

Xiaodi Wu

Associate Professor

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Research interests

- My research aims to bridge the gap between theory and practice for quantum computing by taking a full-stack software-hardware-algorithmic co-design approach. To this end, I actively explore the intersection of quantum computing with diverse disciplines, including theoretical computer science, machine learning, control theory, formal methods, programming languages, and computer architecture.

Research positions

- 07/2023–present **Associate Professor**, *University of Maryland*, College Park, MD.
Department of Computer Science and Institute for Advanced Computer Studies
Fellow of the Joint Center for Quantum Information and Computer Science (QIICS)
- 06/2017–06/2023 **Assistant Professor**, *University of Maryland*, College Park, MD.
Department of Computer Science and Institute for Advanced Computer Studies
Fellow of the Joint Center for Quantum Information and Computer Science (QIICS)
- 06/2021–present **Amazon Visiting Academic**, AWS, Amazon.
AWS Braket.
- 09/2015–06/2017 **Assistant Professor**, *University of Oregon*, Eugene, OR.
Department of Computer and Information Science.
- 09/2013–09/2015 **Postdoctoral Associate**, *Massachusetts Institute of Technology*, Cambridge, MA.
Advisor: Aram Harrow and Scott Aaronson.
- 01/2014–05/2014 **Simons Research Fellow**, *Simons Institute for the Theory of Computing*, *University of California*, Berkeley, CA, Advisor: Umesh Vazirani.
- Summer 2009,2010 **Research Assistant**, *Institute for Quantum Computing*, *University of Waterloo*, Waterloo, Canada, Advisor: John Watrous.

Education

- 09/2008–12/2013 **Ph.D. in Computer Science**, *University of Michigan*, Ann Arbor, MI, *GPA: 4.0/4.0*.
Thesis title: *Space-efficient Simulations of Quantum Interactive Proofs*. Advisor: Prof Yaoyun Shi.
- 08/2004–07/2008 **B.S. in Mathematics and Physics**, *Tsinghua University*, Beijing, China, *GPA: 91/100*.
Thesis title : *Structure Properties of Codeword Stabilized Quantum Error-Correcting Codes*

Honors & Awards

- 02/2023 Alfred P. Sloan Research Fellowship.
- 01/2021 Distinguished Paper Award at POPL 2021.
- 11/2020 AFRL/AFOSR Young Investigator Research Program (YIP) Award, 2021.
- 02/2020 NSF CAREER Award, 2020.
- 02/2018 NSF CISE Research Initiation Initiative (CRII) Award, 2018.

- 02/2014 Plenary talk at the 17th Conference on Quantum Information Processing (QIP 2014).
- 02/2013 Simons-Berkeley Research Fellowship (Spring 2014).
- 06/2008 Distinguished Undergraduate Degree Thesis, Tsinghua University.
- 06/2008 Chi-Sun YEH Prize (highest award to undergraduate physics majors), Tsinghua University.
- 06/2007 Microsoft Young Fellow Scholarship, Microsoft Research, Asia.

Funding

Total grants received (my share): \$7.93 million (\$4.83M as PI and \$3.1M as Co-PI)

- NSF CRII: AF: Theoretical Problems in Quantum Computation. Sole PI. \$175,000. NSF-CCF-1755800, 2018-2020.
- DOE ASCR: Quantum Algorithms from the Interplay of Simulation, Optimization, and Machine Learning (17-020469): Co-PI, \$1.35 M (UMD part), my share: \$225,000, 2017-2020.
- NSF AF: Small: Provable Quantum Advantages in Optimization. Sole PI. \$450,000. NSF-CCF-1816695, 2018-2021.
- DOE ASCR: Efficient and Reliable Mapping of Quantum Computations Onto Realistic Architectures in Quantum Testbed Pathfinder Program. Co-PI, with Andrew Childs, Alexey Gorshkov, and Michael Hicks. \$4.47 M in total (my share \$1.12M), 2018-2023.
- AFOSR MURI: Semantics and Structures for Higher-level Quantum Programming Languages. Sole PI at UMD. \$262,380. 2018-2020.
- DOE ASCR: Tough Errors Are no Match (TEAM): Optimizing the quantum compiler for noise resilience. Sole PI at UMD. \$875,000. 2019 - 2024.
- DOE ASCR: Fundamental Algorithmic Research for Quantum Computing (FAR-QC). Co-PI at UMD. my share: \$400,000. 2019 - 2024.
- ARO Quantum algorithms for algebra and discrete optimization. Co-PI, with Andrew Childs, Gorjan Alagic, Yi-Kai Liu, and Carl Miller. \$750,000 in total. (my share:\$150,000.) 2019-2022.
- NSF CAREER: On the Foundations of End-to-End Quantum Applications. Sole PI. \$509,275. NSF-CCF-1942837, 2020-2025.
- NSF Collaborative Research: FET: Medium: Quantum Localization and Synchronization Networks. Sole PI at UMD. \$331,893. NSF-CCF-1955206, 2020-2024.
- DOE QIS Center: The Quantum Science Center. Sole PI at UMD. \$900,000. 2020 - 2025.
- AFOSR Young Investigator Research Program (YIP): Automated Security Analysis of Cryptographic Systems Under Quantum Attacks. Sole PI. \$450,000. 2021-2024.
- AFOSR MURI: Towards Robust Scalable Quantum Random Access Memories (QRAMs). Sole PI at UMD. \$1.125M. 2021-2026.
- Sloan Foundation Alfred P. Sloan Research Fellowship in computer science. \$75k. 2023-2025.
- NSF FET: SHF: Small: A Verification Framework for Hybrid Classical and Quantum Protocols (VeriHCQ). Sole PI at UMD. \$600k. 2024-2027.
- DOE ASCR: FAR-Qu: Fundamental Algorithmic Research toward Quantum Utility. Co-PI at UMD. my share: \$300,000. 2024-2029.

Patents

- Oct. 2016 **“Physical Randomness Extractors”**, *Kai-Min Chung, Yaoyun Shi, Xiaodi Wu*, US Patent 9,471,280.
- Apr. 2023 **System and method for optimization using quantum Hamiltonian descent**, *Jiaqi Leng, Ethan Hickman, Joseph Li, Xiaodi Wu*, US20230350976A1, US patent application filed.
- Apr. 2023 **Systems and methods for quantum simulation with analog compilation**, *Yuxiang Peng, Jacob Young, Xiaodi Wu*, US20240119327A1, US patent application filed.
- Aug. 2023 **Differentiable analog quantum computing for optimization and control**, *Jiaqi Leng, Yuxiang Peng, Yiling Qiao, Ming Lin, Xiaodi Wu*, WO2024107251A1, PCT international patent filed.

Professional service

- PC Member
- ◇ The 9th Conference on the Theory of Quantum Computation, Communication and Cryptography (TQC 2014).
 - ◇ The 20th Annual Conference on Quantum Information Processing (QIP 2017).
 - ◇ The 21th Annual Conference on Quantum Information Processing (QIP 2018).
 - ◇ International Workshop on Quantum Software Engineering (Q-SE 2020, Q-SE 2021) co-located with ICSE 2020 & ICSE 2021.
 - ◇ The 15th Conference on the Theory of Quantum Computation, Communication and Cryptography (TQC 2020).
 - ◇ 2021 IEEE International Conference on Quantum Computing & Engineering (QCE 2021).
 - ◇ The 43rd ACM SIGPLAN Conference on Programming Language Design and Implementation (PLDI 2022).
 - ◇ (Area Chair) The 10th International Conference on Learning Representations (ICLR 2022).
 - ◇ Quantum Computing Theory in Practice workshop QCTIP 2022.
 - ◇ (Area Chair) The 36th Conference on Neural Information Processing Systems (NeurIPS 2022).
 - ◇ (Area Chair) The 40th International Conference on Machine Learning (ICML 2023).
 - ◇ (Area Chair) The 37th Conference on Neural Information Processing Systems (NeurIPS 2023).
 - ◇ The 51st ACM SIGPLAN Symposium on Principles of Programming Languages (POPL 2024).
 - ◇ The 45th ACM SIGPLAN Conference on Programming Language Design and Implementation (PLDI 2024).
 - ◇ (Area Chair) The 41th International Conference on Machine Learning (ICML 2024).
 - ◇ (Area Chair) The 38th Conference on Neural Information Processing Systems (NeurIPS 2024).
 - ◇ (Senior PC) The 39th AAAI Conference on Artificial Intelligence (AAAI 2025).
 - ◇ The 46th ACM SIGPLAN Conference on Programming Language Design and Implementation (PLDI 2025).
 - ◇ (Area Chair) The 42th International Conference on Machine Learning (ICML 2025).
- Editor Board
- ◇ ACM Transaction on Quantum Computing, Associate Editor since 01/2024.
 - ◇ Algorithmica, Editorial Board Member since 04/2024.
- Guest Editor
- ◇ Special Issue on the Techniques of Programming Languages, Logic, and Formal Methods in Quantum Computing , ACM Transaction on Quantum Computing.

- Workshop ◇ QuICS' Workshop on Quantum Machine Learning, 09/24 - 09/28, 2018.
- Organizer ◇ Programming Languages and Quantum Computing (PLanQC), workshop at POPL 2020.
 ◇ Advancing Quantum Computing Beyond Gate-Model (BGM 2024) on October 7 - 9, 2024 at College Park, Maryland.
- Tutorials ◇ *An Invitation to the Intersection of Quantum Computing and Programming Languages* at the 48th ACM SIGPLAN Symposium on Principles of Programming Languages (POPL 2021).
- Reviewer ◇ *Conferences*: STOC, FOCS, QIP, POPL, SODA, CCC, ICALP, ITCS, CRYPTO, PODC, CCS, AsiaCrypt, TCC, and ISAAC for multiple years.
PC Reviewers: AAI 2020, AAI 2021, ICML 2020, ICML 2021, NeurIPS 2020.
 ◇ *Journals*: Journal of the ACM, Nature, Nature Physics, Nature Communications, PNAS, SIAM Journal of Computing, Quantum Information and Computation, International Journal of Quantum Information, Theoretical Computer Science, Theory of Computing, IEEE Transaction on Information Theory, IEEE Journal on Selected Areas in Information Theory, Physical Review Letter, ACM Transaction on Algorithms, Quantum, and npj Quantum Information.
 ◇ *Grants*: Natural Sciences and Engineering Research Council of Canada (NSERC), 2018. National Science Foundation, 2020, 2022, 2023.
- Travel Grants ◇ NSF Student Travel Grant for 2019 Annual Conference on Quantum Information Processing (QIP). Sole PI. \$10,000. NSF-CCF-1840547.
 ◇ NSF Student Travel Grant for 2020 Annual Conference on Quantum Information Processing (QIP). Sole PI. \$25,000. NSF-CCF-1946395.

Teaching experience

- Instructor **On the Foundation of End-to-End Quantum Applications (CMSC 8580)**, *University of Maryland*, graduate-level CS course, Fall 2021, Fall 2022, Spring 2024.
- Instructor **Introduction to Quantum Information Processing (CMSC 657)**, *University of Maryland*, graduate-level CS course, Fall 2018, Fall 2019.
- Instructor **Introduction to Quantum Computation (CMSC 457)**, *University of Maryland*, undergraduate-level CS course, Spring 2018, Spring 2020, Spring 2021, Spring 2022, Spring 2023, Fall 2023.
- Instructor **Complexity Theory (CMSC 652)**, *University of Maryland*, graduate-level CS major course, Fall 2017.
- Instructor **Intermediate Data Structure (CIS 313)**, *University of Oregon*, undergraduate-level CS major course, Winter 2016, Fall 2016, Winter 2017.
- Instructor **Introduction to Quantum Information Processing (CIS 410/510)**, *University of Oregon*, undergraduate/graduate level course, Spring 2016, Spring 2017.

Advising & Mentorship

- Post-docs Robert Rand (co-advised with Mike Hicks, 2018-2020. Now an assistant professor at University of Chicago),
 Xiong Fan (co-advised with Jonathan Katz, 2020-2021. Now an assistant professor at Rutgers University),
 Liyi Li (co-advised with Mike Hicks, 2020-2023. Now an assistant professor at Iowa State University),
 Junyi Liu (2023-).

- QIICS Penghui Yao (now Professor at Nanjing University),
Hartree Xin Wang (now Associate Professor at Hong Kong University of Science and Technology
Fellows (Guangzhou)),
Cedric Lin (now at AWS Braket).
- Current Jacob Young, Ethan Hickman, Haowei Deng, Yufan Zheng, Yingkang Cao, Yi Lee, Connor
Students Clayton, Joesph Li, Suying Liu, Haohai Shi, Gengzhi Yang
- Past ◇ Shouvanik Chakrabarti (2017-2022), thesis on "Quantum Computing for Optimization
Students and Machine Learning". First job: VP - Applied Research Lead in the Quantum Research
Team at J.P. Morgan Chase.
◇ Xuchen You (2017-2023), thesis on "Optimization Problems in Quantum Machine
Learning". First Job: Citadel Securities.
◇ Yuxiang Peng (2019-2024), thesis on "Theoretical and Practical High-assurance Software
Tools for Quantum Applications". First Job: Assistant Professor at Purdue University.
◇ Jiaqi Leng (2019-2024), thesis on "Quantum Algorithms for Non-Convex Optimization:
Theory and Implementation". First Job: Simons Fellow at the Simons Institute for the
Theory of Computing, UC Berkeley.
- Thesis Christopher Jackson (Physics, U Oregon, 2017). Tongyang Li (CS, U Maryland, 2020),
Committee Honghao Fu (CS, U Maryland, 2021), Daiwei Zhu (ECE, U Maryland, 2021), Shih-Han
Hung (CS, U Maryland, 2021), Fangli Liu (Physics, U Maryland, 2021), Jonas Landman
(CS, Universite de Paris/CNRS, 2021), Shouvanik Chakrabarti (CS, U Maryland, 2022,
Chair), Jin-Peng Liu (AMSC, U Maryland, 2022), Shangjie Guo (Physics, U Maryland,
2022), Keshu Hietala (CS, U Maryland, 2022), Andrew Guo (Physics, U Maryland, 2022),
Xuchen You (CS, U Maryland, 2023, Chair), Daochen Wang (CS, U Maryland, 2023),
Gong Cheng (Physics, U Maryland, 2023), Qingfeng Wang (Physics, U Maryland, 2024),
Nhung Nguyen Hong (Physics, U Maryland, 2024), Jiaqi Leng (AMSC, U Maryland, 2024,
Chair), Yuxiang Peng (CS, U Maryland, 2024, Chair).

Publications

(* = equal contribution)

Surveys/Miscellanies

- ◇ **Xiaodi Wu**, *Introduction to the Special issue on the Techniques of Programming Languages, Logic, and Formal Methods in Quantum Computing*, ACM Transactions on Quantum Computing. 2, 4, Article 15 (October 2021).
- ◇ Shouvanik Chakrabarti, Xuchen You, and **Xiaodi Wu**, *Quantum Variational Methods for Quantum Applications*, in the proceedings of the 40th International Conference on Computer Aided Design (ICCAD 2021).

Journals

- ◇ (by contribution) Samuel Kushnir, Jiaqi Leng, Yuxiang Peng, Lei Fan, and **Xiaodi Wu**, *QHDOPT: A Software for Nonlinear Optimization with Quantum Hamiltonian Decent*, INFORMS Journal on Computing, Nov 25th, 2024.
- ◇ (by contribution) Alen Senanian, Sridhar Prabhu, Vladimir Kremenetski, Saswata Roy, Yingkang Cao, Jeremy Kline, Tatsuhiko Onodera, Logan G. Wright, **Xiaodi Wu**, Valla Fatemi, and Peter L. McMahon, *Microwave Signal Processing using an Analog Quantum Reservoir Computer*, Nature Communication, 15, 7490 (2024).

- ◇ (by contribution) Wang Fang, Mingsheng Ying, and **Xiaodi Wu**, *Differentiable Quantum Programming with Unbounded Loops*, ACM Transactions on Software Engineering and Methodology, Volume 33, Issue 1, Article No.: 19, Pages 1 - 63, 2023.
- ◇ (by contribution) Kesha Hietala, Robert Rand, Shih-Han Hung, **Xiaodi Wu**, and Michael Hicks, *A Verified Optimizer for Quantum Circuits*, ACM Transactions on Programming Languages and Systems, Volume 45, Issue 3, Article No.: 18, Pages 1 - 35, 2023.
- ◇ (by contribution) Yuxiang Peng, Kesha Hietala, Runzhou Tao, Liyi Li, Robert Rand, Michael Hicks, and **Xiaodi Wu**, *A Formally Certified End-to-End Implementation of Shor's Factorization Algorithm*, Proceedings of the National Academy of Sciences (PNAS), vol. 120, no. 21, 2023.
- ◇ Shouvanik Chakrabarti, Andrew Childs, Shih-han Hung, Tongyang Li, Chunhao Wang, and **Xiaodi Wu**, *Quantum algorithm for estimating volumes of convex bodies*, ACM Transaction on Quantum Computing, vol. 4, issue 3, article no.20, pp 1-60. 2023.
- ◇ (by contribution) Haowei Deng, Yuxiang Peng, Michael Hicks, and **Xiaodi Wu**, *Automating NISQ Application Design with Meta Quantum Circuits with Constraints (MQCC)*, ACM Transaction on Quantum Computing, vol. 4, issue 3, article no.16, pp 1-29. 2023.
- ◇ (by contribution) Tianyi Peng, Aram Harrow, Maris Ozols, and **Xiaodi Wu**, *Simulating large quantum circuits on a small quantum computer*, Physical Review Letters, 125, 150504, 2020. also available at arXiv:1904.00102.
- ◇ Shouvanik Chakrabarti, Andrew M. Childs, Tongyang Li, and **Xiaodi Wu**. *Quantum algorithms and lower bounds for convex optimization*, Quantum 4, 221 (2020).
- ◇ Tongyang Li and **Xiaodi Wu**, *Quantum query complexity of entropy estimation*, IEEE Transaction on Information Theory, Vol. 65, Issue 5, pages 2899 - 2921, May 2019. Also available at arXiv: 1710.06025.
- ◇ Aram W. Harrow, Anand Natarajan, and **Xiaodi Wu**, *Limitations of semidefinite programs for separable states and entangled games*, Communications in Mathematical Physics, Volume 366, Issue 2, pp 423–468, 2019.
- ◇ Jeongwan Haah, Aram W. Harrow, Zhengfeng Ji, **Xiaodi Wu** and Nengkun Yu, *Sample-optimal tomography of quantum states*. IEEE Transaction on Information Theory, Volume: 63, Issue: 9, pp. 5628 – 5641, 2017.
- ◇ Aram W. Harrow, Anand Natarajan, and **Xiaodi Wu**, *An improved semidefinite programming hierarchy for testing entanglement*, Communications in Mathematical Physics, Volume 352, Issue 3, pp 881–904, 2017. Also available at arXiv:1506.08834.
- ◇ Yaoyun Shi and **Xiaodi Wu**, *Epsilon-net method for optimizations over separable states*. Theoretical Computer Science, 598:51–63, 2015.
- ◇ Gus Gutoski and **Xiaodi Wu**, *Parallel approximation of min-max problems with applications to classical and quantum zero-sum games*. Computational Complexity, 22(2):385-428, 2013, the **special issue** of CCC 2012.
- ◇ (by contribution) **Xiaodi Wu** and Runyao Duan, *Exact Quantum Search by Parallel Unitary Discrimination Schemes*, Physical Review A, **78**, 012303 (2008). Selected for the July 2008 issue of Virtual Journal of Quantum Information.
- ◇ (by contribution) **Xiaodi Wu** and Gui Lu Long, *Verifier-based Algorithm for Unsorted Database Search Problem*, International Journal of Quantum Information, vol.5 no.4, pp **597 - 604** (2007).

- ◇ (by contribution) **Xiao-di Wu**, Yong-tao Huang, Xin-kun Ma, *Data processing and software realization of wave-lengths of spectrum during CCD measurement*, Experimental Technology and Management, vol.24, no.4 p48-51 (2006).

Peer-reviewed Conferences with Published Proceedings

- ◇ (by contribution) Connor Clayton, Jiaqi Leng, Gengzhi Yang, Yi-Ling Qiao, Ming Lin, and **Xiaodi Wu**, *Differentiable Quantum Computing for Large-scale Linear Control*. In the Proceedings of the Thirty-eighth Conference on Neural Information Processing Systems (NeurIPS 2024).
- ◇ (by contribution) Connor Clayton, **Xiaodi Wu**, and Bobby Bhattacharjee, *Efficient Routing on Quantum Networks using Adaptive Clustering*, in the Proceedings of the 32nd IEEE International Conference on Network Protocols (ICNP 2024).
- ◇ (by contribution) Liyi Li, Mingwei Zhu, Rance Cleaveland, A. Nicolellis, Yi Lee, Le Chang, and **Xiaodi Wu**, *Qafny: A Quantum-Program Verifier*, in the Proceedings of the 38th European Conference on Object-Oriented Programming (ECOOP 2024).
- ◇ (by contribution) Yuxiang Peng, Jacob Young, Pengyu Liu, and **Xiaodi Wu**, *SimuQ: A Framework for Programming Quantum Hamiltonian Simulation with Analog Compilation*, in the Proceedings of the 51st ACM SIGPLAN Symposium on Principles of Programming Languages (POPL 2024).
- ◇ (by contribution) Haowei Deng, Runzhou Tao, Yuxiang Peng, and **Xiaodi Wu**, *Syntax-guided Synthesis of Unitary Programs*, in the Proceedings of the 51st ACM SIGPLAN Symposium on Principles of Programming Languages (POPL 2024).
- ◇ Manuel Barbosa, Gilles Barthe, Christian Doczkal, Jelle Don, Serge Fehr, Benjamin Grégoire, Yu-Hsuan Huang, Andreas Hülsing, Yi Lee, and **Xiaodi Wu**, *Fixing and Mechanizing the Security Proof of Fiat-Shamir with Aborts and Dilithium*, in the Proceedings of the International Cryptology Conference (CRYPTO 2023).
- ◇ (by contribution) Xuchen You, Shouvanik Chakrabarti, Boyang Chen, and **Xiaodi Wu**, *Analyzing Convergence in Quantum Neural Networks: Deviations from Neural Tangent Kernels*, in the Proceedings of the 40th International Conference on Machine Learning (ICML 2023).
- ◇ (by contribution) Yingkang Cao, and **Xiaodi Wu**, *Distributed Quantum Sensing Network with Geographically Constrained Measurement Strategies*, in the Proceedings of the 2023 IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP 2023).
- ◇ (by contribution) Jiaqi Leng*, Yuxiang Peng*, Yi-Ling Qiao*, Ming Lin, and **Xiaodi Wu**, *Differentiable Analog Quantum Computing for Optimization and Control*, in the Proceedings of the Thirty-sixth Conference on Neural Information Processing Systems (NeurIPS 2022 **Spotlight**). Also available at arXiv:2210.15812.
- ◇ (by contribution) Liyi Li, Finnegan S Voichick, Kesha Hietala, Yuxiang Peng, **Xiaodi Wu**, and Michael Hicks, *Verified Compilation of Quantum Oracles*, in the Proceedings of the OOPSLA (Object-oriented Programming, Systems, Languages, and Applications) 2022. Also available at ArXiv: 2112.06700.
- ◇ (by contribution) Yuxiang Peng, Mingsheng Ying and **Xiaodi Wu**, *Algebraic Reasoning of Quantum Programs via Non-Idempotent Kleene Algebra*. In the Proceedings of the 43rd ACM SIGPLAN Conference on Programming Language Design and Implementation (PLDI 2022). Also available at arXiv:2110.07018.

- ◇ Kai-Min Chung, Yi Lee, Han-Hsuan Lin, and **Xiaodi Wu**, *Constant-round Blind Classical Verification of Quantum Sampling*. In the Proceedings of the 41st Annual International Conference on the Theory and Applications of Cryptology and Information Security (Eurocrypt 2022). Also available at arXiv:2012.04848.
- ◇ Manuel Barbosa, Gilles Barthe, Xiong Fan, Benjamin Gregoire, Shih-Han Hung, Jonathan Katz, Pierre-Yves Strub, **Xiaodi Wu**, and Li Zhou. *EasyPQC: Verifying Post-Quantum Cryptography*. In the proceedings of the ACM Conference on Computer and Communication Security (CCS 2021).
- ◇ (by contribution) Xuchen You and **Xiaodi Wu**, *Exponentially Many Local Minima in Quantum Neural Networks*. In the Proceedings of the 38th International Conference on Machine Learning (ICML 2021).
- ◇ (by contribution) Tongyang Li, Shouvanik Chakrabarti, Chunhao Wang, and **Xiaodi Wu**, *Sublinear Classical and Quantum Algorithms for Matrix Games*. In the proceedings of the 35th AAAI Conference on Artificial Intelligence (AAAI 2021).
- ◇ (by contribution) Kesha Hietala, Robert Rand, Shih-Han Hung, **Xiaodi Wu**, and Michael Hicks, *A Verified Optimizer for Quantum Circuits*. Appeared as a **distinguished paper** at the 48th ACM SIGPLAN Symposium on Principles of Programming Languages (POPL 2021). also available at arXiv:1912.02250.
- ◇ (by contribution) Shaopeng Zhu, Shih-han Hung, Shouvanik Chakrabarti, and **Xiaodi Wu**, *On the Principles of Differentiable Quantum Programming Languages*. In the proceedings of the 41st ACM SIGPLAN Conference on Programming Language Design and Implementation (PLDI 2020). arXiv: 2004.01122.
- ◇ (by contribution) Shouvanik Chakrabarti*, Yiming Huang*, Tongyang Li, Soheil Feizi, and **Xiaodi Wu**, *Quantum Wasserstein Generative Adversarial Networks*. In the proceedings of the 33rd Annual Conference on Neural Information Processing Systems (NeurIPS 2019).
- ◇ (by contribution) Kesha Hietala, Robert Rand, Shih-Han Hung, **Xiaodi Wu**, and Michael Hicks., *Verified Optimization in a Quantum Intermediate Representation*, extended abstract in Quantum Physics and Logic (QPL 2019), arXiv:1904.06319.
- ◇ (by contribution) Tongyang Li, Shouvanik Chakrabarti, and **Xiaodi Wu**. *Quantum algorithms for training linear and kernelized classifiers*. In the proceedings of the 36th International Conference on Machine Learning (ICML 2019). Also available at arXiv:1904.02276.
- ◇ Fernando G. S. L. Brandao, Amir Kalev, Tongyang Li, Cedric Yen-Yu Lin, Krysta M. Svore, and **Xiaodi Wu**, *Quantum SDP Solvers: Large Speed-ups, Optimality, and Applications to Quantum Learning*. In the Proceedings of the 46th International Colloquium on Automata, Languages and Programming (ICALP 2019). also available at arXiv: 1710.02581v2.
- ◇ (by contribution) Shih-Han Hung, Kesha Hietala, Shaopeng Zhu, Mingsheng Ying, Michael Hicks, and **Xiaodi Wu**. *Quantitative Robustness Analysis of Quantum Programs*. In the proceedings of the 46th ACM SIGPLAN Symposium on Principles of Programming Languages (POPL 2019). also available at arXiv: 1809.01731.
- ◇ (by contribution) Mingsheng Ying, Shenggang Ying, and **Xiaodi Wu**, *Invariants of Quantum Programs: Characterizations and Generation*. In Proceedings of the 44th ACM SIGPLAN Symposium on Principles of Programming Languages (POPL 2017).
- ◇ Jeongwan Haah, Aram W. Harrow, Zhengfeng Ji, **Xiaodi Wu** and Nengkun Yu, *Sample-optimal tomography of quantum states*. In Proceedings of the ACM 48th Annual Symposium on the Theory of Computing (STOC 2016), available at arXiv:1508.01797.

- ◇ Aram W. Harrow, Anand Natarajan, and **Xiaodi Wu**, *Tight SoS-degree bounds for approximate Nash equilibria*. In Proceedings of the Computational Complexity Conference (CCC 2016).
- ◇ Kai-Min Chung, **Xiaodi Wu**, and Henry Yuen, *Parallel repetition for entangled k -player games via fast quantum search*. In Proceedings of the Computational Complexity Conference (CCC 2015), also available at arXiv:1501.00033, 2015.
- ◇ Yaoyun Shi and **Xiaodi Wu**, *Epsilon-net method for optimizations over separable states*. In Proceedings of the 39th International Colloquium on Automata, Languages and Programming (ICALP 2012), pp. 798–809.
- ◇ Gus Gutoski and **Xiaodi Wu**, *Parallel approximation of min-max problems with applications to classical and quantum zero-sum games*. In Proceedings of the 27th Annual IEEE Conference on Computational Complexity (CCC 2012), pp. 21–31.

Peer-reviewed Workshop Talks without Published Proceedings

- ◇ (by contribution) Yufan Zheng, Jiaqi Leng, Yizhou Liu, and **Xiaodi Wu**, *On the computational complexity of Schrödinger operators*, to appear at the 28th Conference on Quantum Information Processing (QIP 2025). arXiv: 2411.05120.
- ◇ Brandon Augustino, Jiaqi Leng, Giacomo Nannicini, Tamas Terlaky, and **Xiaodi Wu**, *A quantum central path algorithm for linear optimization*, to appear at the 28th Conference on Quantum Information Processing (QIP 2025). arXiv:2311.03977.
- ◇ (by contribution) Xuchen You, Shouvanik Chakrabarti, Boyang Chen, and **Xiaodi Wu**, *A Convergence Theory of Overparameterized Variational Quantum Algorithms*, appeared in the 26th Conference on Quantum Information Processing (QIP 2023). Also at arXiv:2205.12481.
- ◇ Shouvanik Chakrabarti, Andrew Childs, Shih-han Hung, Tongyang Li, Chunhao Wang, and **Xiaodi Wu**, *Quantum algorithm for estimating volumes of convex bodies*, appeared as a single-track talk at the 23rd Conference on Quantum Information Processing (QIP 2020), arXiv:1908.03903.
- ◇ Shouvanik Chakrabarti, Andrew M. Childs, Tongyang Li, and **Xiaodi Wu**. *Quantum algorithms and lower bounds for convex optimization*, at the 22th Conference on Quantum Information Processing (QIP 2019). Also available at arXiv: 1809.01731.
- ◇ Fernando G. S. L. Brandao, Amir Kalev, Tongyang Li, Cedric Yen-Yu Lin, Krysta M. Svore, and **Xiaodi Wu**, *Quantum SDP Solvers: Large Speed-ups, Optimality, and Applications to Quantum Learning*, at the 22th Conference on Quantum Information Processing (QIP 2019). Also available at arXiv:1710.02581v2.
- ◇ Yi-Hsiu Chen, Kai-Min Chung, Ching-Yi Lai, Salil P. Vadhan, and **Xiaodi Wu**, *Computational Notions of Quantum Min-Entropy*, at the 7th International Conference on Quantum Cryptography (QCrypt 2017). Also available at arXiv: 1704.07309.
- ◇ Aram W. Harrow, Anand Natarajan, and **Xiaodi Wu**, *Limitations of semidefinite programs for separable states and entangled games*, at the 20th Conference on Quantum Information Processing (QIP 2017).
- ◇ Kai-Min Chung, Yaoyun Shi, and **Xiaodi Wu**, *General randomness amplification with non-signaling security*, at the 20th Conference on Quantum Information Processing (QIP 2017).
- ◇ Jeongwan Haah, Aram W. Harrow, Zhengfeng Ji, **Xiaodi Wu** and Nengkun Yu, *Sample-optimal tomography of quantum states*, at the 19th Conference on Quantum Information Processing (QIP 2016), available at arXiv:1508.01797.

- ◇ Kai-Min Chung, Yaoyun Shi, and **Xiaodi Wu**, *Physical Randomness Extractors*, appeared as a **plenary talk** at the 17th Conference on Quantum Information Processing (QIP 2014), also available at arXiv:1402.4797v2.
- ◇ Yaoyun Shi and **Xiaodi Wu**, *Epsilon-net method for optimizations over separable states*. **Contributed talk** at the 15th Workshop on Quantum Information Processing (QIP 2012), also available at arXiv:1112.0808, 2011.
- ◇ Gus Gutoski and **Xiaodi Wu**, *Parallel approximation of min-max problems with applications to classical and quantum zero-sum games*. **Featured talk** at the 15th Workshop on Quantum Information Processing (QIP 2012), available at arXiv:1011.2787, 2010.
- ◇ Zhengfeng Ji and **Xiaodi Wu**, *Non-Identity Check Remains QMA-Complete for Short Circuits*, **contributed talk** at the 9th Asian Conference on Quantum Information Science (AQIS09), also available at arXiv:0906.5416, 2009.

Manuscripts

- ◇ (by contribution) Haowei Deng, Charles Cao, and **Xiaodi Wu**, *Neurosymbolic Search for Quantum Error Correcting Codes enhanced by Large Language Models*, manuscript 2025.
- ◇ (by contribution) Yingkang Cao, Suying Liu, Haowei Deng, Zihan Xia, **Xiaodi Wu**, and Yuxin Wang, *Robust analog quantum simulators by quantum error-detecting codes*, manuscript 2024. arXiv: 2412.07764.
- ◇ (by contribution) Yufan Zheng, Yingkang Cao, and **Xiaodi Wu**, *A Scalable Classical Verification reveals the Gap of the State-Of-The-Art Gaussian Boson Sampling Experiments*, manuscript, 2024.
- ◇ (by contribution) Jiaqi Leng*, Joseph Li*, Yuxiang Peng, and **Xiaodi Wu**, *Expanding Hardware-efficiently Manipulable Hilbert space by Hamiltonian Embedding*, manuscript, 2024. arXiv:2401.08550.
- ◇ (by contribution) Jiaqi Leng, Yufan Zheng, and **Xiaodi Wu**, *A Quantum-Classical Performance Separation in Nonconvex Optimization*, manuscript, 2023. arXiv:2311.00811.
- ◇ (by contribution) Jiaqi Li, Ethan Hickman, Joseph Li, and **Xiaodi Wu**, *Quantum Hamiltonian Descent*, manuscript, 2023. arXiv:2303.01471.
- ◇ **Xiaodi Wu**, Penghui Yao, and Henry Yuen , *Raz-McKenzie simulation with the inner product gadget*, manuscript, 2017. also available at ECCC TR17-010.
- ◇ **Xiaodi Wu** and Henry Yuen, *On the limits of communication with non-local resources*, manuscript, 2015.
- ◇ Kai-Min Chung, Xin Li, and **Xiaodi Wu**, *Multi-Source Randomness Extractors Against Quantum Side Information, and their Applications*, manuscript, also available at arXiv:1411.2315, 2014.
- ◇ Yaoyun Shi, Wei Yu, and **Xiaodi Wu**, *Limits of Quantum One-way Communication by Matrix Hypercontractive Inequalities*, manuscript, 2013.
- ◇ **Xiaodi Wu**, *Equilibrium Value Method for the proof of QIP=PSPACE*, manuscript, available at arXiv:1004.0264, 2010.

Invited Talks

- ◇ **A Full-stack Software Solution for Hamiltonian Simulation and Beyond.**
03/2025 Invited Talk at APS Joint March and April Meeting - Global Physics Summit.

- ◇ **RISC-Q: a generator for real-time quantum control system-on-chip (SoCs) compatible with RISC-V.**
11/2024 Quantum OS and real-time control workshop at SOSP 2024.
- ◇ **Hamiltonian-oriented Quantum Algorithm Design and Programming.**
05/2023 SIAM Conference on Optimization 2023.
08/2023 Plenary talk at Modeling and Optimization: Theory and Applications (MOPTA) 2023.
09/2023 CS Seminar - Columbia University.
09/2023 CS Seminar - University of Washington.
10/2023 INFORMS Annual Conference 2023.
11/2023 University of California, Los Angeles.
11/2023 University of California, Berkeley.
04/2024 Pennsylvania State University.
05/2024 IRIF, University Paris Diderot
05/2024 Quantinuum, Cambridge, UK.
05/2024 PhaseCraft, Bristol, UK.
- ◇ **Quantum Hamiltonian Descent.**
05/2022 MIT Quantum Information Seminar.
07/2022 QuERA.
09/2022 AWS.
10/2022 Cornell.
10/2022 Workshop on Quantum Computing and Operations Research at Fields Institute, Toronto.
02/2023 USC.
10/2023 AWS-IQIM Seminar, Caltech.
- ◇ **Toward Applications and Tool-chains of Analog Quantum Computing.**
04/2022 Invited Talk at Yale's Quantum Computing Colloquium Series.
- ◇ **Quantum Machine Learning for Quantum Applications.**
11/2021 Invited Talk at ICCAD 2021's special session on Quantum Machine Learning.
- ◇ **Computational Thinking Toward End-to-End Quantum Applications.**
06/2021 ARQC Quantum Seminar Series.
04/2022 NCSU/Duke Quantum Seminar Series.
- ◇ **How hard is it to train variational quantum circuits?.**
02/2020 Simons' Quantum Algorithm Workshop, UC Berkeley.
- ◇ **Application and training of quantum generative models.**
12/2019 Q2B Practical Quantum Computing Workshop, San Jose.
- ◇ **Toward End-to-End quantum applications.**
12/2019 IQI seminar, Caltech.
12/2019 Stanford University.
11/2019 Texas Tech University.
11/2019 Quantum Computing Lecture series, Louisiana State University.
- ◇ **Provable quantum advantages for optimization and machine learning.**
05/2019 2nd IAMCS Workshop on Quantum Computation and Information, TAMU.
- ◇ **Quantum algorithms for semidefinite programs and convex optimization.**
11/2018 Capital Area Theory Day.
- ◇ **Quantum algorithms for convex optimization and leading eigenvalue computation.**
10/2018 Quantum Information Processing Seminar, MIT.
- ◇ **Quantum algorithms for semidefinite programs.**
05/2018 Workshop on "Quantum Computing & Optimization of large Power Systems", Stanford.
- ◇ **Algorithms for quantum computers.**
05/2018 CCC Workshop on Next Steps in Quantum Computing, D.C.

- ◇ **Quantum query complexity of entropy estimation.**
07/2017 Microsoft Quantum Algorithms Workshop, Redmond.
04/2017 Microsoft Research, Redmond.
- ◇ **General randomness amplification with non-signaling security.**
03/2017 IQI Seminar, Caltech.
01/2017 The 20th Workshop on Quantum Information Processing (QIP 2017).
- ◇ **Limitations of monogamy, Tsirelson-type bounds, and other semidefinite programs in quantum information.**
08/2016 QMA(2) Workshop, QUICS, University of Maryland
12/2015 IQI Seminar, Caltech
- ◇ **Device-independent Quantum Cryptography.**
02/2016 Oregon Crypto Meeting, Oregon State University
- ◇ **New Upper and Lower Bounds for Entanglement Testing.**
05/2015 Microsoft Research, Redmond.
- ◇ **Randomness Extraction in the Presence of Quantum Side Information.**
06/2015 1st Trustworthy Quantum Information Workshop, Ann Arbor, USA
05/2015 Simon's Institute for the Theory of Computing, UC Berkeley.
- ◇ **Improved Entanglement Detection with Tools from Algebraic Geometry.**
11/2014 Colloquium, Institute for Quantum Computing, University of Waterloo.
- ◇ **Multi-Source Randomness Extractors Against Quantum Side Information.**
11/2014 Theory Seminar, Virginia Commonwealth University, Richmond.
- ◇ **Physical Randomness Extractors.**
07/2014 Gordon Research Seminar, Advances in Quantum Information Science, Stonehill College.
03/2014 University of Michigan, Ann Arbor
02/2014 IQI Seminar, Caltech.
- ◇ **Robust Full Randomness Extraction from Any Weak Source.**
05/2013 Quantum Information Processing Seminar, MIT.
- ◇ **Equilibrium Value Method for Optimization Problems and its Applications in Quantum Computation.**
04/2013 IQI Seminar, Caltech
- ◇ **Applications of Sum of Squares in Quantum Information.**
04/2013 University of California, San Diego.
- ◇ **Epsilon-net method for optimizations over separable states.**
07/2012 The 39th International Colloquium on Automata, Languages and Programming (ICALP'12).
03/2012 Tsinghua University.
12/2011 The 15th Workshop on Quantum Information Processing (QIP'12).
- ◇ **Parallel approximation of min-max problems with applications to classical and quantum zero-sum games.**
06/2012 The 27th Annual IEEE Conference on Computational Complexity (CCC'12).
12/2011 The 15th Workshop on Quantum Information Processing (QIP'12).