

# Sunil Subedi

## Curriculum Vitae

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## Personal Information

### Professional Appointments

Aug. 2023 – Present	Postdoctoral Research Associate, Oak Ridge National Laboratory (ORNL), Knoxville, TN, USA
May. 2020 – Aug. 2023	Graduate Research Assistant, South Dakota State University (SDSU), Brookings, SD, USA
May 2022 – Dec. 2022	Graduate III Electrical Engineering Research Intern, National Renewable Energy Laboratory (NREL), Golden, CO, USA
Aug. 2019 – May 2020	Graduate Teaching Assistant, South Dakota State University (SDSU), Brookings, SD, USA
Oct. 2018 – Apr. 2019	Electrical Engineering Intern, Nepal Electricity Authority (NEA), Bharatpur, Chitwan, Nepal

### Education

<i>Date</i>	<i>Degree</i>	<i>School</i>
2023	Ph.D. Electrical Engineering GPA: 4.0 (4.0 Scale)	South Dakota State University (SDSU), Brookings, SD, USA
2018	B.E. Electrical Engineering GPA: 3.38 (4.0 Scale)	Tribhuvan University (TU), Kathmandu, Nepal

#### *Doctoral Dissertation:*

“Automatic Data-Driven Partitioned Modeling of Power System Dynamics with Smart Power Electronic Inverters”

#### *Doctoral Advisor:*

Timothy M. Hansen, SDSU

## Awards and Honors

- 2024 Recipient of “**Outstanding Reviewer for 2024 IEEE Transactions on Sustainable Energy**” from IEEE PES. Recognition for exceptional reviewer for IEEE TSTE 2024.
- 2024 Recipient of “**Best Postdoc in Research Award**” in Oak Ridge National Laboratory, by ORPA, Sept. 2024. Recognized for signification contributions in the field of research by innovative approaches, publications, and collaborations.
- 2024 Nominated for “**ORNL Teamwork Core Value Empower Staff**” in Oak Ridge National Laboratory, May 2024.
- 2024 Recipient of “**Supplemental Performance Award (SPA) 2024**” in Oak Ridge National Laboratory. Recognized for exceeding expectations on project deliverables or performing above-normal job duties with a financial reward of \$1500.
- 2024 Winner in “**2024 SDSU Distinguished Dissertation Award**” at South Dakota State University. Recognized with a financial reward of \$250 for the university-wide best dissertation of 2023-2024, demonstrating impactful work among peers.
- 2023 Second place winner in “**IEEE Power and Energy Society Ideathon’23**”, Dec. 2023.
- 2021 **EPSCoR South Dakota Discovery Center Science Communication Fellow**, Fall 2021.
- 2017 “**Academic Excellence Award**” at Kathmandu Engineering College, Kathmandu, Nepal. Recognized as one of the top two students in a cohort of 44 for this award.
- 2014-2018 “**Scholarship for Semester Excellence**” at Kathmandu Engineering College, Kathmandu, Nepal. Recognized as one of the top two students in a cohort of 44, with a financial reward of \$1000 for achieving the highest rank in each semester. Received this prestigious honor five times out of eight semesters.

## Research Interest

• Grid Integration of Distributed Renewable Energy Resources • Power System Dynamic Modeling • Stability Analysis • Application of Machine Learning in Converter Dominated Power Systems • Protection Enhancement on Cyber-Physical Power Systems • Dynamic Estimations Techniques • Data-Driven Dynamic Modeling of Smart Inverters • Microgrid • Digital Twin

## Experience

- **Postdoctoral Research Associate, Oak Ridge National Laboratory (ORNL)**
  - **Project 1:** Dynamic Security Enhancement Platform of Converter Interfaced Resource Rich Power Grids Using a Power Grid and Protection Co-Model
    - \* Developed detailed physics-based, data-driven, and hybrid models for power electronic converters.
    - \* Developed an optimization-based observer to enhance fault detection and isolation capabilities in converter-rich power systems.
  - **Project 2:** Integrated Multi-Fidelity Model and Co-Simulation Platform for Distribution System Transient and Dynamic Analysis-DistribuDy (Technical Lead)
    - \* Developed deep learning-based dynamic models for three-phase inverter-based resources (IBRs).
    - \* Integrated deep-learning black-box models of power electronic IBRs and motor-driven loads into the open-source power simulation tool, *GridLAB-D*, for dynamic studies.
  - **Project 3:** Hydro Power Plant Modeling – Digital Twin
    - \* Formulated an optimization-based estimator to estimate the coefficients of the hydro-turbine model in hydropower systems.
    - \* Developing deep learning-based digital twin model for Kaplan Turbine-Generation Hydro Power Systems.

**Graduate III-Electrical Engineer Intern, National Renewable Energy Laboratory (NREL)**

- Modeled reduced 240-bus WECC test system and high IBR penetration scenarios in PSS/E.
- Conducted a cost-benefit analysis and assessed the technical potential of fast frequency response in grid-supportive end-use electronics, informing strategies for enhancing grid stability.

**Graduate Research Assistant, South Dakota State University (SDSU)**

- Developed a data-driven partitioned modeling approach to streamline computational complexity and reduce simulation time for converter-dominated power systems.
- Characterized smart commercial inverter dynamics in hardware-in-the-loop testbed using Opal-RT real-time simulator system.

**Intern Electrical Engineer, Nepal Electricity Authority (NEA)**

- Assisted distribution system fault analysis for residential and industrial regions.

## Research Activities

### Journal Publications

- [J10] **Sunil Subedi** and Yaosuo Xue, “Dynamic modeling and validation of deep learning-based commercial grid-following DER model in an open-source solver,” *IEEE Trans. Smart Grid*, (To be Submitted).
- [J9] **Sunil Subedi**, Yonghao Gui, and Yaosuo Xue, “Hybrid dynamic modeling and validation of smart inverter using hardware-in-the-loop data,” *IEEE Trans. Power Electron. Letters*, (In Review).
- [J8] **Sunil Subedi**, Yonghao Gui, and Yaosuo Xue, “Bidirectional long short-term memory-based dynamic modeling of three-phase inverter,” *IEEE Trans. Ind. Electron.*, (In Review).
- [J7] Jesus D. Vasquez-Plaza, **Sunil Subedi**, *et al.*, “Aggregated inverter-based generator model parameterization via online moving horizon estimation using a DER\_A smooth mathematical representation,” *IEEE Trans. Smart Grid*, (In Review).
- [J6] Bidur Poudel, Nischal Guruwacharya, **Sunil Subedi**, Ujjwol Tamrakar, Felipe Wilches-Bernal, Hossein Moradi Rekabdarkolaee, Timothy M. Hansen, and Reinaldo Tonkoski, “Experimentation in exploring photovoltaic inverter dynamics under different irradiance levels through a data-driven approach,” *IEEE Access*, vol. 12, pp. 164137–164150, Oct 2024.
- [J5] **Sunil, Subedi**, Yonghao Gui, and Yaosuo Xue, “Applications of data-driven dynamic modeling of power converters in power systems: An overview,” *IEEE Transactions on Industry Applications*, 2025, early-access, doi:10.1109/TIA.2025.3529797.
- [J4] **Sunil Subedi**, Jesus D. Vasquez-Plaza, Fabio Andrade, Hossein Moradi Rekabdarkolaee, Robert Fournay, Reinaldo Tonkoski, and Timothy M. Hansen, “Aggregated Dynamic Partition Modeling for Active Distribution Network for Stability Studies,” *IET Renewable Power Generation*, July 2024.
- [J3] **Sunil Subedi**, Bidur Poudel, Pooja Aslami, Robert Fournay, Hossein Moradi Rekabdarkolaee, Reinaldo Tonkoski, and Timothy M. Hansen, “Automated data-driven model extraction and validation of inverter dynamics with grid support function,” *e-Prime-Advances Elect. Eng. Electron. Energy*, vol. 6, p. 100365, 2023.
- [J2] **Sunil Subedi**, Nischal Guruwacharya, Bidur Poudel, Jesus D. Vasquez-Plaza, Fabio Andrade, Robert Fournay, Hossein Moradi Rekabdarkolaee, Timothy M. Hansen, and Reinaldo Tonkoski, “Leveraging data-driven models for accurate analysis of grid-tied smart inverters dynamics,” *arXiv*, 2023.

- [J1] **Sunil Subedi**, Manisha Rauniyar, Saima Ishaq, Timothy M. Hansen, Reinaldo Tonkoski, Mariko Shirazi, Richard Wies, and Phylisia Cicilio, "Review of Methods to Accelerate Electromagnetic Transient Simulation of Power Systems," *IEEE Access*, vol. 9, pp. 89714–89731, June 2021.

## Conference Publications and Presentations

- [C14] **Sunil Subedi**, Yonghao Gui, and Yaosuo Xue, "Optimization-Based Data-Driven Approach for Detecting Fault Location in Power Systems," in *IEEE Power Energy Soc. General Meeting 2024*, (Submitted).
- [C13] Hong Wang, **Sunil Subedi**, and Wenbo Jia, "Dynamic Modeling and Parameter Optimization of Kaplan Hydroturbines Using Operational Data," in *33rd Ed. IEEE Mediterranean Control Automat. (IEEE-MED) 2025*, (Submitted).
- [C12] Alaa Selim, Soroush Vahedi, **Sunil Subedi**, and Junbo Zhao, "Urban-Scale Control of School Bus Fleet Charging and Discharging Strategies Using Single and Multi-Stage Optimization," in *IECON–50th Annu. Conf. IEEE Ind. Electron. Soc.*, (Accepted, to appear Nov. 2024).
- [C11] **Sunil Subedi**, Yonghao Gui, and Yaosuo Xue, "Grid Parameters and Voltage Estimation Approach Integrating Data-Driven Converter Model," in *IECON–50th Annu. Conf. IEEE Ind. Electron. Soc.*, (Accepted, to appear Nov. 2024).
- [C10] Yonghao Gui, **Sunil Subedi**, and Yaosuo Xue, "Passivity-Based Grid Forming Control for DERs," in *IEEE Energy Convers. Congr. Expo. 2024*, (Accepted, to appear Oct. 2024).
- [C9] **Sunil Subedi**, Yonghao Gui, and Yaosuo Xue, "Deep Learning-Based Dynamic Modeling of Three-Phase Voltage Source Inverters," in *IEEE Energy Convers. Congr. Expo. 2024*, (Accepted, to appear Oct. 2024).
- [C8] Srijib Mukherjee, Supriya Chintavali, Narayan Bhusal, Varisara Tansakul, **Sunil Subedi**, and Arjun Bhattacharya, "The Challenges of Modeling Distributed Energy Resources (DERs) as Black Start Resources," in *IEEE Rural Electric Power Conference 2024*, (Accepted).
- [C7] **Sunil Subedi**, Yonghao Gui, and Yaosuo Xue, "Hybrid Modeling of Three-Phase Grid-Supporting Inverters for Dynamic Studies," in *IEEE Power Energy Soc. General Meeting 2024*, (Accepted).
- [C6] **Sunil Subedi**, Michael Blonsky, Yeongrack Son, and Barry Mather, "Cost-benefit Analysis of Grid-Supportive Loads for Fast Frequency Response," in *IEEE PES Grid Edge Techno. Conf. Expo. (Grid Edge)*, San Diego, CA, USA, 5 pages, April 2023.
- [C5] **Sunil Subedi**, Robert Fournay, Hossein Moradi Rekabdarkolaee, Reinaldo Tonkoski, Timothy M. Hansen, Jesus D. Vasquez-Plaza, and Fabio Andrade, "Impact of PLL Design on Data-driven Models for Grid-connected Single-phase Inverters," in *Int. Symp. Power Electron. Elect. Drives, Automat. Motion (SPEEDAM)*, Sorrento, Italy, 5 pages, June 2022.
- [C4] Nischal Guruwacharya, Harish Bhandari, **Sunil Subedi**, Jesus D. Vasquez-Plaza, Matthew Lee Stoel, Ujjwol Tamrakar, Felipe Wilches-Bernal, Fabio Andrade, Timothy M. Hansen, and Reinaldo Tonkoski, "Data-driven Modeling of Commercial Photovoltaic Inverter Dynamics Using Power Hardware-in-the-Loop," in *Int. Symp. Power Electron. Elect. Drives, Automat. Motion (SPEEDAM)*, Sorrento, Italy, 6 pages, June 2022.
- [C3] **Sunil Subedi**, Nischal Guruwacharya, Robert Fournay, Hossein Moradi Rekabdarkolaee, Reinaldo Tonkoski, Timothy M. Hansen, Ujjwol Tamrakar, and Phylisia Cicilio, "Computationally Efficient Partitioned Modeling of Inverter Dynamics with Grid Support Functions," in *IECON–47th Annu. Conf. IEEE Ind. Electron. Soc.*, Toronto, Ontario, Canada, Oct. 2021, 6 pages.

- [C2] Manisha Rauniyar, Sterling Berg, **Sunil Subedi**, Ujjwol Tamrakar, Timothy M. Hansen, Robert Fournay, and Reinaldo Tonkoski, "Evaluation of Probing Signals for Implementing Moving Horizon Inertia Estimation in Microgrids," in *IEEE North American Power Symp. (NAPS20)*, Tempe, AZ, 5 pages, Apr. 2021.
- [C1] Nischal Guruwacharya, Niranjana Bhujel, Ujjwol Tamrakar, Manisha Rauniyar, **Sunil Subedi**, Sterling E. Berg, Timothy M. Hansen, and Reinaldo Tonkoski, "Data-Driven Power Electronic Converter Modeling for Low Inertia Power System Dynamic Studies," in *IEEE Power Energy Soc. General Meeting 2020*, Montreal, Quebec, Canada, 5 pages, Aug. 2020.

## Technical Report

- [R1] Yeongrack son, **Sunil Subedi**, Michael Blonsky, and Barry Mather, "Hardware implementation and market impacts of grid-supportive functions in end-use loads," Tech. Rep. NREL/TP-5D00-85188, National Renewable Energy Laboratory, Mar. 2023.

## Invited Talks

- [T5] **Sunil Subedi**, "Dynamic Modeling of IBRs in Power Systems," *Oak Ridge National Laboratory*, invited seminar, Knoxville, TN, Jan. 2025.
- [T4] **Sunil Subedi** and Yaosuo Xues, "Data-Driven Inverter-Based Resource Black-Box Modeling," *IEEE Power and Energy Society General Meeting*, Special Issue Panelist, Seattle, WA, July 2024.
- [T3] **Sunil Subedi**, "Automated Data-Driven Partitioned Modeling of Power System Dynamics with Smart Power Electronic Inverters," *Sandia National Laboratories*, invited seminar, Albuquerque, NM, July 2023.
- [T2] **Sunil Subedi**, "Dynamic Modeling and Simulation of Converter Dominated Power Systems," *Oak Ridge National Laboratory*, invited seminar, Oak Ridge, TN, March 2023.
- [T1] **Sunil Subedi**, "Dynamic Modeling and Simulation of Converter Dominated Power Systems," *National Renewable Energy Laboratory*, invited seminar, Golden, CO, March 2022.

## Poster Presentations

- [P5] **Sunil Subedi**, Yonghao Gui, and Yaosuo Xue, "Hybrid Modeling of Three-Phase Grid-Supporting Inverters for Dynamic Studies," presented at the *IEEE Power and Energy Society General Meeting Paper Poster Session*, July 2024.
- [P4] **Sunil Subedi**, Robert Fournay, Hossein Moradi Rekabdarkolaee, Reinaldo Tonkoski, and Timothy M. Hansen, "Automated Data-Driven Model Extraction and Validation of Grid-Tied Single-Phase Inverters Dynamics with Grid Support Function," presented at the *IEEE Power and Energy Society General Meeting Poster Session*, July 2023.
- [P3] **Sunil Subedi**, Robert Fournay, Hossein Moradi Rekabdarkolaee, Reinaldo Tonkoski, and Timothy M. Hansen, "Automated Data-Driven Model Extraction and Validation of Grid-Tied Single-Phase Inverters Dynamics with Grid Support Function," presented at the *Graduate Research Scholarship and Creative Activity Day (GRSCAD) Poster Session*, April 2023.
- [P2] **Sunil Subedi**, Robert Fournay, Hossein Moradi Rekabdarkolaee, Reinaldo Tonkoski, and Timothy M. Hansen, "Data-driven Model Extraction and Validation of a Grid-tied Single-phase Smart Inverter," presented at the *IEEE Power and Energy Society General Meetings Poster Session*, July 2022.
- [P1] **Sunil Subedi**, Phylcia Cicilio, Robert Fournay, Hossein Moradi Rekabdarkolaee, Reinaldo Tonkoski, and Timothy M. Hansen, "Partitioned Dynamic Modeling of Inverter with Grid Support Functions," presented at the *IEEE Power and Energy Society General Meetings Poster Session*, July 2021.

## Educational Activities

### Teaching Experience

2020 (Spring) **Instructor:** EE-321/321L Electronics II and Laboratory, SDSU, Brookings, SD, USA  
 2019 (Fall) **Instructor:** EE-300/300L Basic Electrical Engineering and Laboratory, SDSU, Brookings, SD, USA

## Professional Activities

### Professional Society Activities

IEEE Power & Energy Society

Grade: Member (since 2023)  
 Grade: Graduate Student Member (2020 to 2023)  
 Grade: Student Member (2019 to 2020)

IEEE Young Professionals

Grade: Member (Since 2021)

IEEE Smart Grid Community

Grade: Member (Since 2021)

### Conference Committees and Positions

2. Topic chair in the technical program committee at IEEE Energy Conversion Congress & Expo (ECCE) 2024, Phoenix, AZ, USA.
1. Conference Volunteer Committee, *Grid Forward 2022*, Denver, CO, Oct. 2022.

### Activities as a Referee

The specified year indicates the first year of referee activity with the given source.

#### Journals

2024	IEEE Transactions on Power Delivery
2024	IEEE PES Transactions on Power Systems
2024	Elsevier's e-Prime
2023	IEEE Transactions on Smart Grid
2023	IEEE Transactions on Energy Conversion
2023	Nature Communications
2023	IEEE Power and Energy Technology Systems Journal
2021	IEEE Access
2021	IEEE Systems Journal
2021	IEEE Transactions on Sustainable Energy
2019	Sustainable Computing: Informatics and Systems (SUSCOM)

#### Conferences and Workshops

2023	IEEE Energy Conversion Congress and Exposition (ECCE)
2020-2023	IEEE Power & Energy Society General Meeting (PESGM)
2023	IEEE PES Grid Edge Technologies Conference & Exposition (Grid Edge)
2022	IEEE Symposium on Power Electronics, Electrical Drives, Automation and Motion (SPEEDAM)
2021	IEEE Industrial Electronics Society (IECON)
2020	IEEE North American Power Symposium (NAPS)

## Professional Credentials and Certifications

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|------|--|
| 2021 | Avera Research Integrity Conference, Responsible Conduct of Research Training Certification                        |
| 2021 | EPRI, GridEd Short Course: Machine Learning and Big Data Analytics in Smart Grid (Distance Learning Certification) |
| 2019 | Certified Electrical Engineer by Nepal Engineering Council   |

## Professional Development and Leadership Activities

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|----------------|---|
| 2024 - Present | <b>Executive Committee Member</b> , IEEE PELS/PES East TN Jt. Chapter, TN, USA        |
| 2020 - 2021    | <b>Executive Committee Member</b> , SDSU Nepalese Student Association (NeSA), SD, USA |
| 2018           | <b>Event Organizer</b> , Jumla Project, Child Education Nepal (CEN)UK, Nepal          |
| 2018           | <b>Organizer</b> , Tunza Eco-generation E-gen Event, Nepal                            |
| 2010           | <b>Participants</b> , 8th National Scout Jamboree, Gazipur, Bangladesh                |