Ajay Pratap Yadav

yadavap@ornl.gov (**Google Scholar** link)

Education

University of Texas (UT) at Arlington — Arlington, TX
Doctor of Philosophy in Electrical Engineering — *Sept. 2015 - Aug 2021*

Indian Institute of Technology Kanpur (IIT-K) — Kanpur, India
Master of Technology in Electrical Engineering — *July 2012 - July 2014*

Indian Institute of Technology Roorkee (IIT-R) — Roorkee, India
Bachelor of Technology in Electrical Engineering — *Aug 2006 - May 2010*

Technical Skills

Expertise: Power Electronics | Electric Machines | Power Systems | Control Systems | Smart Grids | Neural Networks

Programming/Computer Skills: Python | C | MATLAB | Simulink | MATPOWER | OpenDSS | MS Office | LaTeX| Adobe Illustrator | Inscape

Platforms:

- Typhoon Hardware-in-the-loop (HIL): HIL602, HIL604
- dSPACE Rapid Control Prototyping (RCP): MicroLab Box (DS1202), DS1103
- Speedgoat Real-time Target Machine
- Speedgoat Electric Motor Control Kit equipped with permanent-magnet synchronous motor

Experience

Research Scientist — April 2024 - Present
Oak Ridge National Laboratory (ORNL) — *Oak Ridge, TN*

- LEEP Qubit Engineering
  - ∗ Developed neural network-based power flow solvers for IEEE test feeders, improving solution efficiency and scalability.
- DarkNet
  - ∗ Analyzed the impact of high penetration of inverter-based resources on grid inertia using data from the THYME simulation model.
  - ∗ Designed a distributed, consensus-based algorithm for real-time control and optimization of inertia sources.

Postdoctoral Research Associate - Energy — Oct. 2021 - March 2024
Oak Ridge National Laboratory (ORNL) — *Oak Ridge, TN*

- OEDI – Solar Grid Integration Data and Analytics Library
  - ∗ Conducted distribution system state estimation using data from smart meters and PMUs.
  - ∗ Used HELICS-based co-simulation of distribution network (in OpenDSS) and estimation algorithms (in MATLAB/Octave or Python).
- Grid Research Integration and Deployment Center
  - ∗ Designed controllers for three-phase inverters to achieve multiple grid functions simultaneously, e.g., Volt-VAr, Volt-watt, and harmonic compensation.
- ExaSGD project (a subproject of Exascale Computing Project)
  - ∗ Designed a field-oriented speed controller for inverter-fed permanent-magnet synchronous machine.
  - ∗ Developed a scalable model of microgrid to test the multi-step integration scheme.
  - ∗ Utilized Sundials IDAS software package for the numerical integration of electric machine and microgrid models.
- DarkNet
  - ∗ Analyzed data from phasor measurement units (PMU) and frequency disturbance recorders (FDR) to study inter-area oscillations and inertia in the grid.

Graduate Research and Teaching Assistant — Aug. 2015 - Aug. 2021
University of Texas at Arlington — *Arlington, TX*

Research Experience

- Led the installation/testing of dSPACE–Typhoon controller/hardware-in-the-loop testbed,
  - The setup involved 10 Typhoon HIL604 units and 9 dSPACE MicroLab Boxes (DS1202).
  - HIL units emulate physical components such as inverters while the control routines are deployed on dSPACE.
  - Entire equipment costs around $600,000.
- Developed a convex optimization framework for electric machine parameterization,
  - Extracted lumped-parameter model of a synchronous machine from its magnetic-equivalent circuit model.
  - Obtained all induction motor parameters using limited and lossy transient data.
  - Used CVX in MATLAB environment with solvers such as SDPT3, MOSEK, and SeDuMi.
- Designed a partial-update Kalman filter robust to losses in measured signals,
  - Employed for permanent-magnet synchronous motor (PMSM) state and parameter estimation.
  - Derived the critical arrival rate of measurement data for accurate filter operation.
  - Validated on a PMSM controlled using field-oriented control deployed on Speedgoat real-time target machine.
- Studied FPGA-based accelerated simulations of voltage-behind-reactance (VBR) machine models,
  - Used high-level synthesis to map discretized models onto FPGA.
  - Obtained fastest FPGA implementation (minimum latency) using optimization-based design space explorer.
- Designed hardware-in-the-loop simulation for multiple microgrid research projects (see publications),
  - IEEE 34-bus feeder system, augmented with four inverters, on dSPACE–Typhoon environment.
  - 48 V DC microgrid comprising of active loads with power buffers using Typhoon HIL602 and dSPACE controller board DS1103.
- Assisted in writing proposals for multiple federal grants (National Science Foundation(NSF) and Office of Naval Research(ONR)).

Teaching Experience

- Assisted in multiple undergraduate and graduate-level courses on *Power Electronics, System Identification, Optimal Control, and Signals & Systems.*
- Delivered lectures and prepared/evaluated assignments & exams.

Project Associate — Aug. 2014 - Feb. 2015
Indian Institute of Technology Kanpur — *Kanpur, India*

- Collaborated on the development of a training algorithm for feedforward neural networks based on optimal control theory (using *Hamilton–Jacobi–Bellman equation*).
- Worked on solar radiation forecasting using neural networks.

Engineer, Electrical & Mechanical Department — Sept. 2010 - July 2012
Coal India Limited (CIL) — *Dhanbad, India*

- Conducted performance analysis of 12 Side Dump Loader (SDL) machines operating in four different mines of the Sijua Area, BCCL (a subsidiary of CIL).
- Participated in the Technological Awareness Program at the *Indian Institute of Coal Management*.

Intern — June 2008 - July 2008
National Thermal Power Corporation (NTPC) Limited — *Singrauli, India*

- Completed an internship at the 2000 MW Singrauli Super Thermal Plant, gaining firsthand experience with machinery such as generators, motors, transformers, circuit breakers, and relays.

Scholastic Achievements/Services

- **2017-2018 Transactions Best Paper Award** (*IEEE Trans. Energy Conversion*): Awarded to three papers, among all the papers published throughout the whole year.
- Five-year Enhanced Graduate Teaching Assistant (**EGTA**) fellowship at UT Arlington.
- Conducted research for NSF grant titled "*Real-time Ab Initio Modeling of Electric Machines*".
- Reviewer for multiple IEEE Transactions and conference proceedings (e.g., IEEE TEC, CDC).
- Volunteer for Office of Naval Research Control Workshop, 2018.
- Social Chair for ORNL's Postdoc Association (2022-23).

PUBLICATIONS (**Google Scholar** LINK)

Journals

- S. Dulal, C. Zhang, M. Olama, Q. Liu, N. Bhusal, **A.P. Yadav**, M. Baldwin, N. Stenvig, Y. Liu, "Inertia Estimation and Trend Analysis of the United States Power Grid Interconnections", in *IEEE Access*, 2024.
- O. Alaca, E.C. Piesciorovsky, A.R. Ekti, N. Stenvig, Y. Gui, M.M. Olama, N. Bhusal, **A.P. Yadav**, "Assessment of Envelope-and Machine Learning-Based Electrical Fault Type Detection Algorithms for Electrical Distribution Grids", in *Electronics*, 2024.
- E.C. Piesciorovsky, N. Stenvig, Y. Gui, M.M. Olama, N. Bhusal, **A.P. Yadav**, "Advanced testbed to assess disturbances in electrical grids with DERs using relays/meters with varying sampling frequencies", in *Energy Reports*, 2024.
- W. Qiu, **A.P. Yadav**, S. You, B. Park, T. Kuruganti, Y. Liu, H. Yin, "Inverter Control: Modeling and Adaptive Optimization for Smart Distribution Networks", in *IEEE Transactions on Sustainable Energy*, 2023.
- **A. P. Yadav**, J. Nutaro, B. Park, J. Dong, B. Liu, Y. Srikanth, H. Yin, J. Dong, Y. Dong, Y. Liu, and T. Kuruganti, "Review of Emerging Concepts in Distribution System State Estimation: Opportunities and Challenges," in IEEE Access, 2023.
- **A. P. Yadav**, M. Davoodi, N. Gans, and A. Davoudi, "Partial-Update Kalman Filter for Permanent Magnet Synchronous Motor Estimates Under Intermittent Data," in *IEEE Access*, 2022.
- **A. P. Yadav**, R. Madani, N. Amiri, J. Jatskevich, and A. Davoudi, "Induction Machine Parameterization from Limited Transient Data using Convex Optimization," in *IEEE Transactions on Industrial Electronics*, Feb. 2021.
- T. Altun, R. Madani, **A. P. Yadav**, A. Nasir, and A. Davoudi, "Optimal Reconfiguration of DC Networks," in *IEEE Transactions on Power Systems*, Nov. 2020.
- **A. P. Yadav**, S. Xu, B. C. Schafer and A. Davoudi, "Hardware-Assisted Simulation of Voltage-Behind-Reactance Models of Electric Machines on FPGA," in *IEEE Transactions on Energy Conversion*, Sept. 2020.
- **A. P. Yadav**, T. Altun, R. Madani, and A. Davoudi, "Macromodeling of Electric Machines From Ab Initio Models," in *IEEE Transactions on Energy Conversion*, June 2020.
- V. Nasirian, **A. P. Yadav**, F. L. Lewis, and A. Davoudi, "Distributed Assistive Control of Power Buffers in DC Microgrids," in *IEEE Transactions on Energy Conversion*, Dec. 2017. **(2017-2018 Transactions Best Paper Award)**

Conferences/Workshops

- S. Dulal, C. Zhang, M. Baldwin, Q. Liu, M.M. Olama, N.M. Stenvig, N. Bhusal, **A.P. Yadav**, Y. Liu, "Measurement-Based Approach for Inertia-Trend Analysis of the US Western Interconnection", in *2024 IEEE Kansas Power and Energy Conference (KPEC)*, 2024.
- **A.P. Yadav**, M.M. Olama, E.C. Piesciorovsky, Y. Gui, N. Bhusal, N. Stenvig, "Inertia Estimation Under High Penetration of Inverter-based Resources", in *2024 IEEE Kansas Power and Energy Conference (KPEC)*, 2024.
- W. Qiu, H. Yin, Y. Wu, S. Bu, C.Y. Chung, B. Park, T. Kuruganti, **A. P. Yadav**, Y. Xue, W. Yao, and Y. Liu, "Data-driven based coordinated smart inverter control for distributed energy resources" *12th IET International Conference on Advances in Power System Control, Operation and Management (APSCOM 2022) IET*, 2022.
- O. A. Beg, **A. P. Yadav**, T. T. Johnson, and A. Davoudi, "Formal Online Resiliency Monitoring in Microgrids," *2020 Resilience Week (RWS)*, 2020.
- V. Nasirian, **A. P. Yadav**, F. L. Lewis, and A. Davoudi, "Distributed Assistive Control of Power Buffers in DC Microgrids," *IEEE Power and Energy Society General Meeting*, 2019.
- V. Arora, L. Behera, T. K. Reddy, and **A. P. Yadav**, "HJB Equation based Learning Scheme for Neural Networks", *2017 International Joint Conference on Neural Networks (IJCNN)*, 2017.
- **A. P. Yadav** and L. Behera, "Solar Radiation Forecasting using Neural Networks and Wavelet Transform," *IFAC Proceedings*, 2014.
- **A. P. Yadav**, A. Kumar, and L. Behera, "RNN based Solar Radiation Forecasting using Adaptive Learning Rate," *International Conference on Swarm, Evolutionary, and Memetic Computing*, Springer, 2013.

Preprints

- **A.P. Yadav**, "Multiobjective Backstepping Controller for Parallel Buck Converters," *arXiv:2008.00428*, 2020.