

Shi Jie Samuel Tan

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EDUCATION

University of Maryland, College Park

College Park, MD

Ph.D. in Computer Science (Temp. Advisors: Andrew Childs and Daniel Gottesman)

Aug 2023 - Present

Haverford College

Haverford, PA

B.S. in Computer Science & Physics, *magna cum laude*

Aug 2019 - May 2023

Graduate Courses: Concentration Inequalities, Intro to Quantum Information Processing, Quantum Control & Metrology, Quantum Error Correction and Fault Tolerance, Quantum Mechanics, Randomized Algorithms

Relevant Undergraduate Courses: Abstract Algebra, Analysis of Algorithms, Real Analysis, Probability, Scientific Computing, Statistical Physics, Theory of Computation

RESEARCH EXPERIENCE

University of Maryland

College Park, MD

Quantum Computing Research Assistant

Nov 2023 - Present

- Under the supervision of Prof. Daniel Gottesman, I am exploring ways to implement practical fault-tolerant protocols with quantum LDPC codes in low-dimensional architectures. I also worked with Prof. Murphy Yuezhen Niu on quantum metrology strategies using quantum signal processing.

Los Alamos National Laboratory

Los Alamos, NM

Quantum Research Fellow

Jun 2023 - Present

- Working under Dr. Yiğit Subaşı and Dr. Andrew Sornborger, I derived the optimal ancilla state for quantum phase estimation using classical signal processing techniques and analytically proved its average-case optimality. Under the supervision of Dr. Subaşı and Dr. Samuel Slezak, I am exploring how we can fix the quantum metropolis sampling algorithm for Gibbs state preparation and quantize the classical parallel tempering algorithm.

California Institute of Technology

Pasadena, CA

Quantum Computing Research Fellow

May 2022 - June 2024

- Under the supervision of Prof. John Preskill and Chris Pattison, I studied the resilience of surface codes against error bursts caused by cosmic rays and global control noise. We attempted to prove the existence of an accuracy threshold for the Union-Find decoder algorithm.

University of Maryland

College Park, MD

Quantum Computing Research Assistant

May 2021 - May 2023

- Under the supervision of Prof. Matthew Coudron, we developed a classical algorithm to approximate output probabilities for low-depth quantum circuits that have any constant number of dimensions. We attempted to design a quasi-polynomial time algorithm for AC^0 postprocessing of 2D geometrically-local low-depth quantum circuits for decision problems.

Haverford College

Haverford, PA

Algorithms Research Assistant

May 2020 - May 2023

- Working under Prof. Sara Mathieson and other collaborators, we validated *thread*, the algorithm to reconstruct ancestral haplotypes from endogamous Amish population and improved the algorithm's accuracy rate to 90%. We designed a KNN algorithm to reduce false positives from the identical-by-descent (IBD) segments identified by IBD detection software.

PUBLICATIONS AND PRE-PRINTS

- [1] **S.J.S. Tan** and L. Stambler. Effective distance of higher dimensional hgps and weight-reduced quantum ldpc codes. *arXiv preprint arXiv:2409.02193*, 2024
- [2] **S.J.S. Tan**, C. A. Pattison, M. McEwen, and J. Preskill. Resilience of the surface code to error bursts. *arXiv preprint arXiv:2406.18897*, 2024
- [3] **S.J.S. Tan**, H.T. Dang, S. Keim, M. Bucan, and S. Mathieson. Identity-by-descent (ibd) segment outlier detection in endogamous populations using pedigree cohorts. *bioRxiv*, pages 2024–08, 2024
- [4] D. Patel, **S.J.S. Tan (co-first author)**, Y. Subaşı, and A. Sornborger. Optimal coherent quantum phase estimation via tapering. *arXiv preprint arXiv:2403.18927*, 2024
- [5] Y. Deng and **S.J.S. Tan (co-first author)**. Random walks on the generalized symmetric group: Cutoff for the one-sided transposition shuffle. *arXiv preprint arXiv:2211.10462*, 2022
- [6] S. Dontha, **S.J.S. Tan (co-first author)**, S. Smith, S. Choi, and M. Coudron. Approximating Output Probabilities of Shallow Quantum Circuits Which Are Geometrically-Local in Any Fixed Dimension. In *Proceedings of the 17th Conference on the Theory of Quantum Computation, Communication and Cryptography (TQC 2022)*, 2022. <https://doi.org/10.4230/LIPIcs.TQC.2022.9>
- [7] K. Finke, M. Kourakos, G. Brown, H.T. Dang, **S.J.S. Tan**, Y. Simons, S. Ramdas, A. Schäffer, R. Kember, M. Bućan, and S. Mathieson. Ancestral haplotype reconstruction in endogamous populations using identity-by-descent. *PLOS Computational Biology*, 2021. <https://doi.org/10.1371/journal.pcbi.1008638>

CONTRIBUTED ORAL PRESENTATIONS

- [1] “Signal-Processing Phase Estimation against Time-dependent Errors.” 19th Conference on the Theory of Quantum Computation, Communication and Cryptography (TQC 2024), September 9-13, 2024. **(Presented by co-author)**
- [2] “Tapered Quantum Phase Estimation.” APS March Meeting 2024, March 4-8, 2024. **(Presented by co-author)**
- [3] “Proving the existence of an accuracy threshold for the Union-Find decoder.” Caltech SFP Summer Seminar Day, August 18, 2022.
- [4] “Approximating Output Probabilities of Shallow Quantum Circuits which are Geometrically-local in any Fixed Dimension.” 17th Conference on the Theory of Quantum Computation, Communication and Cryptography (TQC 2022), July 11-15, 2022. **(Presented by co-first author)**
- [5] “Simulation of Low-Depth Quantum Circuits.” University of Maryland Research Experience for Undergraduates Combinatorics and Algorithms for Real Problems (REU-CAAR) Research Presentation, August 13, 2021. **(Co-presented)**

CONTRIBUTED POSTER PRESENTATIONS

- [1] “Tapered Quantum Phase Estimation.” 19th Conference on the Theory of Quantum Computation, Communication and Cryptography (TQC 2024), September 9-13, 2024.
- [2] “Resilience of the surface code to error bursts.” 6th International Conference on Quantum Error Correction (QEC), October 30-November 3, 2023.
- [3] “Comparison of cohort-based identical-by-descent (IBD) segment finding methods for endogamous populations.” In *Proceedings of the 13th ACM International Conference on Bioinformatics, Computational Biology and Health Informatics (ACM-BCB 2022)*, August 7-10, 2022. <https://doi.org/10.1145/3535508.3545104>
- [4] “Approximating Output Probabilities of Shallow Quantum Circuits which are Geometrically-local in any Fixed Dimension.” 25th Annual Conference on Quantum Information Processing (QIP 2022), 2022.
- [5] “Improvements to ancestral haplotype reconstruction in pedigrees.” 7th-8th International Conference on Algorithms for Computational Biology (AlCoB 2020 & 2021), November 9-11, 2021.

- [6] “Improvements to ancestral haplotype reconstruction in pedigrees.” Research in Computational Molecular Biology - 25th Annual International Conference (RECOMB 2021), August 29-September 1, 2021.
- [7] “Validating Ancestral Haplotype Reconstruction In Endogamous Populations using Identical-by-Descent.” Haverford College Marian E. Koshland Integrated Natural Sciences Center (KINSC) Undergraduate Science Research Symposium, 2020.

AWARDS AND FELLOWSHIPS

2024	National University of Singapore Development Grant
2023	MathQuantum Graduate Fellowship (University of Maryland)
2023	QuICS Lanczos Graduate Fellowship (University of Maryland)
2023	Louis B. Green Prize in Physics and Astronomy (Haverford College)
2023	Phi Beta Kappa
2023	Los Alamos National Laboratory Quantum Computing Summer School Fellowship
2023	Singloh Hsu Scholarship (Haverford College)
2023	Computing Research Association (CRA) Outstanding Undergraduate Researcher Award Finalist
2022	Caltech Summer Undergraduate Research Fellowship
2022	Marian E. Koshland Integrated Natural Sciences Center Summer Scholarship (Haverford College)
2021	An Zhu-Google University of Maryland REU-CAAR Fellowship
2020	Brian Kovaric Fellowship (Haverford College)
2016	Prime Minister’s Book Prize (Ministry of Education, Singapore)

WORK EXPERIENCE

Haverford College	Haverford, PA
<i>Teaching Assistant</i>	<i>Aug 2020 - May 2023</i>
<ul style="list-style-type: none">• Hold office hours and grade for analysis of algorithms, quantum mechanics and theory of computation• Run Math Question Center & tutor multivariable calculus, real analysis, linear & abstract algebra	
Innosparks	Singapore
<i>Junior Software Developer</i>	<i>Jul 2018 - Jan 2019</i>
<ul style="list-style-type: none">• Built APIs for prototype submitted to Singapore’s Ministry of Health & National University Hospital	
BigBulb Studio	Singapore
<i>Co-founder and Software Developer</i>	<i>Nov 2017 - Apr 2019</i>
<ul style="list-style-type: none">• Offered tech consulting and developed company websites for small and medium enterprises	
Singapore Armed Forces	Singapore
<i>Assistant Platoon Commander (1st Lieutenant)</i>	<i>Jan 2016 – Nov 2017</i>
<ul style="list-style-type: none">• Trained over 100 officer cadets into logistics officers and planned local and overseas military exercises	

OUTREACH AND COMMUNITY SERVICE

CodeForPhilly	Philadelphia, PA
<i>Co-lead and Software Engineer (MATchmapper)</i>	<i>Feb 2020 – May 2023</i>
<ul style="list-style-type: none">• Co-founded MATchmapper to offer data insights on the opioid crisis for Health Federation Philadelphia and the Department of Public Health• Constructed Django web application and data pipeline to scrape public databases and built PostgreSQL database and interactive map on Heroku for more than 500 healthcare providers	
Haverford College	Haverford, PA
<i>Co-head of HaverCode</i>	<i>Nov 2019 - May 2023</i>
<ul style="list-style-type: none">• Organize computer science-related academic, industry and social events for faculty and students	