Phani Arvind Vadali

Phani Arvind Vadali | phani.vadali@colorado.edu | +1-(979)-402-8922

Education

Ph.D. in Architectural Engg.	University of Colorado, Boulder	On-going
M.S. in Mechanical Engg.	Texas A&M University, College Station	Spring '22
B.Tech. in Mechanical Engg.	Indian Institute of Technology, Madras	Spring '19

Skills

Building Energy Modelling, Building Model Calibration, Building Controls, Grid Interaction & Optimization, Fault Detection and Diagnostics, Data Analysis and Machine Learning
Relevant Software: Python, EnergyPlus, MATLAB, R, Rhino/Grasshopper, EES

Research

Automatic Calibration and Retrofit Analysis Tool *Fall '22 – present*
Guide: Moncef Krarti, Building Energy Smart Technologies (BEST) Center, University of Colorado Boulder

- Developed SABER, a simplified Python-based tool to conduct electrification retrofit analysis of residential buildings using EnergyPlus.
- Developed an algorithm to automatically calibrate lighting, equipment, and setpoint schedules of Energy Plus models.
- Developed a unified framework to conduct cost-benefit analysis of various individual and packaged retrofit measures.
- Utilized optimization techniques to identify cost-optimal electrification retrofit strategies under different scenarios.

Combined Design and Control Optimization of Energy Systems in Electrified Residential Buildings *Fall '22 – present*
Guide: Moncef Krarti, Building Energy Smart Technologies (BEST) Center, University of Colorado Boulder

- Developed a comprehensive framework for the integrated design and control optimization of heat pumps, domestic hot water systems, PV arrays and batteries for electrified residential buildings.
- Optimized heat pump size and setpoints to minimize energy consumption and occupant discomfort using a GA-based optimizer built on Energy Plus.
- Implemented a bi-level optimization framework using GA and MILP techniques to simultaneously optimize energy system sizing and operation using reduced-order models.
- Conducted sensitivity analyses to quantify impact of different pricing strategies, climate zones, and system configurations on cost-optimal designs.

Large-Scale Data Analytics for Fault Severity Analysis of Residential HVAC Systems using Smart Thermostat Data *Spring '20 – Spring '22*
Guide: Bryan Rasmussen, Texas A&M University, College Station

- Used large-scale smart thermostat data from Trane Technologies from over 40,000 residential HVAC systems to develop a energy and comfort impact metrics.
- Developed a fault severity index to quantify the energy and comfort impact of common HVAC faults such as inadequate capacity, and control system issues.
- Implemented statistics-based fault detection algorithms to identify fault systems using data parsing, feature extraction, and statistical multivariate data analysis.

Academic Projects

Data Analysis of Energy Markets in Spain and Portugal *Fall '23*
Guide: Prof. Gregor Henze, Course: Data Science for Energy and Buildings

- Analyzed electricity demand, imports, and generation data from ENTSOE for Spain and Portugal to identify trends in energy consumption and pricing.
- Built and compared machine learning models including Linear Regression, tree-based ensembles, and an RNN to forecast day-ahead prices and 24-hour demand.
- Tuned model hyperparameters to achieve an R^2 of 0.982, within 1% of the official system forecast. Code available on GitHub.

Conceptual Design of a Net-Zero Energy Building *Spring '23*
Guide: Prof. Jay Arehart, Course: Sustainable Building Design

- Designed a 50000 sq. ft. net-zero energy office in Port Angeles, WA (Cool-Marine climate) with passive strategies to reduce Energy Use Intensity by 35%.
- Simulated and compared HVAC systems (VRF, GSHP, DOAS) for energy and whole-life carbon performance using Honeybee/Grasshopper.
- Conducted scenario analysis of sustainability, including grid carbon projections, operational and embodied carbon, and on-site renewable energy savings.

Grants

Evaluation of Integrated Water-Source Heat Pumps with Solar Electric and Thermal Energy Storage Systems *Apr '25 – present*
Guide: Moncef Krarti, Co-PI

- Successfully secured a $55,000 research grant from Building Energy Smart Technologies (BEST) Center, University of Colorado Boulder.
- Co-designed a research plan to evaluate the performance of thermal energy storage tanks integrated with Phase Change Materials (PCMs) in residential water-source heat pump systems.

Scholastic Achievements

2025/26 - Finalist, 3 Minute Thesis Competition, University of Colorado Boulder.
2023/24 - Center for Teaching & Learning's "Best Should Teach" Silver Award, Graduate School, University of Colorado Boulder.
2023 - Selected Ph.D. Fellow, Durham School Future of Building Industry (FoBI) Workshop, University of Nebraska-Lincoln.
2022/23 - Graduate Teaching Assistantship, Dept. of Civil, Environmental and Architectural Engineering, University of Colorado Boulder.
2021/22 - Graduate Research Assistantship, Dept. of Mechanical Engineering, Texas A&M University

Publications

Vadali, Phani Arvind (Apr. 2022). "Impact of Metrics for Residential HVAC Systems Using Cloud-Based Smart Thermostat Data". MA thesis. Texas A&M University.

Vadali, Phani Arvind, Ashit Harode, and Moncef Krarti (2025). "A Simplified and Automated Building Energy Retrofit Analysis Tool". In: *Submitted to Journal of Building Performance Simulation*.

Vadali, Phani Arvind and Moncef Krarti (July 2025a). "Combined Design and Control Optimization of Heat Pumps in Residential Buildings". In: *Energy* 326, p. 136317. ISSN: 0360-5442. DOI: 10.1016/j.energy.2025.136317. (Visited on 05/02/2025).

Vadali, Phani Arvind and Moncef Krarti (2025b). “Combined Design and Control Optimization of Heat Pumps, Domestic Hot Water Systems, PV Arrays and Batteries for Electrified Residential Buildings”. In: *Submitted to Energy*.