ARASH JALIL KHABBAZI

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SUMMARY

My research is on modeling, control, optimization, and machine learning for building energy systems, focusing on reinforcement learning and predictive control. It aims to advance the state of the art of practical automation systems for efficient, occupant- and grid-interactive buildings. I am developing and demonstrating scalable algorithms in real buildings, minimizing data and engineering requirements. I also work with Purdue's Energy and Utilities team on demand flexibility in campus buildings, and I develop power control systems for homes.

EDUCATION

Purdue University, *West Lafayette, IN* — *08/2023 – 08/2028*
PhD in Mechanical Engineering — **GPA:** 3.9/4.0
Concentration in Computational Science and Engineering

University of British Columbia (UBC), *BC, Canada* — *05/2021 – 08/2023*
MS in Mechanical Engineering — **GPA:** 94% (4.0/4.0)
Thesis: "Mixing gaseous hydrogen into natural gas distribution pipelines"

University of Tabriz, *EA, Iran* — *08/2016 – 08/2020*
BS in Mechanical Engineering — **GPA:** 19.12/20 (4.0/4.0) – **Rank:** 1/155+

SELECT AWARDS AND RECOGNITION

ASHRAE Graduate Student Grant-in-Aid Award *2025*
Best PhD Forum Presentation Runner-up Award, *ACM BuildSys* *2025*
ACM SIGEnergy Student Travel Grant, *ACM BuildSys* *2025*
Best Paper Award, *CSME International Congress* *2023*
Best Presentation Award, *CSME International Congress (Advanced Energy Symposium)* *2022*
Graduate Research Scholarship, *University of British Columbia* *2022*
Graduate Dean's Entrance Scholarship, *University of British Columbia* *2021*

PUBLICATIONS

Journal Articles

2. **A.J. Khabbazi**, E.N. Pergantis, L.D. Reyes Premer, P. Papageorgiou, A.H. Lee, J.E. Braun, G.P. Henze, and K.J. Kircher, "Lessons learned from field demonstrations of model predictive control and reinforcement learning for residential and commercial HVAC: A review." *Applied Energy, 2025.*
1. **A.J. Khabbazi**, M. Zabihi, R. Li, M. Hill, V. Chou, and J. Quinn, "Mixing hydrogen into natural gas distribution pipeline system through Tee junctions." *International Journal of Hydrogen Energy, 2024.*

Preprints

1. L.D. Reyes Premer, **A.J. Khabbazi**, and K.J. Kircher, "Indirect data-driven predictive control and the state-space predictor." *arXiv:2602.10936, 2026. Under review.*

Conference Papers

6. W.G. Dierking, **A.J. Khabbazi**, L.D. Reyes Premer, and K.J. Kircher, "Scalable supervisory HVAC control for linear objectives." *65th IEEE Conference on Decision and Control (CDC), 2026.*
5. L.D. Reyes Premer, E.N. Pergantis, **A.J. Khabbazi**, F. Wu, and K.J. Kircher, "Evaluating power control strategies for avoiding residential panel upgrades in cold climates." *ACEEE Summer Study on Energy Efficiency in Buildings, 2026.*
4. **A.J. Khabbazi** and K.J. Kircher, "Small HVAC control demonstrations in larger buildings often overestimate savings." *American Control Conference (ACC), 2026.*
3. E.N. Pergantis, L.D. Reyes Premer, **A.J. Khabbazi**, Priyadarshan, F. Wu, D. Ziviani, and K.J. Kircher, "Active current limiting control of residential appliances for breaker panel protection across the US: A preliminary study." *CISBAT, 2025.*

2. **A.J. Khabbazi**, E.N. Pergantis, L.D. Reyes Premer, A.H. Lee, J. Ma, H. Liu, G.P. Henze, and K.J. Kircher, "What have we learned from field demonstrations of advanced commercial HVAC control?" *8th International High Performance Buildings Conference, 2024.*
1. **A.J. Khabbazi**, M. Zabihi, R. Li, V. Chou, and J. Quinn, "Blending of hydrogen into a natural gas distribution pipeline in British Columbia through a Tee junction for reducing GHG emissions." *Canadian Society for Mechanical Engineering (CSME) International Congress, 2023.* ***Best Paper Award.***

Abstracts

3. **A.J. Khabbazi**, "PhD Forum abstract: Field demonstration of advanced commercial HVAC control for scalable deployment." *12th ACM International Conference on Systems for Energy-Efficient Buildings, Cities, and Transportation (BuildSys), 2025.* ***Best PhD Forum Presentation Runner-up Award.***
2. **A.J. Khabbazi**, R. Li, and J. Quinn, "Green hydrogen supply to urban infrastructure and buildings through blending into the existing grid." *Canadian Society for Mechanical Engineering (CSME) International Congress, 2022.* ***Best Presentation Award.***
1. **A.J. Khabbazi**, R. Li, J. Quinn, and M. Hoorfar, "The blending and transmission of hydrogen and natural gas in transmission and distribution pipelines." *13th International Green Energy Conference (IGEC-XIII), 2021.*

TALKS

10. "Advanced HVAC control in real buildings: State of the art, protocols, and deployment." *Google Smart Buildings Simulator (SBSim) Group, 2026.*
9. "Small HVAC control demonstrations in larger buildings often overestimate savings." *American Control Conference (ACC), New Orleans, LA, 2026.*
8. "Model predictive control for buildings." *Google Smart Buildings Simulator (SBSim) Group, 2026.*
7. "Field demonstration of advanced commercial HVAC control for scalable deployment." *PhD Forum, 12th ACM International Conference on Systems for Energy-Efficient Buildings, Cities, and Transportation (BuildSys), Golden, CO, 2025.*
6. "What have we learned from field demonstrations of advanced commercial HVAC control?" *8th International High Performance Buildings Conference, Purdue University, West Lafayette, IN, 2024.*
5. "Field demonstrations of advanced commercial HVAC control." *Intelligent Building Operations Workshop, Purdue University, West Lafayette, IN, 2024.*
4. "Mixing gaseous hydrogen into natural gas distribution pipelines." *Herrick Graduate Seminar, Purdue University, West Lafayette, IN, 2023.*
3. "Blending of hydrogen into a natural gas distribution pipeline in British Columbia through a Tee junction for reducing GHG emissions." *CSME International Congress, Université de Sherbrooke, QC, Canada, 2023.*
2. "Green hydrogen supply to urban infrastructure and buildings through blending into the existing grid." *CSME International Congress, University of Alberta, AB, Canada, 2022.*
1. "The blending and transmission of hydrogen and natural gas in transmission and distribution pipelines." *13th International Green Energy Conference (IGEC-XIII), 2021.*

RESEARCH EXPERIENCE

Purdue University, Graduate Research Assistant, Kircher Research Group, *West Lafayette, IN* *08/2023–Present*

- Identified a grey-box thermal model of a 13-zone campus building from BAS data for predictive pre-cooling control.
- Developed a two-parameter, tuning-free HVAC controller with **up to 87% of optimal savings** in simulation (CDC'26).
- Built data-driven predictive control with the **lowest prediction error and failure rate** of all predictors (under review).
- Derived and tested a multi-zone model showing small HVAC demos **overstate savings** (ACC'26).
- Developed current-limiting control for home appliances to **avoid $2k–$10k panel upgrades** (CISBAT'25, ACEEE'26).
- Led a 4-institution review of **all known** real-world demonstrations of MPC and RL for HVAC (Applied Energy).

Google, Open-Source Contributor, Smart Buildings Simulator (SBSim), *Remote* *12/2025–Present*

- Co-leading a benchmark of SBSim against EnergyPlus on **RL training speed** with **Google** and **Berkeley Lab**.
- Proposed the **predictive control** workstream and presented **two talks** to the Google-led working group.
- Contributed code and **reviewed pull requests** for the open-source codebase.

UBC, Graduate Research Assistant, TMMF Lab & FortisBC Renewable Gas, *BC, Canada* *05/2021–08/2023*

- Ran CFD simulations of hydrogen blending into natural gas pipelines; built ideal- and real-gas mixture models in C.

– Delivered **1** journal paper, **3** conference papers, an MS thesis, and **2** awards on a project that seeded the UBC H_2Lab.

INDUSTRY EXPERIENCE

Tesla, Inc., Applied ML Intern, *Sparks, NV* *05/2025–08/2025*

– Developed MySQL data pipelines and engineered high-signal features for defect detection models.
– Trained machine learning (ML) models and ensembles (XGBoost, LightGBM, random forests, SVR, neural nets) to $\mathbf{R^2}$ **0.9**.
– Delivered ML-driven quality gains projected to cut testing costs by over **$1M/year**; offered a **three-month extension**.

Purdue Energy & Utilities, Energy Systems Researcher, *West Lafayette, IN* *02/2026–Present*

– Designed and ran a **three-day pre-cooling trial** in a 13-zone campus building to shift cooling demand off-peak.
– Delivered a nine-year energy-use assessment of 21 renovations to **Purdue leadership** for the Giant Leaps Master Plan.
– Quantified ∼**$41k/yr** savings and a statistically significant **8%** lower approach from a two-plant air/dirt-separator retrofit.

TEACHING EXPERIENCE

Purdue University, Graduate Teaching Assistant (PhD)

– ME597: Distributed Energy Resources (DERs) *Spring'26*
  – Supported 52 students on modeling and control of DERs such as batteries, solar PV, EVs, and HVAC.
  – Assisted with homework, coding modules, and office hours covering DER concepts.
  – Guided semester projects on DER topics, including building controls and data center cooling.

University of British Columbia, Graduate Teaching Assistant (MS)

– Engineering Analysis I *Fall'21, Spring'22, Fall'22*
– Fluid Mechanics II Lab *Spring'22, Spring'23*

LEADERSHIP & MENTORSHIP

Research Mentor, Purdue University *2024–Present*

– Mentored three master's students and one undergraduate on research planning and technical writing.
– Collaborated on their research and co-authored the resulting publications.

Disability Resource Centre Invigilator, University of British Columbia *2021–2023*

– Invigilated accommodated exams, supporting students with approved testing accommodations.

ACADEMIC SERVICE

Conference and workshop organizing:

July 2026	Student Chair, Intelligent Building Operations (IBO) Workshop, *West Lafayette, IN*
July 2024	Student Chair, Intelligent Building Operations (IBO) Workshop, *West Lafayette, IN*
	About 50 researchers each year, including faculty and national-lab scientists

Society memberships: ASHRAE, ACM, IEEE, CSME

Reviewing: IEEE Transactions on Control Systems Technology; IEEE Conference on Decision and Control; Building and Environment; Journal of Building Performance Simulation; ACEEE Summer Study on Energy Efficiency in Buildings; Herrick Conferences

SELECT COURSES

- ECE570: Artificial Intelligence
- IE690: Reinforcement Learning & Control (RLC)
- AAE568: Applied Optimal Control & Estimation
- AAE 561: Intro to Convex Optimization
- STAT511: Statistical Methods
- ME597: Industrial Internet of Things (IIoT)
- ME597: Distributed Energy Resources (DERs)
- ME511: Analysis of Thermal Systems

SKILLS

AI Methods: Reinforcement Learning (PPO, SAC), Supervised and Unsupervised Learning, Generative AI, Large Language Models (LLMs), Retrieval-Augmented Generation (RAG)

Control & Optimization: Model Predictive Control, Data-Driven Predictive Control, Convex Optimization, System Identification

Frameworks: CVXPY, TensorFlow, TF-Agents, scikit-learn, XGBoost, Stable-Baselines3, PyTorch, Gurobi

Simulation: Google SBSim, Gymnasium, EnergyPlus, BOPTEST, OCHRE, TRNSYS, EES, Ansys Fluent

Programming & Tools: Python (NumPy, SciPy, Pandas), MATLAB, C, SQL, MySQL, InfluxDB, Grafana, Git, Linux, Docker