Muhammad Sarwar

PhD Student (Graduate Research Assistant)
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EDUCATION

2021-2025
- **Ph.D. Electrical Engineering (cont.)** (CGPA: 3.85)
  Iowa State University, Ames, IA, USA
- **Ph.D. Advisor:** Professor Venkataramana Ajjarapu, *Fellow IEEE*
- **Relevant Courses:** Energy Systems Planning, Voltage Stability, Optimal Control, Linear Systems, Linear Programming, Machine Learning, Deep Learning
- **Research:** "*Data-driven Control of DERs and IBRs for Improvement in Power System Voltage Performance and Stability*"

2014-2016
- **M.S Electrical Engineering** (CGPA: 3.91, Gold Medal recipient for *Summa cum Laude*)
  Pakistan Institute of Engineering & Applied Sciences (PIEAS) Islamabad, Pakistan
- Major: Electrical Power & Control Engineering
- **R**elevant Courses: Power System Analysis & Design, Power System Stability & Control, Distributed Generation & Smart Grids, Robust Control in Power Systems
- **Thesis:** "*Grid Connected Operation of Central Power Plants: Fault Ride Through, Voltage Regulation and Frequency Control Aspects*" – Received Best Thesis Award

2010-2014
- **B.Sc. Electrical Engineering** (CGPA: 3.87, Gold Medal recipient for *Summa cum Laude*)
  The Islamia University of Bahawalpur (IUB), Bahawalpur, Pakistan
- Major: Electrical Power Engineering
- **R**elevant Courses: Power System Operation & Control, Power System Analysis, Power System Protection, High Voltage Engineering, Linear Control Systems
- **Final Year Project:** "*Real Time Smart Monitoring, Analysis & Control of Lab-based Microgrid Through Hardware-in-the-Loop (HIL) Simulation*"
- **Role:** Led a team of 6 group members, acquired a funding of 100,000/- PKR and secured 1^{st} position in 6^{th} IEEE Annual Engineering Project Exhibition

PROFESSIONAL EXPERIENCE

2021–
- **Graduate Research Assistant** at the Department of Electrical & Computer Engineering (Iowa State University, Ames, IA)
- Conducting research on Voltage Stability Monitoring and Control of transmission and distribution systems
- Developing a framework for modeling and analysis of Transmission and Distribution systems with high percentage of inverters-based resources
- Data-driven control of T&D systems with high penetration of IBRs using deep reinforcement learning (DRL)

May-Aug24
- **PhD Research Intern** at the Electric Power Research Institute (EPRI) (Knoxville, TN, USA)
- Worked on assessing the impact of Grid-Forming inverters for providing essential reliability services and support to power grids.

May-Aug23
- **PhD Research Intern** at the Electric Power Research Institute (EPRI) (Knoxville, TN, USA)
- Worked on the sensitivity analysis to determine critical locations for Grid-Forming inverters for voltage support to the system.

Jun-Aug22
- **PhD Research Intern** at the Pacific Northwest National Lab (PNNL) (Richland, WA, USA)
- Collaborated with Power System Analytics and Grid Resilience teams in the Electricity Security Group at PNNL to develop an automated and scalable tool for estimating reduced ordered (ROM) models for distribution systems
- The ROM tool was shared with partner utilities to integrate with their distribution energy management systems

PROFESSIONAL EXPERIENCE (continued)

- Delivered the project to DOE within the deadline and allocated budget.

2016-2021
- **Lecturer** in the Department of Electrical Engineering, PIEAS, Islamabad, Pakistan
- **Undergraduate Level Courses:** Power System Protection, Power System Analysis, Calculus-II, Electrical Power Systems
- Designed and implemented a Course & Program Learning Outcome (CLO/PLO) assessment software for Outcome Based Assessment

2014-2016
- **Research Fellow** at the Department of Electrical Engineering, Pakistan Institute of Engineering & Applied Sciences (PIEAS), Islamabad, Pakistan
- Secured fully-funded fellowship by PIEAS for M.S Electrical Engineering
- Completed Fellowship with Honors and was awarded the President's Gold Medal
- Certificate of Appreciation for the Best Thesis and Certificate of Merit for distinction in class

RESEARCH INTERSTS

- Voltage Stability of Power Systems with high penetration of inverter based resources (IBRs)
- Modeling of hybrid PV Plants (Battery Energy Storage System with Solar PV plants)
- Computational & Artificial Intelligence techniques in Power System
- Grid strength assessment of high-IBR low-inertia power systems
- Hybrid power system co-simulations with positive sequence + EMT models
- Dynamic Transmission and Distribution Co-simulation of Power System

Software Tools & Programming Languages

Languages
- MATLAB, Python, Julia, C++

Tools
- {PSS/E, PSCAD, OpenDSS} [with Python APIs], GridLab-D, PLECS, PyTorch, TensorFlow, CPLEX, Gusek

PUBLICATIONS

- **M. Sarwar**, V Ajjarapu, ARR Matavalam, S Roy, H Villegas-Pico "Short-term Voltage Stability Improvement in Powe System through Grid-forming Hybrid PV Plants", accepted for publication in IEEE Transactions on Industry Applications
- Mohammad Almomani, **Muhammad Sarwar**, Venkataramana Ajjarapu "Novel Data-Driven Indices for Early Detection and Quantification of Short-Term Voltage Instability from Voltage Trajectories ," accepted for publication in 2025 IEEE Power & Energy Society General Meeting (PESGM), Austin, TX
- Mohammad Almomani, **Muhammad Sarwar**, Venkataramana Ajjarapu "Enhanced Entropy-Based Metric for Characterization of Delayed Voltage Recovery," accepted for publication in 2025 IEEE Power & Energy Society General Meeting (PESGM), Austin, TX
- **M. Sarwar**, ARR Matavalam, V Ajjarapu, "Deep Reinforcement Learning Framework for Short-Term Voltage Stability Improvement", 2023 Texas Power and Energy Conference (TPEC), College Station, TX, USA, October 2022
- **M. Sarwar**, ARR Matavalam, V Ajjarapu, "Characterization and Mitigation of Fault Induced Delayed Voltage Recovery with Dynamic Voltage Support by Hybrid PV Plants", 2022 North American Power Symposium, Utah, USA, October 2022
- Sohail, Irtaza, Babar Hussain, M. Abubakar, Intisar Ali Sajjad, M. Faisal Nadeem, and **Muhammad Sarwar**. "SC currents minimization in distributed generation embedded distribution networks with optimal application of FCLs." CSEE Journal of Power and Energy Systems (2020).
- **Muhammad Sarwar**, Faisal Mehmood, Muhammad Abid, AQ Khan, Adil Sarwar Khan, "*High Impedance Fault Detection and Isolation in Power Distribution Networks using Support Vector Machines*", King Saud Journal of Engineering Sciences, ISSN 1018-3639, https://doi.org/10.1016/j.jksues.2019.07.001
- Khan, A. S., Khan, A. Q., Iqbal, N., **Sarwar, M.**, Mahmood, A., & Shoaib, M. A. (2020). Distributed fault detection and isolation in second order networked systems in a cyber–physical environment. ISA transactions, 103, 131-142.

PUBLICATIONS (continued)

- Abdul Qayyum Khan, Qudrat Ullah, **Muhammad Sarwar**, Sufi Tabassum Gul, and Naeem Iqbal. "*Transmission Line Fault Detection and Identification in an Interconnected Power Network using Phasor Measurement Units*" IFAC-PapersOnLine 51, no. 24 (2018): 1356-1363
- M. Abubakar, **M. Sarwar**, S. Mehboob and B. Hussain, "Development of Real Time Simulation Model for Resistive Type Fault Current Limiter," 2019 IEEE PES Innovative Smart Grid Technologies Europe (ISGT-Europe), Bucharest, Romania, 2019, pp. 1-5. doi: 10.1109/ISGTEurope.2019.8905742
- **M. Sarwar**, M. Mehmood, M. Azam, K. N. Fatima, M. Abubakar and B. Hussain, "Design and Implementation of an Automatic Synchronizing and Protection Relay through Power-Hardware-in-the-Loop (PHIL) Simulation," International Conference on Emerging Technologies (ICET), Peshawar, Pakistan, 2019, pp. 1-6.
- **M. Sarwar**, B. Hussain, A. Hussain and M. Abubakar, "Improvement of Fault Ride Through Capability of DFIG-based Wind Turbine Systems Using Superconducting Fault Current Limiter," 2019 IEEE Innovative Smart Grid Technologies - Asia (ISGT Asia), Chengdu, China, 2019, pp. 4019-4024. doi: 10.1109/ISGT-Asia.2019.8881155
- M. Abubakar, **M. Sarwar**, T. H. Khan, M. Sarmad and B. Hussain, "Real-time Implementation of Directional Over-current Protection Coordination in a Microgrid," 2018 International Symposium on Recent Advances in Electrical Engineering (RAEE), Islamabad, Pakistan, 2018, pp. 1-6. doi: 10.1109/RAEE.2018.8706888
- **Muhammad Sarwar**, Bilal Asad, "*A Review on Future Power Systems; Technologies and Research for Smart Grids*", 2016 International Conference on Emerging Technologies (ICET), Islamabad, 2016, pp. 1-6. doi: 10.1109/ICET.2016.7813247

Poster Presentations

2024 • **Muhammad Sarwar**, "Data Drive Control of DERs and Hybrid PV Plants to Improve Power System Short-term Voltage Stability," 61st annual meeting of the Electric Power Research Center at Iowa State University, Ames, IA, USA (won 1st prize in the poster competition)

2023 • **Muhammad Sarwar**, "Identification and calibration of critical control parameters in smart inverter dominated distribution systems," 60th annual meeting of the Electric Power Research Center at Iowa State University, Ames, IA, USA (won 2nd prize in the poster competition)

2022 • **Muhammad Sarwar**, "Data-Driven Control of DERs & Hybrid PV Plants for Enhancing Voltage Stability with TSO-DSO Interactions Over Multiple Timescales," presented in industrial advisory board (IAB) meeting of Power System Engineering Research Center (PSERC), Texas A&M University, College Station, TX, USA (won the first prize in the poster competition)

ACADEMIC HONORS, AWARDS AND DISTINCTIONS

2025 • Sidebottom Fellow for the Year 2024-2025

2024 • First position in poster competition at the Electric Power Research Center Annual Meeting held at Iowa State Univesity, Ames, IA

2024 • Sidebottom Fellow for the Year 2023-2024

2023 • Second place in the poster competition in the EPRC Annual meeting held in Texas A&M University, Dec 2023

2022 • First position in the poster competition in the PSERC Industrial Advisory Board (IAB) meeting held in Texas A&M University, Dec 2023

2021 • Graduate Research assistantship funded by the Power System Engineering Research Centre (PSERC) and National Science Foundation (NSF)

2019 • Travel grant funding by the Pakistan Science Foundation for attending 2019 IEEE PES ISGT Conference in Chengdu, China

2016 • Gold Medal in M.S Electrical Engineering from PIEAS, Islamabad, Pakistan
• *Certificate of Merit* for distinction in M.S Electrical Engineering
• *Certificate of Appreciation* for Best Thesis in M.S Electrical Engineering

2014 • Fellowship for M.S. Electrical Engineering, Pakistan Institute of Engineering and Applied Science, Islamabad, Pakistan worth 8,00,000/- PKR

2014 • Gold Medal in B.Sc Electrical Engineering
• *Certificate of Distinction* for Best Final Year Project in Power Engineering category at 6th IEEE AEPEX, UCET, IUB

ACADEMIC HONORS, AWARDS AND DISTINCTIONS (continued)

- ICT R&D Fund'S National Grassroots Research Initiative (NGIRI) grant of PKR 100,000/- for B.S Final Year Project
- On Dean's List from 2^{nd} to 8^{th} semester for Distinction in BSEE

2013 • 1st Position in Matlab Competition at IEEE Congress MUET - October 2013

PROFESSIONAL ASSOCIATION

- Graduate Student Member IEEE
- Member IEEE Power and Energy (IEEE PES) Society
- Member IEEE Eta-Kappa-Nu (HKN) Society
- Life-Time Member of Pakistan Engineering Council as Registered Engineer

ADMINISTRATIVE & COMMUNITY SERVICES

2019 • **Registration Chair** of IEEE symposium on Recent Advances in Electrical Engineering being held on August 28-29, 2019 at PIEAS, Islamabad, Pakistan

• **Member of Technical Committee** of IEEE symposium on Recent Advances in Electrical Engineering held on August 17-18, 2019 at PIEAS, Islamabad, Pakistan

2017 • **Registration Co-Chair** of IEEE symposium on Recent Advances in Electrical Engineering held on October 23-26, 2017 at PIEAS, Islamabad, Pakistan

• **Member of Technical Committee** of IEEE symposium on Recent Advances in Electrical Engineering held on October 23-26, 2017 at PIEAS, Islamabad, Pakistan

2016-Present • **Reviewer: Conferences**

- IEEE symposium on Recent Advances in Electrical Engineering, August 2017-2020 (4 years), Islamabad Pakistan
- IEEE Power and Energy Society General Meeting (PESGM)
- IEEE Texas Power and Energy Conference (TPEC), College Station, TX
- IEEE North American Power Symposium (NAPS)

2017-Present • **Reviewer: Journals**

- IEEE Transactions on Power Systems
- IEEE Transactions on Industry Applications
- IET Generation, Transmission and Distribution
- King Saud Journal of Engineering Sciences