Rahul K. Gupta

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Personal Webpage | GoogleScholar | ResearchGate | Orcid.

Research Interests

- Optimal operation of energy storage systems, electricity networks and multi-energy systems; control and coordination of energy systems; model predictive control of distributed energy resources;
- Integrated planning of energy storage, electricity networks and multi-energy systems; stochastic and robust optimization of energy systems under uncertainty; hosting capacity analysis;
- Data-driven estimation and control; distributed optimization; market-based framework for flexibility in energy system.

Education

- **Ph.D. in Electrical Engineering**, 09/2018 - 01/2023
  École Polytechnique Fédérale de Lausanne (EPFL), Switzerland
  Thesis title: "Methods for Grid-aware Operation and Planning of Active Distribution Networks". (Access Link)
  Thesis directors: Prof. Mario Paolone (EPFL), Prof. Fabrizio Sossan (HES-SO Wallis, Switzerland).
- **M.Sc. in Electrical Engineering** 09/2016 - 07/2018
  Smart Grids Science and Technology Orientation,
  École Polytechnique Fédérale de Lausanne, Switzerland
- **B.Tech in Electrical Engineering** 07/2010 - 06/2014
  National Institute of Technology, Rourkela, India

Experience

- **Assistant Professor, School of Electrical and Computer Engineering, Washington State University** 01/2025 - Present
- **SNSF Postdoctoral Fellow, Georgia Institute of Technology, Atlanta, USA** 10/2023 - 12/2024
  (*Supervisor: Prof. Daniel K. Molzahn*)
- **Postdoctoral Researcher, EPFL, Switzerland** 02/2023 - 09/2023
  (*Supervisor: Prof. Mario Paolone*)
- **Doctoral Researcher, EPFL, Switzerland** 09/2018 - 01/2023
- **Visiting Doctoral Researcher, ParisTech MINES, Nice, France** 09/2019 - 01/2020
- **Intern, ABB Corporate Research Centre, Baden, Switzerland** 08/2017 - 01/2018
- **Research Engineer, National University of Singapore, Singapore** 01/2015 - 07/2016

Honors and Awards

1. **Swiss National Science Foundation Postdoc Mobility Grant** for postdoctoral stay at Georgia Tech.
2. **EPFL PhD Thesis Distinction in Electrical Engineering 2023** (awarded to the 8% best Ph.D. theses of each EPFL Doctoral Program).
3. Finalist in the **Grid Edge Technologies Dissertation Prize Challenge 2023** and nominated for the **ABB Award 2024, EPFL** for my Ph.D. thesis.

4. **Zanelli: Technologie et Développement Durable Prize 2018** for the best master project in the field of sustainable development: environment, economy, or society, EPFL, Switzerland.
5. **J.N. Tata Endowment Award** and **K. C. Mahindra Scholarship** for supporting master studies at EPFL.
6. **Ashim Choudhury Memorial Gold Medal** for overall academic topper among all the undergraduate Electrical Engineering Students of the 2014 batch, NIT Rourkela.
7. **University Silver Medal** for academic topper among Students of 2014 batch, NIT Rourkela, India.
8. **Sugat Kishore Mall Memorial Award** for the best graduate in the 2014 batch of electrical engineering, NIT Rourkela, India.
9. **DAAD WISE-2013 Scholarship** (Deutscher Akademischer Austausch Dienst), (German Academic Exchange Service) for an internship at the University of Bremen, Germany.

Involvement in Research Projects

Synthetic Networks & Hosting Capacity Analysis for USA Oct. 2023 - Sept. 2025
(*funded by Swiss National Science Foundation - CHF 121,400*)

- Developing algorithms for realistic synthetic networks for power distribution networks in the USA using publicly available datasets (street maps, population density, primary substation locations, etc.).
- Photovoltaic hosting capacity analysis of power distribution network using synthetic networks. Optimal planning of battery energy storage for increasing hosting capacity.

MESH4U (*funded by European Union's Horizon 2020 and ERA-Net Smart Energy Systems*) 2022 - 2023

- Experimental validation of a grid-aware dispatching framework by utilizing the flexibility from electric vehicle charging stations (EVCS). Forecasting EVCS demand. *Final Report*.

SWEET PATHFNDR (*funding agency: Swiss Federal Office of Energy's "SWEET" program*) 2020 - 2023

- Modeling and control of multi-energy systems. Experimental validation of a multi-grid dispatch framework on real medium and low voltage distribution grid at EPFL consisting of fuel-cell, electrolyser, PV plants and battery energy storage systems.

REEL Demonstrator (*funding agency: SFOE's "SCCER-FURIES" program*) 2019 - 2022

- Validation of OPF-based real-time control algorithm on a real-life medium voltage distribution network in Aigle, Switzerland, hosting 2.5MWh/1.5MW battery storage capacity, 3.2MWp photovoltaic, 3.4 MVA hydro and 2.8MW base demand. *Final Report*.
- Development of software for the operation of the battery energy storage system for real-time control.

Joint Activity Scenario and Modeling (*funding agency: SFOE, Innosuisse*) 2017 - 2022

- Assessment of photovoltaic generation hosting capacity for the power distribution networks of Switzerland. Providing a set of robust scenarios to realize the Swiss Energy Strategy 2050. *Final Report*.
- Calculation of the cost-optimal placement of energy storage systems for different levels of photovoltaic generation.

Publications

(The citations can be found on *Google Scholar*.)

Journal Articles (Under revision)

[R_1] **Rahul Gupta**, Paolo Attilio Pegoraro, Ognjen Stanojev, Ali Abur, Carlo Muscas, Gabriela Hug, and Mario Paolone. Learning power flow models and constraints from time-synchronised measurements: A review. *[under review in Proc. of the IEEE.]*, 2024

[R_2] **Rahul Gupta** and Daniel K. Molzahn. Improving fairness in photovoltaic curtailments via daily topology reconfiguration for voltage control in power distribution networks. *[under review]*, 2024. Preprint Link.

[R_3] Taheri Babak, **Rahul Gupta**, and Daniel K Molzahn. Optimized lindistflow for high-fidelity power flow modeling of distribution networks. *[under review]*, 2024. Preprint Link.

[R_4] **Rahul Gupta**, Sherif Fahmy, Max Chevron, Enea Figini, and Mario Paolone. Grid-aware scheduling and control of electric vehicle charging stations for dispatching active distribution networks: Theory and experimental validation. *[under review]*, 2024. Preprint Link.

Journal Articles (published)

[J_1] Matthieu Jacobs, **Rahul Gupta**, and Mario Paolone. Week-ahead dispatching of active distribution networks using hybrid energy storage systems. *Sustainable Energy, Grids and Networks*, 39:101500, 2024. Publisher Link.

[J_2] **Rahul Gupta**. Quantifying uncertainty on the power-flow sensitivity coefficients from uncertain branches parameters and noisy grid-state measurements. *IEEE Transactions on Instrumentation and Measurement*, 2023. Publisher Link.

[J_3] **Rahul Gupta** and Fabrizio Sossan. Optimal sizing and siting of energy storage systems considering curtailable photovoltaic generation in power distribution networks. *Applied Energy*, 339, 2023. Publisher Link.

[J_4] **Rahul Gupta**, Antonio Zecchino, Ji-Hyun Yi, and Mario Paolone. Reliable dispatch of active distribution networks via a two-layer grid-aware model predictive control. *IEEE Open Access Journal of Power and Energy*, 2022. Publisher Link.

[J_5] **Rahul Gupta**, Sherif Fahmy, and Mario Paolone. Coordinated day-ahead dispatch of multiple power distribution grids hosting stochastic resources: An admm-based framework. *Electric Power Systems Research*, 212:108555, 2022. Publisher Link.

[J_6] **Rahul Gupta**, Fabrizio Sossan, and Mario Paolone. Model-less robust voltage control in active distribution networks using sensitivity coefficients estimated from measurements. *Electric Power Systems Research*, 212:108547, 2022. Publisher Link.

[J_7] Francesco Gerini, Yihui Zuo, **Rahul Gupta**, Antonio Zecchino, Zhao Yuan, Elena Vagnoni, Rachid Cherkaoui, and Mario Paolone. Optimal grid-forming control of battery energy storage systems providing multiple services: Modeling and experimental validation. *Electric Power Systems Research*, 212:108567, 2022. Publisher Link.

[J_8] **Rahul Gupta**, Fabrizio Sossan, Jean-Yves Le Boudec, and Mario Paolone. Compound admittance matrix estimation of three-phase untransposed power distribution grids using synchrophasor measurements. *IEEE Transactions on Instrumentation and Measurement*, 70:1–13, 2021. Publisher Link.

[J_9] **Rahul Gupta**, Fabrizio Sossan, and Mario Paolone. Countrywide pv hosting capacity and energy storage requirements for distribution networks: The case of switzerland. *Applied Energy*, 281:116010, 2021. Publisher Link.

[J_{10}] **Rahul Gupta**, Fabrizio Sossan, and Mario Paolone. Grid-aware distributed model predictive control of heterogeneous resources in a distribution network: Theory and experimental validation. *IEEE Transactions on Energy Conversion*, 36(2):1392–1402, 2020. Publisher Link.

[J_{11}] Sherif Fahmy, **Rahul Gupta**, and Mario Paolone. Grid-aware distributed control of electric vehicle charging stations in active distribution grids. *Electric Power Systems Research*, 189:106697, 2020. Publisher Link.

[J_{12}] Fabrizio Sossan, Enrica Scolari, **Rahul Gupta**, and Mario Paolone. Solar irradiance estimations for modeling the variability of photovoltaic generation and assessing violations of grid constraints: A comparison between satellite and pyranometers measurements with load flow simulations. *Journal of Renewable and Sustainable Energy*, 11(5):056103, 2019. Publisher Link.

Conference Papers (under review)

[D_1] R. Piansky, **Rahul Gupta**, and D. K. Molzahn. Optimizing battery and line undergrounding investments for transmission systems under wildfire risk scenarios: A benders decomposition approach. *submitted*, 2024

[D_2] A. Rangarajan, **Rahul Gupta**, D. K. Molzahn, and L. A. Roald. Forecast-aided state estimation in unbalanced distribution networks using smart meter data under limited communication bandwidth. *submitted*, 2024

[D_3] **Rahul Gupta** and Daniel K Molzahn. Analysis of fairness-promoting optimization schemes of photovoltaic curtailments for voltage regulation in power distribution networks. *[under review]*, 2024. Preprint Link.

[D_4] **Rahul Gupta** and Daniel K Molzahn. Optimizing phase allocation in unbalanced power distribution networks using a linearized distflow formulation. *[under review]*, 2024

Conference Papers (published)

[C_1] Richard Asiamah, **Rahul Gupta**, Rabab Haider, and Daniel. Molzahn. Performance assessment of data sampling strategies for neural network-based voltage approximations. *56th North American Power Symposium (NAPS 2024), October 13-15, 2024*, 2024. Publisher Link.

[C_2] Samuel Talkington, **Rahul Gupta**, Richard Asiamah, Paprapee Buason, and Daniel K Molzahn. Strategic electric distribution network sensing via spectral bandits. *To appear in the 63rd IEEE Conference on Decision and Control (CDC), December 16-19, 2024, Milano, Italy*, 2024. Preprint Link.

[C_3] **Rahul Gupta**, Paprapee Buason, and Daniel K Molzahn. Fairness-aware photovoltaic generation limits for voltage regulation in power distribution networks using conservative linear approximations. *8th Texas Power and Energy Conference (TPEC), February 12-13, 2024*, 2024. Publisher Link.

[C_4] Robin Henry and **Rahul Gupta**. Measurement-based/model-less estimation of voltage sensitivity coefficients by feedforward and lstm neural networks in power distribution grids. *8th Texas Power and Energy Conference (TPEC), February 12-13, 2024*, 2024. Publisher Link.

[C_5] **Rahul Gupta** and Mario Paolone. Experimental validation of model-less robust voltage control using measurement-based estimated voltage sensitivity coefficients. *IEEE Belgrade PowerTech, June 25-29, 2023*, pages 1–8, 2023. Publisher Link.

[C_6] **Rahul Gupta**, Sherif Fahmy, and Mario Paolone. Coordinated day-ahead dispatch of multiple power distribution grids hosting stochastic resources: An admm-based framework. In *2022 Power Systems Computation Conference (PSCC), Porto, Portugal*. Publisher Link.

[C_7] **Rahul Gupta**, Fabrizio Sossan, and Mario Paolone. Model-less robust voltage control in active distribution networks using sensitivity coefficients estimated from measurements. In *2022 Power Systems Computation Conference (PSCC), Porto, Portugal*. Publisher Link.

[C_8] Francesco Gerini, Yihui Zuo, **Rahul Gupta**, Antonio Zecchino, Zhao Yuan, Elena Vagnoni, Rachid Cherkaoui, and Mario Paolone. Optimal grid-forming control of battery energy storage systems providing multiple services: Modeling and experimental validation. In *2022 Power Systems Computation Conference (PSCC), Porto, Portugal*. Publisher Link.

[C_9] **Rahul Gupta**, Vladimir Sovljanski, Fabrizio Sossan, and Mario Paolone. Performance comparison of alternating direction optimization methods for linear-opf based real-time predictive control. In *2021 IEEE Madrid PowerTech*, pages 1–6. IEEE, 2021. Publisher Link.

[C_{10}] Sherif Fahmy, **Rahul Gupta**, and Mario Paolone. Grid-aware distributed control of electric vehicle charging stations in active distribution grids. In *2020 Power Systems Computation Conference (PSCC), Porto, Portugal*. Publisher Link.

[C_{11}] **Rahul Gupta**, Fabrizio Sossan, and Mario Paolone. Performance assessment of linearized opf-based distributed real-time predictive control. In *2019 IEEE Milan PowerTech*, pages 1–6. IEEE, 2019. Publisher Link.

[C_{12}] **Rahul Gupta**, Fabrizio Sossan, Enrica Scolari, Emil Namor, Luca Fabietti, Colin Jones, and Mario Paolone. An admm-based coordination and control strategy for pv and storage to dispatch stochastic prosumers: Theory and experimental validation. In *2018 Power Systems Computation Conference (PSCC)*, pages 1–7. IEEE, 2018. Publisher Link.

Presentations

Invited presentations

1. Invited presentation on a session titled Power Systems Optimization Under Uncertainty, *Informs Annual Meeting 2024*, Oct. 20-24, 2024, Seattle, WA, USA.

2. Panel session on Learning Power Flow Models from Synchronized Measurements at *International Conference on Smart Grid Synchronized Measurements & Analytics (SGSMA) 2024*, Washington DC, USA.

3. *Joint US-European Workshop on Flexible Electric Grid Critical Infrastructure for Resilient Society*, Temple University Conference Center, April 21-22, 2023, Philadelphia, PA, USA.

4. *The 7th Purple Mountain Forum Panel Session - Advanced Optimization and Control Methods toward a Carbon Neutral Energy Internet, Nanjing China (Virtual):* Grid-Aware Model Predictive Control of Distributed Energy Resources in a Distribution Network Theory and Experimental Validation, Gupta, R., 2022.

Conference (Oral)

1. *8th Texas Power and Energy Conference, College Station, Texas, USA:* Measurement-based/model-less estimation of voltage sensitivity co-efficients by feedforward and lstm neural networks in power distribution grids, February 12-13, 2024, 2024.

2. *8th Texas Power and Energy Conference, College Station, Texas, USA:* Fairness-aware photovoltaic generation limits for voltage regulation in power distribution networks using conservative linear approximations, February 12-13, 2024, 2024.

3. *15^{th} PowerTech Conference, Belgrade, Serbia:* Experimental validation of model-less robust voltage control using measurement-based estimated voltage sensitivity coefficients, June 2023.

4. *XXII PSCC, Porto, Portugal:* Coordinated Day-ahead Dispatch of Multiple Power Distribution Grids hosting Stochastic Resources: An ADMM-based Framework, June 2022.

5. *XXII PSCC, Porto, Portugal:* Model-less Robust Voltage Control in Active Distribution Networks using Sensitivity Coefficients Estimated from Measurements, June 2022.

6. *14^{th} PowerTech Conference, Madrid, Spain:* Performance Comparison of Alternating Direction Optimization Methods for Linear-OPF based Real-time Predictive Control, June 2021.

7. *13^{th} PowerTech Conference, Milan, Italy:* Performance assessment of linearized opf-based distributed real-time predictive control, June 2019.

8. *XX PSCC, Dublin, Ireland:* An admm-based coordination and control strategy for pv and storage to dispatch stochastic prosumers: Theory and experimental validation, July 2018.

Poster presentations

1. *PATHFNDR Workshop, Bern, Switzerland:* Coordinated Day-ahead Dispatch of Multiple Power Distribution Grids hosting Stochastic Resources, Gupta, R., Paolone, M., 2022.

2. *PATHFNDR Workshop, Bern, Switzerland:* Model Predictive Control of Multi-Energy Systems in a Microgrid, Gupta, R., Fernando, S., Paolone, M., 2022.

3. *SCCER-FURIES Annual Conference, EPFL, Lausanne, Switzerland:* Linearized-OPF based Distributed Real-time Predictive Control of Distribution Networks, Gupta, R., Sossan, F., Paolone, M. 2019.

4. *SCCER-FURIES Annual Conference, EPFL, Lausanne, Switzerland:* Optimal Planning of Energy Storage Systems in Electrical Distribution Grids using Receding Horizon Control Strategies, Gupta, R., 2018.

Teaching Activities

- Instructor, EE-485: Electric Energy Distribution Systems, WSU — Spring 2025
- Teaching Assistant, Smart Grids Technologies (EE-472), EPFL — Spring 2022
- Teaching Assistant, Smart Grids Technologies (EE-472), EPFL — Spring 2021
- Teaching Assistant, Smart Grids Technologies (EE-472), EPFL — Spring 2020

My role was to prepare teaching material for the course, supervising the lab exercises, evaluating the laboratory reports, and preparing and grading exams.

Supervised Student Projects

During my PhD and postdoctoral period, I supervised sixteen student projects on various topics ranging from distributed optimization algorithms, forecasting, synthetic networks, optimal planning, etc.

1. *Synthetic Transmission Network Generation for the Case of Georgia, USA*, Susannah Gordon, Bachelor Project, Georgia Tech, Fall 2024.
2. *ML-based Realistic Synthetic Network Generation for the Power Distribution Networks in USA*, Yuhao Chen, Bachelor Project, Georgia Tech, Spring 2024.
3. *Realistic Synthetic Network Generation for the Power Distribution Networks in USA*, Susannah Gordon, Bachelor Project, Georgia Tech, Spring 2024.
4. *Grid-aware Optimal Planning of Multi-energy System in Power Distribution Grids,* Master Semester Project, EPFL, Jennifer Abou-Najm, Spring 2023.
5. *ML-based Power Consumption Forecasting of an EPFL Building,* Corentin Jaire, Kelyan Hangard, Jennifer Abou-Najm, CS433 Machine Learning, EPFL, Project, Fall 2022.
6. *Model Predictive Control of Multi-Energy Systems in a Microgrid,* Master Thesis Project, Mr. Sooria Fernando, EPFL, Spring 2022.
7. *Day-ahead Grid-aware Dispatcher for Active Distribution Networks Embedding Stochastic Electric Vehicle Charging Stations,* Master Thesis Project, Mr. Max Chevron, Spring 2021.
8. *Optimal Planning of Electric Vehicle Charging Stations and Photovoltaic Generation in a Distribution Network,* Master Thesis Project, Mr. Vladimir Sovljanski, Fall 2021.
9. *Generating Realistic Low Voltage Distribution Networks using Representative Geographical and Socio-economic Information for Switzerland,* Bachelor Project, Mr. Kristoffer Berglund, KTH, Spring 2021.
10. *Detection of Medium and High Voltage poles using Convolutional Neural Network,* Bachelor Project, Mr. Louis Drame, EPFL, Spring 2021.
11. *Modeling of a PEM Electrolyzer for Model Predictive Control,* Bachelor Project, Keske Cem, EPFL, Spring 2021.
12. *Solar Irradiance Forecast using Sky-Camera Images,* Ms. Maissara Beliazi, Mr. Ahmed Achiche, Bachelor Project, EPFL, Spring 2021.
13. *Solar Irradiance Forecast using Time-series Forecasting,* Mr. Aziz Ben, Bachelor Project, EPFL, Spring 2021.
14. *Generating Realistic Power Distribution Network for Switzerland,* Master Semester Project, EPFL, Fall 2020.
15. *Data-driven Estimation of Voltage Sensitivity Coefficients in Power Distribution Grids,* Master Thesis Project, Mr. Robin Henry, The University of Edinburgh, Fall 2020.
16. *State Estimation of Power Grids: Analysis of Available Methods and Effects of Parameter Inaccuracies,* Master Thesis Project, Mr. Bruno Gabriele, University of Genova, Spring 2019.
17. *Performance Comparison of Different Distributed Algorithms for Grid Aware Predictive Control,* Master Semester Project, Mr. Vladimir Sovljanski, EPFL, Fall 2018.

Service to the profession

I regularly act as a reviewer for the top international journals and international conferences. Some are listed below:

- IEEE PES Transactions on Power Systems, 2020-present
- IEEE PES Transactions on Sustainable Energy 2019-present
- IEEE PES Transactions on Smart Grid 2021-present
- IEEE Transactions on Circuits and Systems-I 2022-present
- IEEE Transactions on Instrumentation and Measurement 2022-present
- Elsevier Electric Power Systems Research 2019-present
- Elsevier Sustainable Energy, Grids and Networks Journal 2018-present
- Elsevier Energy for Sustainable Development 2021-present
- IEEE Powertech Conference 2019-present
- Power Systems Computation Conference 2020-present
- IEEE International Conference on Smart Energy Systems and Technologies 2020-present
- IEEE Power and Energy General Meeting 2023-present.