Narayan Bhusal, Ph.D. (PE Passed)

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Objective: A highly motivated and detail-oriented researcher and engineer specializing in power systems, machine learning applications, and energy resilience. With over 6 years of experience in developing innovative solutions for energy grid reliability, I seek to leverage my expertise to enhance the resilience of cyber-physical energy systems.

EDUCATION

University of Nevada, Reno, Reno, Nevada USA
- PhD in Electrical Engineering (Power System) 2019 – 2021
  - Dissertation: Bridging Machine Learning for Smart Grid Applications

University of Nevada Las Vegas, Las Vegas, Nevada, USA
- M.S. in Electrical Engineering 2016 – 2018
  - Thesis: The Combine effect of high PV and EV penetration on CVR in a distribution system

Institute of Engineering, Pulchowk Campus, Tribhuvan University, Pulchowk, Lalitpur, Nepal
- B.E. in Electrical Engineering 2011 – 2015
  - Final year project: Peak Load Energy Management Using Secondary Battery Coupling System in Micro-Hydro

RESEARCH INTEREST

• Resilience, Reliability, Cyber-Security, and Stability enhancement of Cyber-Physical Energy Systems • Application of Machine Learning on Power System • Virtual Inertia • Distributed Energy Resources • Tertiary Reserve Market • Utility Scale Shared Energy Storage

TECHNICAL SKILLS

• Softwares and Simulation Environments: Python, OpenDSS, SYNERGI, CYME, MATLAB, GridLAB-D, ASPEN, RSCAD/RTDS • Mathematical programming: Gurobi

PROFESSIONAL EMPLOYMENT HISTORY

Research Professional, Oak Ridge National Laboratory May 2023-Current
- Developed analytical tools and methodologies for resilience ranking, outage cost estimation, and power outage-weather mapping, leading to improved decision-making for grid operators.
- Designed and refined grid frequency and waveform analytics frameworks for event detection and robust data integration, enhancing the reliability of the grid.
- Contributed to distribution planning to enhance grid resilience and adaptability to future challenges.
- Advancing critical customer estimation methods and integrated resilience metrics to assist stakeholders in resource prioritization for vulnerable communities.
- Performed economic studies to optimize Volt-VAR control strategies, improving grid efficiency and operational cost-effectiveness.

Principal Engineer, Quanta Technology LLC Mar 2023-May 2023
- Area planning for LUMA Energy. Technical lead for N-1 contingency analysis and solution mitigation (Synergi-Python). Developed N-1 analysis strategy for feeder/transformer/substation level analysis using python, graph theory, and Synergi-integrated automation scripts. Recommending N-1 solution mitigation.
- Technical Lead SDG&E Load Transfer Analysis. Developing peak load and optimal load-based load transfer scenarios for breaker/bus bar/substation/feeder level analysis using python, graph theory, and Synergi-integrated automation scripts. Developing SAIFI/SAIDI-based justification for new investments.
- Technical Lead for Entergy Recloser placement project. Developing a Recloser placement strategy and automation scheme based on different criteria.

Senior Engineer, Quanta Technology LLC Dec 2021 – Mar 2023
- Engineering analysis and studies of distribution system resiliency, reliability, hosting capacity, distributed energy resource integration, scenario planning, load transfer analysis, and system impact studies through power system analysis tools and various programming languages interface.
- Automated the device placement and reliability analysis for several feeders of the LUMA (Synergi and Python Integration).
- Developed the automation scripts for the load transfer analysis of several SDG&E substations, this script has reduced the analysis time of a substation from a couple of weeks to a couple of days. (Synergi, Python, and Graph Theory Integration).

- Developed automation scripts for the SCE scenario planning project (CYME and Python integration).
- Supporting the Entergy VVO project to resolve several issues associated the some of the Entergy feeders.
- Developing automation scripts for load transfer plan to act as a first response on N-1 contingency situation (CYME, Python, and Graph Theory Integration) for PEPCO.
- Fiona storm restoration and resilience justification project.
- Area planning for LUMA Energy. Developed several scripts for load allocation, tie switch identification, and mainline reconductoring. Technical lead for N-1 contingency and Reliability analysis and solution mitigation (Synergi-Python).

NSF-funded Collaborative Researcher, Quanta Technology LLC, Raleigh, NC Feb 2021 – Jul 2021

- Estimating the hosting capacity of the real distribution system to EVs and PVs using python and Synergi. Performed the load transfer analysis to determine how hosting capacity is going to be impacted when considering different operational criteria. Large scale modeling of the electric vehicles (light duty, heavy duty) considering various factors such as travel time, temperature, seasons, etc.
- Studying Implication of Existing Hosting Capacity Tools. Developing Hosting Capacity Streamlining Tool (development of Synergi-Python integrated backend process script).
- Performing the system Impact study of the integration of CI&S programs (e.g. integration of EVs, PVs, Smart Thermostate, and other demand response programs)
- Developed LUMA model conditioning script development to improve the models, wrote the script to deal with phase mismatch, unfed sections, transformer and regulator mismatch, load allocation, customer allocation, critical customer allocations, etc.

Graduate Research/Teaching Assistant (NSF and DOE Funded Projects), E- RESILIENCY Research Laboratory, University of Nevada, Reno Jan 2019 – Aug 2021

- Developing resilience enhancement tools and methodologies using Reinforcement Learning.
- Quantifying the resilience value of solar plus storage for City of Reno (a Solar Energy Innovation Network (SEIN) project, supported by US DOE and facilitated by NREL).
- Machine/Deep learning application for resilience enhancement of cyber-physical energy systems. Specifically, detecting cyber-threats in cyber-physical power system using machine/deep learning based approaches.
- Developing resilience metrics and evaluation methods for the future grid (funded by NSF).
- Teaching assistant for the electric circuit class, tutoring, and preparing teaching materials.

Graduate Teaching/Research Assistant, University of Nevada Las Vegas Aug 2016 – Dec 2018

- Supervised Electrical Power Engineering (EE340L) to conduct the various tests on three-phase circuits, Power Transformer, Transmission line, DC Motor, Synchronous Generator, Asynchronous Generator, and Synchronization of Power Grid.
- Prepared lecture material for different classes.
- Testing Diesel generator for various parameter estimation (Capacitor and Resistor load rejection test to estimate the electrical and mechanical parameter of diesel generator set).

SELECTED PUBLICATIONS

- **N. Bhusal**, M. Abdelmalak, M. Kamruzzaman and M. Benidris, “Power System Resilience: Current Practices, Challenges, and Future Directions,” in IEEE Access, vol. 8, pp. 18064–18086, 2020.
- **N. Bhusal**, R.M. Shukla, M. Gautam, M. Benidris, S. Sengupta, Deep ensemble learning-based approach to real-time power system state estimation, International Journal of Electrical Power & Energy Systems, Volume 129, 2021, 106806.
- **N. Bhusal**, M. Gautam, and M. Benidris “Detection of cyber attacks on voltage regulation in distribution systems using machine learning,” IEEE Access 9 (2021): 40402-40416
- **N. Bhusal**, M. Gautam, and M. Benidris, “Sizing of Movable Energy Resources for Service Restoration and Reliability Enhancement”, Power and Energy Society General Meeting 2020, pp. 1–5.
- M. Kamruzzaman, **N. Bhusal**, and M. Benidris, “Determining Maximum Hosting Capacity of Electric Distribution Systems to EVs,” 2019 IEEE IAS Annual Meeting, Baltimore, MD, USA, 2019, pp. 1–7.
- S. M. Lee, S. Chinthavali, **N. Bhusal**, N. Stenvig, A. Tabassum and T. Kuruganti, ”Quantifying the Power System Resilience of the US Power Grid Through Weather and Power Outage Data Mapping,” in IEEE Access, vol. 12, pp. 5237–5255, 2024
- **N. Bhusal**, M. Gautam, M. Benidris, and S.J. Louis ”Optimal sizing and siting of multi-purpose utility-scale shared energy storage systems.” In 2020 52nd North American Power Symposium (NAPS), pp. 1-6. IEEE, 2021.

- **N. Bhusal**, M. Gautam, M. Abdelmalak and M. Benidris, "Modeling of Natural Disasters and Extreme Events for Power System Resilience Enhancement and Evaluation Methods," 2020 PMAPS, Liege, Belgium, 2020, pp. 1–6.
- **N. Bhusal**, M. Gautam, and M. Benidris "Cybersecurity of electric vehicle smart charging management systems," In 2020 52nd North American Power Symposium (NAPS) (pp. 1-6). IEEE.
- Gautam, M., MansourLakouraj, M., Hossain, R., **Bhusal, N.**, Benidris, M., & Livani, H. (2024). Enabling Active Distribution Systems' Participation in Tertiary Frequency Regulation through Coalitional Game Theory-based Reserve Allocation. IEEE Access.
- Gautam, M., **Bhusal, N.**, & Ben-Idris, M. (2023). Postdisaster Routing of Movable Energy Resources for Enhanced Distribution System Resilience: A Deep Reinforcement Learning-Based Approach. IEEE Industry Applications Magazine.
- **N. Bhusal**, M. Gautam, R.M. Shukla, M. Benidris, and S. Sengupta, "Coordinated data falsification attack detection in the domain of distributed generation using deep learning," International Journal of Electrical Power & Energy Systems 134 (2022): 107345.
- M. Kamruzzaman, **N. Bhusal**, and M. Benidris, "A convolutional neural network-based approach to composite power system reliability evaluation," International Journal of Electrical Power & Energy Systems 135 (2022): 107468.
- M. Gautam, **N. Bhusal**, and M. Benidris, "A Cooperative Game Theory-based Approach to Sizing and Siting of Distributed Energy Resources," In 2021 North American Power Symposium (NAPS), pp. 01-06. IEEE, 2021
- **N. Bhusal**, A. Sadikovic, M. Ben-Idris, "Implication of Hosting Capacity Approaches", CIGRE Grid of the Future, pp 1-10.
- M. Benidris, **N. Bhusal**, M. Abdelmalak, M. Gautam, S. Groneman, and T. Farkas " Quantifying Resilience Value of Solar plus Storage in City of Reno." In 2021 Resilience Week (RWS), pp. 1-6. IEEE, 2021.
- M. Gautam, **N. Bhusal**, and M. Benidris "Deep Q-Learning-based Distributed Network Reconfiguration for Reliability Improvement", IEEE T&D Conference & Exposition, 2022.
- M. Gautam, **N. Bhusal**, R. Mishan, M. MansourLakouraj, M. Ben-Idris, and H. Livani, "Enabling Active Distribution Systems to Participate in Frequency Regulation: A Cooperative Game Theory-based Approach", ISGT 2022.
- M. Gautam, **N. Bhusal**, J.Thapa, and M. Benidris, "A cooperative game theory-based approach to formulation of distributed slack buses." Sustainable Energy, Grids and Networks 32 (2022): 100890.
- M. Gautam, R. Hossain, M. MansourLakouraj, **N. Bhusal**, M. Benidris and H. Livani, "A Deep Reinforcement Learning-based Reserve Optimization in Active Distribution Systems for Tertiary Frequency Regulation, "2022 IEEE Power & Energy Society General Meeting (PESGM), 2022, pp. 1–5.

PROFESSIONAL MEMBERSHIP

- Member, Institute of Electrical and Electronics Engineers (IEEE)
- Member, IEEE Power and Energy Society

CERTIFICATION

PE Power Exam Passed
Engineering In Training (certification number: 0T7984)

SCHOLARSHIPS AND AWARD

• **NSF Non-Academic Research Internships Award for Graduate Students (INTERN) (FY 2020–2021)** • Fall 2020 Outstanding Graduate Student Scholarship • Impact Research Award- Summer 2017 • Graduate College Recruitment Scholarship at UNLV • Merit-Based Full Scholarship throughout Undergraduate Level

VOLUNTEER EXPERIENCE

Volunteer Staff at University of Nevada Las Vegas Jul 2018 – Jan 2019
Volunteered IEEE IAS Electrical Safety Workshop 2020

Peer-review: Aug 2019 – present

• IEEE Transactions on Smart Grid • IEEE Transactions on Power System • IEEE Access • Future Generation Computer Systems (Elsevier) • Reliability ENgineering & System Safety (Elsevier) • IEEE Transaction on Industry Application

• Electric Power Research Journal (Elsevier) • IAEE Energy Journal • IEEE Power and Energy General Meeting Conference; • SEST 2021 • ELectrical Energy (Springer) • IEEE PES ISGT NA 2022