AVIK GHOSH

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⋄ **Hyperlinks** at appropriate places

EDUCATION

Doctorate of Philosophy in Mechanical and Aerospace Engineering Fall 2019 - Ongoing
University of California, San Diego
Advisors: Prof. Jan Kleissl and **Prof. Sonia Martinez**

Master of Science in Mechanical Engineering Fall 2019 - Winter 2021
University of California, San Diego
GPA: **3.82/4.00**

Bachelor of Technology (Hons.) in Mechanical Engineering Fall 2015 - Spring 2019
Indian Institute of Engineering Science and Technology, Shibpur
Graduating CGPA: **8.39/10.00**

RESEARCH INTERESTS

Model Predictive Control, Smart EV/Battery charge scheduling, Chance-constrained optimization, ML for Load/EV/PV prediction, HVAC-R

PUBLICATIONS

[1] **Ghosh, A.**, Zapata, M.Z., Silwal, S., Khurram, A., Kleissl, J., 2022. Effects of number of electric vehicles charging/discharging on total electricity costs in commercial buildings with time-of-use energy and demand charges. **Journal of Renewable and Sustainable Energy** 14, 035701. *Link*

[2] **Ghosh, A., Cortes-Aguirre, C., Chen, Y.**, Khurram, A., Kleissl, J., 2023. Adaptive Chance Constrained MPC under Load and PV Forecast Uncertainties. **2023 IEEE PES Grid Edge Technologies Conference & Exposition (Grid Edge), San Diego, CA, USA, 2023, pp. 1-5.** *Link*

[3] McClone, G., **Ghosh, A.**, Khurram, A., Washom, B., Kleissl, J., 2023. Hybrid Machine Learning Forecasting for Online MPC of Work Place Electric Vehicle Charging. **IEEE Transactions on Smart Grids.** *Link*

[4] **Ghosh, A.**, Ganguly, A., 2017. Performance analysis of a partially closed solar regenerated desiccant assisted cooling system for greenhouse lettuce cultivation. **Solar Energy** 158, 644-653. *Link*

[5] **Ghosh, A.**, Bhattacharya, J., 2021. A solar regenerated liquid desiccant evaporative cooling system for office building application in hot and humid climate. **Thermal Science and Engineering Progress** 22, 100804. *Link*

[6] **Ghosh, A.**, Ganguly, A., Bhattacharya, J., 2019. Exergy analysis of a solar regenerated liquid desiccant assisted air conditioning system for hot and humid climates. **J. Phys.: Conf. Ser.** 1240 012148. *Link*

DISSERTATION PROJECTS

Analysis of the number of EV charging stations on total cost savings in buildings June 2020 - May 2022
Guide: Prof. Jan Kleissl *Graduate Student Researcher, UCSD*

· Wrote and implemented an optimization algorithm in CVX and MATLAB to smartly charge/discharge EVs using V2G/V1G schemes to minimize the total electricity cost of buildings incorporated with charging stations.

· Analyzed the results to quantify the savings of implementing V2G charging over V1G/V0G/No charging using real load data of buildings along with realistic demand and energy charges.

· Developed generalized equations to predict the effect of charging type, load shape, layover period and EV charging demand on total electricity costs using pre-EV building load and tariff data.

· Method developed can be used to approximate the optimal number of V2G charging stations to be installed in buildings such that original (pre-EV) electricity costs are not exceeded.

Smart battery dispatch using MPC and chance-constrained optimization
Guide: Prof. Jan Kleissl

December 2021 - Ongoing

Graduate Student Researcher, UCSD

- Developed, and implemented an online optimization algorithm using receding-horizon model predictive control (MPC) in CVX to minimize electricity import costs from the grid at the Port of San Diego by smartly dispatching an installed battery.
- Developed (and **mathematically proved convergence** of) a novel online adaptive method based on chance-constrained optimization of smartly violating battery constraints and analyzed its effect on battery dispatch, grid import and electricity costs.
- The method lowers electricity costs as compared to the nominal deterministic one, and I am currently writing a journal paper on it as the primary author.
- The novel method can be used for any general system where a trade-off between full constraint satisfaction and minimization of cost is required.
- Currently exploring Economic Model Predictive Control methods to reduce demand charges.

Hybrid ML algorithm for EV forecasting and MPC based EV dispatch
Guide: Prof. Jan Kleissl

Sep 2021 - Feb 2023

Graduate Student Researcher, UCSD

- Co-developed a hybrid ML approach involving TreeBagger, LSTM and kNN to forecast EV arrival time (AT), plug duration (PD) and energy demand (ED). The method forecasts AT, PD and ED for non-predetermined number of non-preidentified individual EVs rather than forecasting a known number of EVs or EVs as known agents.
- Co-developed an online shrinking horizon MPC to dispatch EVs based on the forecast and real-time EV data.
- Co-developed a novel error analysis method to determine errors between individual forecasted EVs and real-time EVs, for vectors of different lengths and indices.
- The hybrid ML method performs better than persistence forecasting, and the MPC is able to reduce electricity costs to come closest to offline perfect forecast optimal control.

Smart Charging Aggregation, Flexibility and Decarbonization for Electric Vehicles
Guide: Prof. Jan Kleissl and Wente Zeng

July 2022 - Ongoing

Graduate Student Researcher, UCSD

- TotalEnergies funded project, evaluating and demonstrating large scale smart workplace charging to achieve demand flexibility and achieve both environmental and economic goals.
- Analyzed over 4 million EV charging sessions of ChargePoint EVSE to quantify driver behavior in San Diego county.
- Developed clustering methodology using unsupervised learning to aid in developing high-level charging control techniques for different driver groups.
- Co-developing cluster based optimal control methodology to reduce charging costs and emissions.

UNDERGRADUATE PROJECTS

Standalone solar photovoltaic integrated liquid desiccant cooling system
Guide: Prof. Jishnu Bhattacharya

May 2018 - July 2018

SURGE 2018 Fellow, IIT Kanpur

- Designed, numerically modeled, validated and analyzed a standalone liquid desiccant cooling system integrated with solar regenerator and photovoltaic converter for large office buildings with high internal load.
- System could maintain room air conditions within the moderate thermal acceptability criterion for majority of a calendar year in a hot and humid climate and consumed 3 times less energy than vapor compression based air conditioners.

Thermal modeling of a solar regenerated liquid desiccant cooling system
Guide: Prof. Aritra Ganguly

December 2016 - May 2019

Undergraduate Research Assistant, IIEST Shibpur

- Developed a novel scheme and a thermal model of a partially closed solar desiccant assisted greenhouse cooling system.
- System performed better than those existing in extending the growing season of temperate crops in subtropical climates
- Worked on exergy analysis and design optimization of a solar assisted liquid desiccant cooling system for office building application *(Co-Guide: Prof. Jishnu Bhattacharya)*.

INTERNSHIP

Rule based control for a heat pump assisted building HVAC-R system   July 2023 - September 2023
Guide: Dr. Veronica Adetola   *PhD Intern, Resilient Control Methods group, PNNL*

· Designing, implementing, and testing data-driven controls for building HVAC-R systems, including integrated heat pumps and thermal storage.
· Developing component/system models, control strategies, & performing simulations and integrated system evaluation to support multiple objectives geared towards building decarbonization and energy resiliency.

TECHNICAL SKILLS

Programming Languages: C, Java, MATLAB, Python
Optimization Tools: CVX, YALMIP
General Tools: RTDS, LATEX, Cycle-Tempo

POSITIONS OF RESPONSIBILITY

Assistant General Secretary: The Students' Senate of IIEST Shibpur   August 2017 - November 2018
General Secretary: Euphony, The music society of IIEST Shibpur   August 2016 - November 2018
Core Steering Committee member: The Students' Senate of IIEST Shibpur   August 2016 - August 2017
Student Mentor: Tutored and mentored 3 high school students for national board exams   September 2015 - April 2018

AWARDS AND ACHIEVEMENTS

Awarded the GAABESU Research Award: Scholarships awarded to 8 students across the institute   2018 & 2019
GAABESU is the global alumni organization of IIEST Shibpur
Awarded the SURGE 2018 Fellowship: Fellowships awarded to 160 students across India   2018
SURGE is the summer research internship program of IIT Kanpur
Best Design and First Position: Terror Trebuchet - Robotics Competition, Trajectory 2016, Jadavpur University   2016
Second Position: Counter Terrorist - Robotics competition, INSTRUO, IIEST Shibpur   2016