NINAD KIRAN GAIKWAD

PhD Candidate / Research Assistant

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PROFESSIONAL SUMMARY

An engineer with a bend for research in Smart Grids, combining Power Systems, Control Systems, and Machine Learning to create an autonomous energy grid. My work experience in a snapshot is as follows:

- **Jan 2022 – Present** : Graduate Research Assistant at WSU
- **May 2023 – Aug 2023** : Machine Learning Intern at Edo Energy
- **Aug 2018 – Dec 2021** : Graduate Assistant at UFL
- **May 2021 – Aug 2021** : Research Intern at NREL
- **June 2018 – July 2018** : Research Consultant at CoE-CNDS
- **Dec 2017 – May 2018** : Consultant at Mytrah Energy
- **Jan 2017 – June 2017** : Assistant Professor at SPCE
- **Aug 2016 – Jan 2017** : Jr. Project Fellow at GERMI
- **Aug 2015 – June 2016** : Research Intern at GERMI
- **Aug 2013 – Oct 2013** : Engineering Intern at Crompton & Greaves
- **Sept 2012 – Oct 2012** : Engineering Intern at Reliance Infrastructure Limited
- **June 2012 – July 2012** : Coal Power Plant Trainee at Abhijeet MADC Nagpur Energy Pvt. Ltd

PROFESSIONAL SKILLS

- **Technical Competency** : Applied knowledge from Electrical/Control/Computer engineering in industry, research, and academia with productive outcomes.
- **Continuous Learning** : Passionate about the different facets of Power Systems, undertook different projects, positions, and courses to improve practical and theoretical knowledge in the field.
- **Independent Research** : Developed ability to work with minimum guidance and apply scientific method successfully to solve problems through internships and research projects.
- **Leadership** : Gained ability to effectively lead and manage individuals/teams to achieve pre-defined objectives while working at various positions in industry, academia, and research institutions.
- **Team Player** : Working in diverse teams at internships and in academic projects has inculcated the values of sharing knowledge and encouraging the development of others to achieve specific team goals.
- **Communication** : Developed excellent verbal and written communication skills through interacting with seniors, colleagues, mentees, and technicians at various workplaces via phone, e-mails, and direct communication.
- **Writing/Presentation** : Writing documents like thesis, books, and research papers in LATEX Environment and creating presentations for knowledge dissemination.

TECHNICAL SKILLS

- **Programming Languages** : MATLAB & Simulink for Prototyping and Modelling, Python and Julia for open-source implementation and development, and C/C++ for embedded development.
- **Database Skills** : PostgreSQL for RDBMS, MongoDB for NoSQL, and Hadoop & Apache-Spark for HDFS.
- **Cluster Computing Skills** : HPC with Slurm for large-scale parallel computational tasks, and Docker with Kubernetes for sc
- **Power Systems Software** : MATPOWER, OpenDSS and SimPowerSystems for Power System modelling-simulation.
- **Energy Systems Software** : PVSyst for electrical and renewable energy modelling-simulation and EnergyPlus for buildings simulation.
- **Optimization Packages** : Gurobi and CVX in MATLAB, CasADi, Pyomo and PyScipOpt in Python and JuMP in Julia.
- **ML Packages** : TensorFlow, PyTorch, and Neuromancer in Python.
- **RL Packages** : TensorForce, Stable-Baselines, tf_agent, and TorchRL in Python.
- **Mathematics** : Control Theory, Optimal Control, Machine Learning, Reinforcement Learning, Estimation Theory, Algorithmics, Optimization, Probability, Linear Algebra.

LANGUAGES

Marathi - Native, **Hindi** - Native, **English** - Proficient, **French** - Basic

Note: The right aligned items in subsequent pages are web links

EDUCATION

Jan 2022 - Present — **PhD in Electrical Engineering and Computer Science** — **Washington State University (WSU)**

Major areas of study: Power Systems Analysis, Power Systems Dynamics and Control, and Estimation Theory.
Current GPA 3.71/4

Jan 2022 - Present — **MS in Computer Science** — **Washington State University (WSU)**

Major areas of study: Machine Learning, Data Science, and Algorithmics.
Current GPA 3.71/4

Aug 2018 - Dec 2021 — **MS in Mechanical Engineering** — **University of Florida (UFL)**

Major areas of study: Control Theory, Probability, Optimization, Machine Learning, and Reinforcement Learning.
GPA 3.18/4

Aug 2014 - June 2016 — **MTech in Electrical Engineering** — **Sardar Patel College of Engineering (SPCE)**

Major areas of study: Electrical Machine Analysis, Power Electronic Drives, Power System Dynamics and Control .
CGPA 9.88/10

Feb 2014 - June 2014 — **MProfEng in Electrical Engineering (One Semester)** — **University of Wollongong (UOW)**

Major areas of study: Power Systems and Renewable Energy Technologies.
High Distinction with 86.33%

Aug 22008 - June 2012 — **BTech in Electrical Engineering** — **Veermata Jijabai Technological Institute (VJTI)**

Major areas of study: Power Engineering and Control Systems.
CPI 5.8/10

Aug 22006 - June 2008 — **Higher Secondary School Certificate - HSC (12th Grade)** — **V.G. Vaze College of Arts, Commerce, and Science (VAZE)**

Major areas of study: Physics, Chemistry, and Mathematics.
Received an Academic award for obtaining an average of 91.33%.

Aug 22001 - June 2006 — **Secondary School Certificate - SSC (10th Grade)** — **Vasant Vihar High School and Junior College (VVHS)**

Major areas of study: Languages, Sciences, Social Sciences, and Mathematics.
Received an aggregate of 89.6%.

EXPERIENCE

Research Experience:

Jan 2023 - Present — **Graduate Research Assistant** — **WSU**
School of Electrical Engineering and Computer Science

- Working on developing intelligent algorithms for networked Smart Buildings for grid support.
- Developing computationally efficient yet accurate building grey and black box thermal models of residential/commercial buildings.
- Developing a co-simulation test bench for simulating a large number of buildings with the distribution system.

Aug 2018 - Dec 2021 — **Graduate Assistant** — **UFL**
Mechanical & Aerospace Engineering Department

- Developed control algorithms based on MPC and RL for home energy resiliency.
- Aided student learning for undergraduate Controls and Numerical Methods courses as a teaching assistant for 6 semesters.
- Mentored one graduate and two undergraduate students to pursue research in home energy resiliency.

May 2021 - Aug 2021 — **Research Intern** — **NREL**
Energy Systems Control and Optimization Group

- Worked on transient voltage stability of two-bus inverter-based microgrids.
- Analyzed the stability of the two-bus system using the Lyapunov method.
- Developed a GUI-based application for stability analysis and visualization for the two-bus system.

June 2018 - July 2018 — **Research Consultant** — **VJTI**
Centre of Excellence in Complex and Nonlinear Dynamical Systems (CoE-CNDS)

- Performed set up of the self-developed Renewable Energy Forecasting System (SWEEFA-V1.0) at CoE-CNDS.
- Trained two graduate students on the self-developed renewable energy forecasting software.
- Created a road map for the research and development of the SWEEFA system.

Aug 2016 - Jan 2017 — **Jr. Project Fellow** — **GERMI**
Gujarat Energy & Research Management Institute (GERMI)

- Supported the institute's renewable energy training programs by developing program manuals and giving presentations on selected topics.
- Worked on the improvement of the Renewable Energy Forecasting System (SWEEFA).
- Mentored two graduate students to develop RNN-based short-term forecasting models and empirical analysis of ARIMA models for renewable energy generation.

Aug 2015 - June 2016 — **Research Intern** — **GERMI**
Gujarat Energy & Research Management Institute (GERMI)

- Worked on my M-Tech research thesis in the field of Solar and Wind Energy Forecasting.
- Conceptualized and developed an end-to-end renewable energy estimation and forecasting software in MATLAB with a GUI interface called Solar & Wind Energy Estimation and Forecasting Application (SWEEFA).
- Mentored two graduate students to develop components of SWEEFA.

Academic Experience:

June 2024 - Aug 2024 — **Instructor** — **WSU**
Computational Skills for MIRA Summer Bridge Program

- Conducted a six-week course on computer programming with Python for high school transistioners to college.
- Developed syllabus, class material, lab material, and maintained a Google Classroom.
- Taught students programming concepts from basic to intermediate level in Python.

July 2022 - July 2022 — **Tutor** — **WSU**
Bridge Program, College Access & Transition Programs

- Conducted a two-week course on introduction to engineering for recent high school graduates.
- Helped students understand the differences and similarities in the different engineering domains.
- Taught students basic programming skills in Python.

Jan 2017 - June 2017 — **Assistant Professor** — **SPCE**
Electrical Engineering Department

- Taught a graduate course on the Application of Power Electronics in Renewable Energy Systems.
- Guided and mentored three graduate students in their seminar mini-projects.
- Tutored graduate students in MATLAB Programming and Simulink Simulations.

Industrial Experience:

May 2023 - Aug 2023 — **Machine Learning Intern** — **Edo Energy**
Research & Development Group

- Developed an open-source State Estimation toolbox based on Bayesian Filtering and Smoothing for Building Thermal Models.
- Developed Parameter Estimation Algorithms based on Bayesian Inference for Building Thermal Models.

Dec 2017 - May 2018 — **Consultant** — **Mytrah Energy**
Technology & Digital Innovation Group

- Worked on Implementation of Real-Time Renewable Forecasting System.
- Developed tools for Solar and Wind Power Plant Performance Analysis.
- Trained and led a team of three in Data Analytics and associated tools.

Aug 2013 - Oct 2013 — **Engineering Intern** — **Crompton & Greaves**
Transformer Design Department

- Designed an Excel sheet of Terminal Connectors used in Transformer Design, so that, the design team can efficiently select the desired Terminal Connector, reducing the designing time.
- Developed a report on the Interleaving and Counter-shielding of Transformer windings, which helped the designers select the appropriate method for surge protection for a given transformer specification, improving the quality of the product.

Sept 2012 - Oct 2012 — **Engineering Intern** — **Reliance Infrastructure**
Dahanu Thermal Power Plant (DTPS)

- Worked on the Electrostatic Precipitator (ESP) of the Power Plant; collaborated with the ESP control room operators, technicians, and the senior engineer to understand the operation and fault detection in the ESP.
- Created a detailed report on the ESP, which is being used to train new engineers working on the ESP.
- Took the initiative to digitize the fading manuals and the Power and Control Schematic of the ESP from the plant technical library, which has enabled the electrical department to access these documents directly on their intranet.

June 2012 - July 2012 — **Coal Power Plant Trainee** — **Abhijeet Group**
MIHAN Power Plant

- Worked with a team of trainee engineers to understand the functioning of all the departments of the Power Plant.
- Created a report on the training program in collaboration with fellow trainees.

PROJECTS

Washington State University:

Jan 2022 - Present — **Intelligent Control of Networked Buildings** — **Github Link**

The project involves developing and comparing computationally inexpensive black/grey-box developing models (neural network architectures and Bayesian estimation methods) for residential/commercial buildings where data comes from EnergyPlus and other open-source building data repositories like PecanStreet. Then a simulation framework has to be developed to co-simulate these building models at scale with OpenDSS (along with HELICS) to aid the development of both single-building and aggregator-level intelligent controllers which can optimize the energy consumption of buildings for grid support. Currently, we are pursuing model estimation and development of the co-simulation platform.

Aug 2022 - Present — **Power Systems Analysis Toolbox (PowerEdu.jl)** — **Github Link**

Course project for Analysis of Power Systems (EE521). A Julia-based package is being developed to perform Newton-Raphson-based power flow, continuation power flow, power system static state estimation, and basic power system optimization. Currently, power system stability analysis and transient simulation capabilities (EE523) are being implemented.

Jan 2022 - Apr 2022 — **Power System Control Algorithm Vulnerability Analysis using Network Science** — **Github Link**

Course project for Introduction to Network Science (CPTS591). A power system transients simulator with closed-loop control and inter-node communication capabilities was developed in Python in a modular fashion. A comparison was done of the capability of degree centrality, PageRank, and eigenvalue-based analysis for accurately predicting the criticality of the power system nodes about their impact on the performance of a distributed frequency control algorithm.

University of Florida:

Jan 2019 - Present — **Home Energy Resiliency** — **Github Link**

Where during grid outage scenario smart houses with PV, Battery storage, EVs and smart loads will be capable of managing their energy based on optimal control and reinforcement learning. MPC and RL-based central controllers for a single house have been developed. Currently work on centralized and distributed architectures based on MPC and RL for energy resiliency of community of houses is being pursued.

Aug 2020 - Dec 2020 — **GAN and VAE for MNIST** — **Github Link**

Course project for Machine Learning (CAP6610). Generative Adversarial Networks and Variational Autoencoder networks were trained on the MNIST dataset to generate handwritten digits. Two types each of the GAN and VAE were trained one with dense layers and the other with CNN layers, the implementation was done using the TensorFlow library in Python.

Aug 2019 - Dec 2019 **Optimal Control Indirect and Direct Method Implementation** **Github Link**

Course project for Optimal Control (EML6934). The Linear Tangent Steering Control and Robot Arm Control problems were formulated as optimal control problems and solved numerically using MATLAB. For the indirect method, a Hamiltonian Boundary Value Problem (HBVP) was formulated through optimality conditions arising from the calculus of variations, and for the direct method, Collocation was used by formulating a Nonlinear Program (NLP). The NLP was formulated in MATLAB and solved using IPOPT.

Jan 2019 - Apr 2019 **Design and testing of State Feedback based Set-Point Tracking Controller** **Github Link**

Course project for Control Theory (EML5311). System identification of an unknown plant with sensor noise was conducted using the Sine-Sweep technique through simulations in MATLAB. The estimated transfer function was converted to a minimally realized state-space model for designing a Linear Quadratic Regulator (LQR) for set-point tracking using MATLAB.

Aug 2018 - Dec 2018 **ARMA Time Series Modeling for Solar PV Generation Forecasting** **Github Link**

Course project for Optimal Estimation and Kalman Filtering (EML6352). ARMA models based on Least Squares and Maximum Likelihood Estimation techniques were developed and implemented in MATLAB and compared against the ARMA models of MATLAB's Econometrics toolbox, for forecasting solar power generation from a real-world dataset. The effect of different ARMA models, amount of training data, and prediction on different timescales was studied.

Indian Institute of Technology - Bombay (IIT-B):

Aug 2017 - Oct 2017 **Data Fault Detection** **Github Link**

Worked with Dr. Anupama Kowli in the Electrical Department of IIT-B to develop data fault detection algorithms for real-building data collected using Raspberry-Pi-based sensors deployed in one of the lecture halls. The methods applied were SVM, ANN, Wavelets, PCA, and a hybrid PCA-Wavelet. All the algorithms were developed in MATLAB in a modular manner.

Sardar Patel College of Engineering:

Aug 2015 - June 2016 **Forecasting of Solar & Wind Energy** **Github Link**

Master's Thesis project, in which an entire software for solar and wind energy estimation and forecasting was created in MATLAB using GUI. The software can generate plant-level energy estimation capability for both wind and solar generation plants. The software also has a weather and generation data preprocessing system. Forecasting using ANN and ARIMA can be done using their respective GUI interfaces. Forecasting using WRF (NWP model) is also automated by developing BASH Shell scripts and running them on a cluster of four RaspberryPi-2 micro-computers.

Jan 2015 - Apr 2015 **DTC Control of DFIG** **Github Link**

Individual project, in which a research paper on the ANN-based DTC control strategy for the DFIG was studied, a simulation on the same was created in Sim PowerSystems Matlab, and an IEEE-style report was prepared. Gained valuable experience in decoding a research paper and simulation methodology. A seminar on the same was presented before the faculty of the electrical department.

Aug 2014 - Dec 2014 **Vector Control of DFIG** **Github Link**

Individual project, in which a research paper on the vector control strategy for the DFIG was studied, a simulation on the same was created in Sim PowerSystems Matlab, and an IEEE-style report was prepared. Gained valuable experience in decoding a research paper and simulation methodology. A seminar on the same was presented before the faculty of the electrical department.

University of Wollongong:

Feb 2014 - June 2014 **Reactive Power Capability of Distributed Energy Systems** **Project Link**

Team project, in which the reactive power support provided by DFIG, Solar inverter, and Diesel generator was studied. Did the part on DFIG, acquired the skill of interpreting IEEE research papers; and improved upon my skills of report creation, presentation, and teamwork. (Grade Obtained - A).

Veermata Jijabai Technological Institute:

Aug 2011 - June 2012 **Application of Vacuum Tubes in Sound Engineering and High-Frequency Amplification** **Project Link**

Final year team project, dealing with research and analysis of present-day Vacuum Tube devices; in addition to their scope for future applications. Acquired a strong level of knowledge in technical literature analysis and report creation; and experience in teamwork (Grade Obtained - A).

PUBLICATIONS

Journal Papers:

Feb 2021 **'Increasing Energy Resiliency to Hurricanes with Battery and Rooftop Solar Through Intelligent Control'** **Paper Link**

arXiv preprint arXiv:2102.04406

Conference Papers:

Nov 2024 **''Model Predictive Control based Energy Management System for Home Energy Resiliency'** **Paper Link**

Oral Presentation at NAPS-2024, El Paso, USA

May 2021 **'Reinforcement Learning-Based Home Energy Management System for Resiliency'** **Paper Link**

Oral Presentation at ACC-2021, IEEE Conference, New Orleans, USA

Aug 2020 **'Smart Home Energy Management System for Power System Resiliency'** **Paper Link**

Oral Presentation at CCTA-2020, IEEE Conference, Vancouver, Canada

Mar 2017 **'On The Development of Solar & Wind Energy Forecasting Application Using ARIMA, ANN And WRF in MATLAB'** **Paper Link**

Oral Presentation at INDIACom-2017, IEEE Conference, Delhi, India

Oct 2016 **'Photovoltaic Grid Connected Plant Energy Estimation Application in MATLAB'** **Paper Link**

Oral Presentation at PVSEC-26, Singapore

Conference Posters:

Aug 2024 **'From Basic ANN to Scientific ML-Based Building Thermal Models For Grid-Edge Applications'** **Poster Link**

Poster Presentation at Advanced Grid Institute Day 2024, Tri-Cities, USA

Aug 2024 **'Enhancing Building Thermal Models: From Basic Greybox to SciML-Driven Digital Twins'** **Poster Link**

Poster Presentation at Advanced Grid Institute Day 2024, Tri-Cities, USA

Aug 2024 **'Building Energy Models using Generative Learning for Grid-Edge Applications'** **Poster Link**

Poster Presentation at Advanced Grid Institute Day 2024, Tri-Cities, USA

July 2024 **'ANN Based Thermal Modeling of Buildings'** **Poster Link**

Poster Presentation at IEEE Power and Energy Society General Meeting 2024, Seattle, USA

July 2024 **'Comparison of Bayesian Filters-Smoothers for Joint State-Parameter Estimation of Building Thermal Model'** **Poster Link**

Poster Presentation at IEEE Power and Energy Society General Meeting 2024, Seattle, USA

July 2024 **'An Opensource GUI-Based Application for EnergyPlus Data Analysis'** **Poster Link**

Poster Presentation at IEEE Power and Energy Society General Meeting 2024, Seattle, USA

Apr 2024 **'Smart Residential Community Simulator'** **Poster Link**

Poster Presentation at Power and Energy Conference at Illinois 2024, Urbana-Champagne, USA

Feb 2017 **'Development of Solar & Wind Energy Forecasting Application'** **Poster Link**

Poster Presentation at XXXI Gujarat Science Congress 2017, Gandhinagar, Gujarat, India

Oct 2016 **'Photovoltaic Module PV-IV Curve Generator with Shading Analysis in MATLAB'** **Poster Link**

Poster Presentation at PVSEC-26, Singapore

CERTIFICATIONS

Sept 2015 - Dec 2015 **Post Graduate Diploma in Embedded Systems** **Prolific Systems & Technologies**

- Microcontroller (8051, ARM, Pic) Programming
- Embedded Linux

Mar 2013 - June 2013 **Post Graduate Diploma in Industrial Automation** **Prolific Systems & Technologies**

- Programmable Logic Controllers
- SCADA Software
- Variable Speed Drives

TECHNICAL WORKSHOPS

Conducted:

Apr 2017 **Introduction to LaTex** **SPCE**

- Organized and conducted a one-day workshop for graduate students on the basics of LaTex.
- Illustrated how to write a Thesis in Latex.

Apr 2017 **Introduction to MATLAB** **SPCE**

- Conducted a 12-hour workshop for undergraduate students on the basics of MATLAB programming.
- Illustrated designing and programming a GUI application in MATLAB.

Attended:

May 2024 **DataDriven Operation of Autonomous Power Systems** **EECI IGSC**

- Gained expertise in decentralized control of converter-based resources in low-inertia systems, focusing on the integration of distributed renewable energy.
- Developed knowledge in data-driven and online feedback optimization methods for the real-time operation of autonomous power systems.

Sept 2016 **Solar PV Plant Design, Operation & Maintenance Workshop** **GERMI**

- Performed hands-on installation of 15kW Roof-top Solar Power Plant and developed Solar PV Plant Simulation skills on PVsyst Software.
- Presented a talk on the different Tracking Mechanisms available for PV panels to the participants and was a part of the support team for the workshop.

Feb 2015 **Real-Time Simulation in Power Electronics** **IIT-B**

- Performed real-time simulation of Buck, Boost converters, and Squirrel cage Induction Motor.
- Received hands-on training in setting up a real-time simulation on a floating-point DSP board.

Dec 2014 **Short-term Training Program (AICTE Sponsored) on Renewable Energy Sources for Sustainable Developments** **VJTI**

- Attended lectures given by eminent professors of IIT's, NGO volunteers, and government officials.
- Received state-of-art information on technologies in Solar Energy harvesting; and the need for sustainable development and energy auditing.

Dec 2014 **LabView Software Workshop** **SPCE**

- Received hands-on training in LabView software.
- Created Virtual Instruments in LabView and interfaced them with external equipment.

Dec 2014 **Power Electronics Simulation Workshop** **IIT-B**

- Received hands-on training in SimPowerSystems, PSCAD, PSIM, and SABER software for power electronic simulations.

Oct 2014 **ETAP Training Workshop** **AKER Power & Gas**

- Received hands-on training in ETAP software.
- Performed SLD, Load Flow Analysis, Short Circuit Analysis, and Motor Starting Transients on ETAP.

TEST SCORES

June 2017 — **Test of English as a Foreign Language** — **TOEFL**

Total Score: 117/120, Reading: 29/30, Listening: 29/30, Speaking: 30/30, Writing: 29/30

July 2017 — **Graduate Record Examination** — **GRE**

Total Score: 315/340, Verbal: 156/170, Quants: 159/170, AWA: 4/6

AWARDS

Aug 2016 — **Academic Achievement Award** — **SPCE**

First Rank in M-Tech course

Aug 2008 — **Academic Achievement Award** — **VAZE**

Average of 91.33% in HSC Examinations