – 01/01/2024]

City: Cesena | Country: Italy

- As part of my collaboration with Huawei, I investigated deep learning approaches for multi-user detection, preamble detection, and power allocation and pilot assignment in massive machine-type wireless communication.
- Studied various multiple access protocols and wrote a simulator in MATLAB, to simulate multiple access protocols: ALOHA, Slotted ALOHA, Diversity Slotted ALOHA, Contention Resolution Diversity Slotted Aloha (CRDSA), CRDSA with Irregular Repetition Slotted ALOHA (IRSA) and Coded Slotted ALOHA (CSA).
- Investigated deep learning approaches for multi-user detection in massive machine-type wireless communication and grant-free access scenarios. Contributed to the report on research outputs and was responsible for taking meeting minutes.
- During the project's duration, I maintained regular monthly meetings with Huawei to present updates and review our progress. I undertook the task of documenting meeting minutes and emphasizing essential insights for the team's benefit.

Tutor

University of Bologna [20/09/2021 – 30/09/2022]

City: Cesena | Country: Italy

Tutor for the master's degree course "Elettronica dei Sistemi Digitali". Assisted students with lab activities. (30 hours)

Instructor

National University of Computer and Emerging Sciences [28/08/2016 – 29/10/2020]

City: Lahore | Country: Pakistan

I was working as a full-time faculty member at the School of Computing at the National University of Computer and Emerging Sciences, Lahore, Pakistan.

January 2020 – October 2020 I taught the following modules to undergraduate students:

- Digital Logic Design Laboratory (225 hours)
- Computer Organization and Assembly Language Laboratory (135 hours)
- Programming Fundamentals Laboratory (90 hours)

January 2019 – December 2019 I taught the following modules to undergraduate students:

- Operating Systems Laboratory (180 hours)
- Digital Logic Design Laboratory (135 hours)
- Programming Fundamentals Laboratory (135 hours)
- Character and Pattern Recognition Course (45 hours)

August 2016 – July 2017 I taught the following modules to undergraduate students:

- Computer Organization and Assembly Language Laboratory (180 hours)
- Digital Logic Design Laboratory (180 hours)

During this period, I also worked as a teaching assistant to help professors with the evaluation of assignments and quizzes for the course Computer Organization and Assembly Language (90 hours).

I was part of the Lab Instructor Coordination Committee and the National Computing Education Accreditation Council (NCEAC) committee. Improved lab scripts which greatly increased the students' learning outcomes. This boosted my confidence and improved my presentation skills.

Student Ambassador

University of Kent [31/01/2018 – 15/09/2018]

City: Canterbury | Country: United Kingdom

My role on the Unibuddy Scheme was to share my experience at the University of Kent with prospective students through blogs and chats. This role used my good communication skills.

Mentor

University of Kent [15/09/2017 – 15/09/2018]

City: Canterbury | Country: United Kingdom

Mentored Undergraduate Engineering students and undertook a course on mentoring. This has enabled me to develop qualities such as leadership skills and understanding different perspectives.

Course Representative

University of Kent [15/09/2017 – 15/09/2018]

City: Canterbury | Country: United Kingdom

Communicated all academic-related problems to the Student Support Manager, University of Kent. Contributed towards changes in the lab manual scripts to make them more understandable, requiring a great amount of communication and public speaking skills.

Research Assistant

ConSenSys [31/05/2016 – 29/07/2017]

City: Lahore | Country: Pakistan

Worked closely with the research group and achieved two research publications in reputed Journals. Gained teamwork and managing the load.

EDUCATION AND TRAINING

PhD Electronics and Communication Engineering

University of Bologna [31/10/2020 – 12/07/2024]

Address: via dell'Università, 50, 47521 Cesena (Italy) | **Website:** <https://www.unibo.it/> | **Field(s) of study:** Information and Communication Technologies | **Level in EQF:** EQF level 8 | **Thesis:** Deep learning for massive multiple access in 6G

- Worked on user detection, power allocation, and preamble detection in a grant-free random access massive Internet of Things (mIoT) scenario in the 6G system using deep learning.
- Presented a poster on "Deep Neural Network for Detecting Preambles in Asynchronous Random Access" at the GTTI reunion in Rome, Italy.
- Presented a poster at the "6G School" in Linköping, Sweden.
- Presented a poster at the "Restart Plenary Dissemination" in Bologna, Italy.
- Served as a reviewer for IEEE Access, IEEE OJAS, IEEE GLOBECOM, IEEE ICC, IEEE PIMRC, and IEEE WCNC.

Courses

- Communication Systems: Theory and Measurements
- Terza Missione (Third Mission)
- Introduction to Quantum Information
- Introduction to Semiconductors
- MIMO Wireless Systems
- Smart Beamforming Strategies
- Massive Multiple Access for 6G
- Elements of Machine Learning for Sensor and Edge Computing
- Neuromorphic Computing: From Spiking Neural Networks to Neuromorphic Accelerators

PhD Summer Schools

- Defining 6G: Theory, Applications, and Enabling Technologies, Autumn 2022, Linköping, Sweden.
- Machine Learning, Energy Efficient Electronics Science and ICT Applications, Summer 2022, Brixen, Italy.

Projects

- Enumeration and Identification of Active Users for Grant-Free NOMA using DNN.
- Preamble Detection in Asynchronous Random Access using Deep Learning
- Joint Power Control and Pilot Assignment in Cell-Free Massive MIMO
- mmWave Proof of Concept

Projects

1. Enumeration and Identification of Active Users for Grant-Free NOMA using DNN

Developed multiple access protocols for the massive Internet of Things (mIoT) in 6G. The project resulted in a journal publication that outlined the findings.

2. Preamble Detection in Asynchronous Random Access using Deep Learning

Developed multiple access protocols for the massive Internet of Things (mIoT) in 6G. The project resulted in a letter publication that outlined the findings.

3. Joint Power Control and Pilot Assignment in Cell-Free Massive MIMO

Joint Pilot and data power control and pilot assignment through DNN in the uplink of a CF-mMIMO network, where the number of users significantly exceeds that of the available orthogonal pilots.

4. mmWave Proof of Concept

Demonstrate proof of concept (POC) of mmWave communication in a 5G system through Quectel Evaluation Board.

MSc Advanced Electronic Systems Engineering

University of Kent [15/09/2017 – 22/11/2018]

Address: Giles Ln, CT2 7NZ Canterbury (United Kingdom) | **Website:** <https://www.kent.ac.uk/> | **Field(s) of study:** Engineering, manufacturing and construction | **Final grade:** Distinction - 84.33 % | **Level in EQF:** EQF level 7 | **NQF Level:** FHEQ 7 | **Type of credits:** ECTS | **Number of credits:** 90 | **Thesis:** Using Deep Learning Cancer Cell Classification

- Distinction - 84.33 %
- Awarded "The Bestway Foundation Scholarship"
- **Best Overall MSc Engineering Project**
- Best Project on the Advanced Electronic Systems Engineering Programme

Term 1

- Image Analysis with Security Application 85%
- Digital Signal Processing 95%
- Reconfigurable Architecture 90%
- Data Networks and the Internet 87%

Term 2

- Embedded RTOS 97%
- Advanced Pattern Recognition 84%
- Research Methods and Project Design 75%

MSc Project 81%

Individual Projects

1. Using Deep Learning Cancer Cell Classification (MSc Project)

Classification of the cancer cells, mainly found in ovaries, through the digital images of the cells under a microscope using a deep learning approach.

2. Video Graphics Array Controller

Design and Implementation on FPGA of a Video Graphics Array (VGA) Controller through **VHDL** model. I achieved 100% marks.

3. SAYEH Processor

Design and Implementation on FPGA of the SAYEH Processor through model based on VHDL. Beside the 100% marking, I was the only person who was able to complete the project.

Group Project

1. EEG Electrodes with Machine Learning Approach

Machine learning was adopted to reduce the number of electrodes needed for BCI applications using EEG. I proposed a CNN based architecture to reduce the number of electrodes.

B.S. Electrical Engineering

National University of Computer and Emerging Sciences [12/08/2012 – 29/06/2016]

Address: 852-B Milaad St, Block B Faisal Town, 54000 Lahore (Pakistan) | **Website:** <http://nu.edu.pk/> | **Field(s) of study:** Engineering, manufacturing and construction | **Final grade:** Cum-Laude - CGPA: 3.71/4.00 | **Level in EQF:** EQF level 6 | **Type of credits:** Credits | **Number of credits:** 139 | **Thesis:** Distributed Monitoring and Control of Building Utilities

Cum-Laude - CGPA: 3.71/4.00

- 2nd position in Electrical Engineering batch 12 Spring Semester, 2013 and 2015
- 4th position in Electrical Engineering 12 batch
- Dean's List in first six semesters

Group Projects

1. Distributed Monitoring and Control of Building Utilities (Final Year Project)

The design and implementation of a wireless sensor and actuator network for monitoring and control of building utilities. My role was to interface and calibrate the sensors and implements the software. The project won two Engineering Project Exhibition at the National Level.

2. Speed Control of DC Motor with PWM using Microcontroller 8051

Designed and implemented a Feedback Control Project that was capable of running a DC motor on the speed entered by the user. My role was to implement the software.

Individual Projects

1. Comparison between TCP and UDP using ns-3
2. Telephone Directory, Fish Aquarium and Checkers game using C++

LANGUAGE SKILLS

Mother tongue(s): Urdu

Other language(s):

English

LISTENING C1 **READING** C2 **WRITING** B2

SPOKEN PRODUCTION C1 **SPOKEN INTERACTION** C1

Levels: A1 and A2: Basic user; B1 and B2: Independent user; C1 and C2: Proficient user

DIGITAL SKILLS

Microsoft Office / Zoom / Google Drive / Skype / Social Media / Google Docs / Organizational and planning skills / Good listener and communicator / Motivated / Written and Verbal skills / Presenting / Microsoft Teams - Work From Home

PUBLICATIONS

[2024]

[M. U. Khan, E. Testi, M. Chiani, and E. Paolini, "Blind User Activity Detection for Grant-Free Random Access in Cell Free mMIMO Networks," accepted Proc. IEEE Res. Technol. Soc. Ind. \(RTSI\), 2024.](#)

[2024]

[M. U. Khan, E. Testi, M. Chiani, and E. Paolini, "Joint Power Control and Pilot Assignment in Cell-Free Massive MIMO using Deep Learning," in IEEE Open Journal of the Communications Society, vol. 5, pp. 5260-5275, 2024.](#)

[2024]

[M. U. Khan, E. Testi, M. Chiani, and E. Paolini, "Optimizing Power Control and Pilot Allocation in Cell-Free Massive MIMO via Deep Learning," accepted Proc. IEEE Int. Sym. on Personal, Indoor and Mobile Radio Commun. \(PIMRC\), 2024.](#)

[2024]

[M. U. Khan, "Deep learning for massive multiple access in 6G," PhD dissertation, University of Bologna, Italy, Oct. 2024.](#)

[2024]

[M. U. Khan, E. Testi, E. Paolini and M. Chiani, "Preamble Detection in Asynchronous Random Access Using Deep Learning," in IEEE Wireless Communications Letters, vol. 13, no. 2, pp. 279-283, Feb. 2024.](#)

[2022]

[M. U. Khan, E. Paolini, and M. Chiani, "Enumeration and identification of active users for grant-free NOMA using deep neural networks," IEEE Access, vol. 10, pp. 125 616-125 625, Nov. 2022.](#)

[2022]

[E. Paolini, L. Valentini, M. U. Khan, F. Babich, M. Comisso, and V. Tralli, 6G Wireless Systems: Enabling Technologies, ser. CNIT Technical Reports. Texmat, Roma, Italy, 2022, vol. 09, ch. Massive Multiple Access for 6G, pp. 137–158.](#)

[2020]
[D. Mzurikwao, M. U. Khan, O. W. Samuel, J. Cinatl, M. Wass, M. Michaelis, G. Marcelli, and C. S. Ang, "Towards image-based cancer cell lines authentication using deep neural networks," Scientific reports, vol. 10, no. 1, pp. 1–15, 2020.](#)

[2018]
[O. S. Bhatti, F. Abbas, M. U. Khan, M. A. Imtiaz, and S. Khalid, "Adaptive collaborative position control of a tendon-driven robotic finger," J. Control Eng. and Appl. Informat., vol. 20, no. 2, pp. 87–99, 2018.](#)

12.11.2024

