

Hao Wang

314 Main St, Cambridge MA, 02142
✉ hao@ibm.com • 🌐 haowang94.github.io

Professional Experience

MIT-IBM Watson AI Lab

Research Scientist

Postdoc

Project: [Synderella](#) (a platform for creating differentially private synthetic data)

Cambridge, MA

Nov. 2022 – present

Sept. – Oct. 2022

Harvard University

Postdoctoral Fellow

Cambridge, MA

July 2022 – Sept. 2022

IBM Thomas J. Watson Research Center

Research Intern

Yorktown Heights, NY

May 2019 – Aug. 2019

Education

Harvard University

Ph.D. in Applied Mathematics

Advisor: Flavio P. Calmon Committee: Demba Ba, Na Li, Salil Vadhan

Thesis: *Information Theory for Trustworthy Machine Learning*

Cambridge, MA

Sept. 2016 – May 2022

Harvard University

M.S. in Applied Mathematics

Cambridge, MA

Sept. 2016 – May 2019

University of Science and Technology of China (USTC)

B.Sc. in Mathematics and Applied Mathematics

Hefei, China

Sept. 2012 – July 2016

Research Interests

Areas: Information Theory, Statistical Learning Theory, Optimization

Topics: Algorithmic Fairness, Differential Privacy, Deep Learning Theory

Awards, Honors, and Scholarships

NeurIPS Outstanding Reviewer Award (top 8% of reviewers)

2021

Certificate of Distinction in Teaching

2021

Winning Outreach Video at the ISIT Student Video Exposition ([Video](#))

2020

ICML Travel Award

2019

Certificate of Distinction in Teaching

2018

The 35th Guo Moruo Scholarship (highest honor for USTC students)

2015

China National Scholarship

2014

Sponsored Research

MIT-IBM Watson AI Lab grant: **Quantifying Reliability/Uncertainty of Foundation Models (IBM PI)**. MIT PI:

Navid Azizan, IBM Co-PI: Akash Srivastava. 2023–2024.

Publications

Journal Publications

H. Wang, R. Gao, and F. P. Calmon, “Generalization Bounds for Noisy Iterative Algorithms Using Properties of Additive Noise Channels,” *Journal of Machine Learning Research*, 2023.

H. Wang, H. Hsu, M. Diaz, and F. P. Calmon, “To Split or Not to Split: The Impact of Disparate Treatment in

Classification," *IEEE Transactions on Information Theory*, 2021.

H. Wang, L. Vo, F. P. Calmon, M. Médard, K. R. Duffy, and M. Varia, "Privacy with Estimation Guarantees," *IEEE Transactions on Information Theory*, 2019.

M. Diaz*, **H. Wang***, F. P. Calmon, and L. Sankar, "On the Robustness of Information-Theoretic Privacy Measures and Mechanisms," *IEEE Transactions on Information Theory*, 2019. *Equal contribution.

H. Wang, "Information Theory for Trustworthy Machine Learning," *PhD Thesis*, 2022.

Peer-Reviewed Conference Proceedings.....

H. Wang, S. Sudalairaj, J. Henning, K. Greenewald, and A. Srivastava, "Post-processing Private Synthetic Data for Improving Utility on Selected Measures," in *Advances in Neural Information Processing Systems (NeurIPS)*, 2023.

R. Feng, F. P. Calmon, and **H. Wang**, "Adapting Fairness Interventions to Missing Values," in *Advances in Neural Information Processing Systems (NeurIPS)*, 2023.

Y. Chen, W. Huang, **H. Wang**, C. Loh, A. Srivastava, L. M. Nguyen, and T.-W. Weng, "Analyzing Generalization of Neural Networks through Loss Path Kernels," in *Advances in Neural Information Processing Systems (NeurIPS)*, 2023.

H. Wang, L. He, R. Gao, and F. P. Calmon, "Aleatoric and Epistemic Discrimination: Fundamental Limits of Fairness Interventions," in *Advances in Neural Information Processing Systems (NeurIPS)*, 2023. **Spotlight**.

W. Alghamdi, H. Hsu, H. Jeong, **H. Wang**, P. W. Michalak, S. Asodeh, and F. P. Calmon, "Beyond Adult and COMPAS: Fair Multi-Class Prediction via Information Projection," in *Advances in Neural Information Processing Systems (NeurIPS)*, 2022. **Oral presentation**.

H. Jeong, **H. Wang**, and F. P. Calmon, "Fairness without Imputation: A Decision Tree Approach for Fair Prediction with Missing Values," in *AAAI Conference on Artificial Intelligence (AAAI)*, 2022. **Oral presentation**.

H. Wang, Y. Huang, R. Gao, and F. P. Calmon, "Analyzing the Generalization Capability of SGLD Using Properties of Gaussian Channels," in *Advances in Neural Information Processing Systems (NeurIPS)*, 2021.

H. Wang, H. Hsu, M. Diaz, and F. P. Calmon, "The Impact of Split Classifiers on Group Fairness," in *IEEE International Symposium on Information Theory (ISIT)*, 2021.

W. Alghamdi, S. Asodeh, **H. Wang**, F. P. Calmon, D. Wei, and K. N. Ramamurthy, "Model Projection: Theory and Applications to Fair Machine Learning," in *IEEE International Symposium on Information Theory (ISIT)*, 2020.

H. Wang, B. Ustun, and F. P. Calmon, "Repairing without Retraining: Avoiding Disparate Impact with Counterfactual Distributions," in *International Conference on Machine Learning (ICML)*, 2019.

H. Wang, M. Diaz, J. C. S. Santos Filho, and F. P. Calmon, "An Information-Theoretic View of Generalization via Wasserstein Distance," in *IEEE International Symposium on Information Theory (ISIT)*, 2019.

H. Wang, M. Diaz, F. P. Calmon, and L. Sankar, "The Utility Cost of Robust Privacy Guarantees," in *IEEE International Symposium on Information Theory (ISIT)*, 2018.

H. Wang, B. Ustun, and F. P. Calmon, "On the Direction of Discrimination: An Information-Theoretic Analysis of Disparate Impact in Machine Learning," in *IEEE International Symposium on Information Theory (ISIT)*, 2018.

H. Wang and F. P. Calmon, "An Estimation-Theoretic View of Privacy," in *Annual Allerton Conference on Communication, Control, and Computing*, 2017.

Workshop Papers.....

Y.-J. Park, **H. Wang**, S. Ardeshtir, and N. Azizan, "Representation reliability for foundation models," in *Robotics Systems and Science (RSS) Safe Autonomy Workshop*, 2023. **Spotlight presentation**.

H. Jeong, **H. Wang**, and F. P. Calmon, "Fairness without Imputation: A Decision Tree Approach for Fair Prediction with Missing Values," in *Symposium on Foundations of Responsible Computing (FORC)*, 2022.

W. Alghamdi, H. Hsu, H. Jeong, **H. Wang**, P. W. Michalak, S. Asodeh, and F. P. Calmon, "Beyond Adult and COMPAS: Fairness in Multi-Class Prediction," in *ICML Workshop on Responsible Decision Making in Dynamic Environments*, 2022.

H. Wang, H. Hsu, M. Diaz, and F. P. Calmon, "To Split or Not to Split: The Impact of Disparate Treatment in Classification," in *Symposium on Foundations of Responsible Computing (FORC)*, 2020.

H. Wang, B. Ustun, and F. P. Calmon, "Avoiding Disparate Impact with Counterfactual Distributions," in *NeurIPS Workshop on Ethical, Social and Governance Issues in AI*, 2018.

Pre-Prints and Working Papers.....

Y.-J. Park, **H. Wang**, S. Ardeshtir, and N. Azizan, "Representation reliability and its impact on downstream tasks," *arXiv preprint arXiv:2306.00206*, 2023.

H. Sun, N. Azizan, A. Srivastava, and **H. Wang**, "Private synthetic data meets ensemble learning," *arXiv preprint arXiv:2310.09729*, 2023.

News on My Research.....

My research on "An information-theoretic analysis of disparate impact in ML" has been featured in an article entitled "[Just data: How algorithms go bad – and how they can be saved](#)" at the Harvard GSAS alumni magazine.

Mentorship

- Lisa Vo (Harvard College), 2017 – 2019
Project: Privacy with estimation guarantees (published a paper in IEEE Trans. Inf. Theory).
- Winston Michalak (Harvard College), 2019 – 2020
Project: Using ADMM for solving model projection (published a paper in NeurIPS 2022).
- Raymond Feng (Harvard College), 2022 – 2023
Project: Investigating algorithmic discrimination in the presence of missing values (published a first-author paper in NeurIPS 2023, wrote a senior thesis).
- Luxi He (Harvard College), 2022 – 2023
Project: Analyzing fairness-accuracy trade-offs in classification (published a paper in NeurIPS 2023, wrote a senior thesis).
- Haoyuan Sun (MIT PhD, summer intern at MIT-IBM), 2023
Project: Private synthetic data meets ensemble learning.

Teaching Experience

ES 250: Information Theory – Graduate Level Course Fall 2022
Engineering and Applied Sciences | Harvard University
Guest Lecturer
Gave a guest lecture that introduced a set of useful information-theoretic tools for trustworthy machine learning.

ES 201: Decision Theory – Graduate Level Course Spring 2021
Engineering and Applied Sciences | Harvard University **Rating: 4.9/5.0**
Section Leader
Improved section (recitation) notes to include advanced topics. Led weekly sections that extended the lectures. Held weekly office hours to address individual questions and guided 20+ students through their final projects.

ES 156: Signals and Systems – Undergraduate Level Course Spring 2018
Engineering and Applied Sciences | Harvard University **Rating: 4.8/5.0**
Section Leader
Created new section notes that complemented the lectures. Led weekly sections and office hours. Contributed to the design and grading of the midterm and final exams. Prepared new assignments, graded, and gave feedback

to 20+ undergraduate students.

Selected Presentations

MIT-IBM Watson AI Lab	2022
Yale Institute for Network Science (YINS)	2022
MIT Institute for Data, Systems, and Society (IDSS)	2022
Neural Information Processing Systems (virtual)	2021
IEEE International Symposium on Information Theory (virtual)	2021
Symposium on Foundations of Responsible Computing (virtual)	2020
IBM AI Systems Day	2019
International Conference on Machine Learning	2019
IEEE International Symposium on Information Theory	2019
North American School of Information Theory (poster)	2019
Annual New England Machine Learning Day (poster)	2018
Annual Allerton Conference on Communication, Control, and Computing	2017

Professional Service

Conference Reviewer

- o IEEE International Symposium on Information Theory (ISIT)
- o Neural Information Processing Systems (NeurIPS)
- o International Conference on Learning Representations (ICLR)
- o International Conference on Machine Learning (ICML)
- o International Conference on Artificial Intelligence and Statistics (AISTATS)
- o IEEE Information Theory Workshop (ITW)
- o The Web Conference (TheWebConf)
- o ACM Conference on Fairness, Accountability, and Transparency (FAccT)

Journal Reviewer

- o IEEE Transactions on Information Theory (T-IT)
- o IEEE Transactions on Information Forensics & Security (T-IFS)
- o IEEE Transactions on Automatic Control (TAC)
- o IEEE Journal on Selected Areas in Information Theory (JSAIT)
- o IEEE Journal of Selected Topics in Signal Processing (JSTSP)

Program Committee

- o NeurIPS 2020 Workshop on Fair AI in Finance (FAIF)

Membership

IEEE Membership, IEEE Information Theory Society Membership, IEEE Young Professionals

Personal

Computer Skills: Python, C, C++, MATLAB, Mathematica

Interests: Basketball, Foosball, Traveling, Gaming, Movie, Music