

# Bingqing Chen

PhD Candidate at Carnegie Mellon University  
*Autonomous Energy Systems; Reinforcement Learning*  
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## A. Education

2017 – Present      *Carnegie Mellon University; Ph.D., Advanced Infrastructure Systems*  
- Thesis: *Towards Safe and Sample-Efficient Learning for Autonomous Energy Systems*  
2019 – 2021      *Carnegie Mellon University; M.S., Machine Learning*  
2015 – 2017      *University of Hong Kong; M.Sc. (with Distinction), Structural Engineering*  
2012 (Fall)      *McGill University; Exchange Program*  
2011 – 2014      *University of Hong Kong; B.Eng. (First-class Honors), Civil Engineering*

## B. Experience

2021 (Summer, Fall)      *Research Intern, Bosch Research, PA – Domain Adaptation*  
2020 (Summer)      *Research Intern, Lawrence Berkley National Laboratory, CA – Autonomous Energy Systems*  
2014 – 2016      *Structural Engineer, Ove Arup & Partners, Hong Kong – Engineering Design & Consulting*  
2013 – 2014      *Intern, Frost & Sullivan, Shanghai – Management Consulting*  
2013 (Summer)      *Research Assistant, Imperial College London, London – Travel Behavior Analysis*  
2012 (Summer)      *Intern, China Three Gorges Corporation, Beijing – Construction Management*

## C. Selected Projects

*Distributed Optimization of Energy Resources to Provide Grid Services; Lawrence Berkley National Laboratory; CA Research, Distributed Optimization, Smart Grid | 2020*

- Proposed a distributed control solution for coordinating a population of heterogeneous buildings as virtual batteries to provide grid services, such as integrating renewable generation, while satisfying individual buildings' operational constraints
- Forecasted electricity demand and solar generation with a sequence-to-sequence model with attention mechanism
- Validated the proposed solution via hardware-in-the-loop simulation, which included both a real-world testbed along with simulated ones, modelled on data traces from 100,000+ households; the proposed method curtailed daily peak load by an average of 12.5%, while maintaining occupants' comfort.

*Practical and Scalable Reinforcement Learning for Building Control; Carnegie Mellon University; PA Research, Model-based Reinforcement Learning, Building Control | 2019*

- Proposed the 1<sup>st</sup> reinforcement learning solution for building control that enables real-world deployment without the resource-intensive process of developing high-fidelity simulation models, by incorporating domain knowledge on system dynamics
- Validated the proposed solution in a real-world testbed, saving 16.7% of energy and improving occupants' thermal comfort compared to the existing rule-based controller

*Domain Adaptive Energy Disaggregation; Carnegie Mellon University; PA Research, Domain Adaptation, Non-intrusive Load Monitoring (NILM) | 2019*

- Developed a domain-adaptive model for NILM, which accounted for negative transfer by incorporating application-specific constraints into domain adversarial training
- Demonstrated the proposed solution compares favorably to unsupervised methods by evaluating on a publicly available dataset of 16.5kHz electricity measurements

*Human-in-the-Loop Sensing and Control; Carnegie Mellon University; PA Research, Sensing & Instrumentation, Occupancy-aware Smart Campus | 2019*

- Instrumented and maintained 30+ depth camera-based occupancy sensors on CMU campus, as an analogue for smart cities
- Controlled four diverse building testbeds, using occupancy traces and other environmental sensor measurements, which saved 14.2% in energy consumption over a 6-month period

*Infrastructure Project Coordination; Ove Arup & Partners; HK, CN Engineering Design, Project Coordination | 2014-2016*

- Coordinated design changes and addressed contractor queries, for a work-package under the Tuen Mun-Chek Lap Kok Link, a major infrastructure project in Hong Kong with a contract sum of \$6 billion
- Liaised with engineers from different disciplines and compiled holistic solutions for the client

# Bingqing Chen

## D. Selected Publications

- [1] **Bingqing Chen**, Jonathan Francis, James Herman, Jean Oh, Eric Nyberg, and Sylvia L. Herbert. "Safety-aware Policy Optimisation for Autonomous Racing." *arXiv preprint arXiv:2110.07699* (2021). (Under Review at ICLR'22)
- [2] James Herman, Jonathan Francis, Siddha Ganju, **Bingqing Chen**, Anirudh Koul, Abhinav Gupta, Alexey Skabelkin, Ivan Zhukov, Max Kumskey, and Eric Nyberg. "Learn-to-Race: A Multimodal Control Environment for Autonomous Racing." In *Proceedings of the IEEE/CVF International Conference on Computer Vision*, pp. 9793-9802. 2021. [DOI]
- [3] **Bingqing Chen**, Priya L. Donti, Kyri Baker, J. Zico Kolter, and Mario Bergés. 2021. "Enforcing Policy Feasibility Constraints through Differentiable Projection for Energy Optimization". In *Proceedings of the Twelfth ACM International Conference on Future Energy Systems (e-Energy '21)*, pp. 199–210. 2021. [DOI] (**Best Paper Runner-up**)
- [4] Henning Lange, **Bingqing Chen**, Mario Berges, and Soumya Kar. "Learning to Solve AC Optimal Power Flow by Differentiating through Holomorphic Embeddings." *arXiv preprint arXiv:2012.09622* (2020).
- [5] **Bingqing Chen**, Jonathan Francis, Marco Pritoni, Soumya Kar, and Mario Bergés. "COHORT: Coordination of Heterogeneous Thermostatically Controlled Loads for Demand Flexibility." In *Proceedings of the 7th ACM International Conference on Systems for Energy-Efficient Buildings, Cities, and Transportation*, pp. 31-40. 2020. [DOI]
- [6] **Bingqing Chen**, Ming Jin, Zhe Wang, Tianzhen Hong, and Mario Bergés. "Towards Off-policy Evaluation as a Prerequisite for Real-world Reinforcement Learning in Building Control." In *Proceedings of the 1st International Workshop on Reinforcement Learning for Energy Management in Buildings & Cities*, pp. 52-56. ACM, 2020. [DOI]
- [7] **Bingqing Chen**, Weiran Yao, Jonathan Francis, and Mario Bergés. "Learning a distributed control scheme for demand flexibility in thermostatically controlled loads." In *2020 IEEE International Conference on Communications, Control, and Computing Technologies for Smart Grids (SmartGridComm)*, pp. 1-7. IEEE, 2020. [DOI] (**Best Student Paper Nominee**)
- [8] **Bingqing Chen**, Jingxiao Liu, Henning Lange, and Mario Bergés. "Dyna-Bolt: Domain Adaptive Binary Factorization of Current Waveforms for Energy Disaggregation." In *ICASSP 2020-2020 IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP)*, pp. 3262-3266. IEEE, 2020. [DOI]
- [9] Jingxiao Liu, **Bingqing Chen**, Siheng Chen, Mario Bergés, Jacobo Bielak, and HaeYoung Noh. "Damage-sensitive and domain-invariant feature extraction for vehicle-vibration-based bridge health monitoring." In *ICASSP 2020-2020 IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP)*, pp. 3007-3011. IEEE, 2020. [DOI]
- [10] **Bingqing Chen**, Zicheng Cai, and Mario Bergés. "Gnu-RL: A precocious reinforcement learning solution for building HVAC control using a differentiable MPC policy." In *Proceedings of the 6th ACM international conference on systems for energy-efficient buildings, cities, and transportation*, pp. 316-325. 2019. [DOI] (**Best Paper Award**)
- [11] Scott Le Vine, **Bingqing Chen**, and John Polak. "Does the income elasticity of road traffic depend on the source of income?." *Transportation Research Part A: Policy and Practice* 67 (2014): 15-29. [DOI]

## E. Teaching

*Head TA* CMU 12740 Data Acquisition (F19, F20): developed new course materials for environmental sensing based on commercial embedded hardware; advised student projects; created course website

*Head TA* CMU 12741 Data Management (F19, F20): designed assignments and advised student projects for database management; setup course database infrastructure for student projects

## F. Skills

- *Programming Languages*: Python, C/C++/C#, Java
- *Machine Learning*: tensorflow, pytorch, keras, scikit-learn
- *Data Analysis*: numpy, pandas, PySpark, R, SQL, Matlab, Mathematica

## G. Coursework at CMU

Statistical Machine Learning • Deep Learning • Deep Reinforcement Learning • Convex Optimization • Statistics • Probabilistic Graphical Models • Machine Learning with Large Datasets

## H. Professional Service

TPC Co-chair *ACM Workshop on Reinforcement Learning for Energy Mgmt. in Buildings & Cities, RLEM'20*  
Reviewer *ACM BuildSys'20; IEEE Transactions on Power Systems; IEEE Transactions on Smart Grid*

## I. Outreach

Volunteer – Pollinate Energy, India (2016): Promoted solar lamps to improve the quality of life for people with no access to electricity  
Volunteer – Project Little Dream, Cambodia (2015): Contributed to designing and building an elementary school in rural Cambodia