

Hanmeng (Harmony) Zhan

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**Xiamen University**, Xiamen, Fujian, China

• Bachelor of Economics

Sep 2008 - Jun 2014

Department of Statistics, Faculty of Economics

Thesis: *Multi-Player Multi-State Quantum Games*

Supervisor: Zhengming Qian

## PUBLICATIONS    **Book**

1. C. Godsil, H. Zhan, *Discrete Quantum Walks on Graphs and Digraphs*. Cambridge University Press (2023).

## **Peer-Reviewed Papers**

2. A. Chan, H. Zhan, *Pretty good state transfer in discrete-time quantum walks*. Journal of Physics A: Mathematical and Theoretical (2023). doi:10.1088/1751-8121/acc4f5
3. H. Zhan, *The average search probabilities of discrete-time quantum walks*. Quantum Information Processing (2022) 21(9): pp. 336. doi:10.1007/s11128-022-03681-9
4. A. Chan, G. Coutinho, W. Drazen, O. Eisenberg, C. Godsil, M. Kempton, G. Lippner, C. Tamon, H. Zhan, *Fundamentals of fractional revival in graphs*. Linear Algebra and its Applications (2022). doi:10.1016/J.LAA.2022.09.010
5. H. Zhan, *Factoring discrete quantum walks on distance regular graphs into continuous quantum walks*. Linear Algebra and its Applications (2022), 648: pp. 88-103. doi:10.1016/J.LAA.2022.04.017
6. A. Chan, B. Johnson, M. Liu, M. Schmidt, Z. Yin, H. Zhan, *Laplacian pretty good fractional revival*. Discrete Mathematics (2022), 345(10), 112971. doi:10.1016/J.DISC.2022.112971
7. A. Chan, B. Johnson, M. Liu, M. Schmidt, Z. Yin, H. Zhan, *Laplacian fractional revival on graphs*. Electronic Journal of Combinatorics (2021) 28(3): P3.22.
8. A. Chan, G. Coutinho, C. Tamon, L. Vinet, H. Zhan, *Fractional revival and association schemes*. Discrete Mathematics (2020) 343(11), 112018. doi:10.1016/j.disc.2020.112018
9. L. Vinet, H. Zhan, *Perfect state transfer on weighted graphs of the Johnson scheme*. Letter in Mathematical Physics (2020). doi.org/10.1007/s11005-020-01298-6
10. H. Zhan, *Quantum walks on embeddings*. Journal of Algebraic Combinatorics (2020). doi.org/10.1007/s10801-020-00958-z
11. H. Zhan, *An infinite family of circulant graphs with perfect state transfer in discrete quantum walks*. Quantum Information Processing (2019) 18(12): pp. 369.
12. G. Coutinho, L. Vinet, H. Zhan, A. Zhedanov. *Perfect state transfer in a spin chain without mirror symmetry*. Journal of Physics A: Mathematical and Theoretical (2019) 52(45), pp. 455302.
13. C. Godsil, H. Zhan, *Discrete-time quantum walks and graph structures*. Journal of Combinatorial Theory, Series A (2019), pp. 181212.
14. A. Chan, G. Coutinho, C. Tamon, L. Vinet, H. Zhan, *Quantum fractional revival on graphs*. Discrete Applied Mathematics (2019) 269, pp. 86-98.

15. G. Coutinho, C. Godsil, K. Guo, H. Zhan, *A new perspective on the average mixing matrix*. Electronic Journal of Combinatorics (2018) 25(4): P4.14.
16. C. Godsil, H. Zhan, *Uniform mixing on Cayley graphs*. Electronic Journal of Combinatorics (2017) 24(3): P3.20.
17. G. Coutinho, C. Godsil, M. Shirazi, H. Zhan, *Equiangular lines and covers of the complete graph*. Linear Algebra and its Applications (2016) 488: pp. 264-283.
18. R. Alvir, S. Dever, B. Lovitz, J. Myer, C. Tamon, Y. Xu, H. Zhan. *Perfect state transfer in Laplacian quantum walk*. Journal of Algebraic Combinatorics (2016) 43(4): pp. 801-826.

### Submitted Preprints

19. Q. Chen, C. Godsil, M. Sobchuk, H. Zhan. *Hamiltonians of bipartite walks*. arXiv:2207.01673 (2022).
20. H. Kumar, B. Mohar, S. Pragada, H. Zhan. *Subdivision and Graph Eigenvalues*. arXiv:2303.10488 (2023).

### SUPERVISION EXPERIENCE

#### Undergraduate Research Programs

- Fields Undergraduate Summer Research Program Jul - Aug, 2020  
Co-supervised an undergraduate research project with Ada Chan on Laplacian fractional revival at the Fields Institute. This results in two papers [6] and [7]. One student was awarded the Book Prize by the Fields Institute.
- University of Waterloo May - Aug, 2018  
Mentored one undergraduate student under the supervision of Chris Godsil. The student extended my results in the paper [10], and developed the theory of a new quantum walk called the vertex-face walk. This leads to the joint work [19].

### PRESENTATIONS **Invited Talks**

1. *The second largest eigenvalue of a tree*. In: CMS Winter Meeting, Chelsea Hotel, Toronto, ON, Canada, December 2 - 5, 2022.
2. *The effect of marking vertices in discrete quantum walks*. In: Graph Theory, Algebraic Combinatorics and Mathematical Physics, Centre de Recherches Mathématiques, July 25 - August 19, 2022.
3. *The average search probability in a quantum walk with an oracle*. In: Algebraic Graph Theory Seminar, University of Waterloo, Waterloo, ON, Canada, August 2, 2021.
4. *Arc-reversal quantum walks*. In: Discrete Math Seminar, Simon Fraser University, Vancouver, BC, Canada, February 24, 2021.
5. *DRACKNs and their applications in quantum information*. In: Codes and Expansions, United States, September 8, 2020.
6. *Factoring discrete quantum walks into continuous quantum walks*. In: Algebraic Graph Theory Seminar, University of Waterloo, Waterloo, ON, Canada, August 3, 2020.

7. *Quantum fractional revival*. In: Discrete Math Seminar, University of Delaware, Newark, DE, United States, April 23, 2020.
8. *New advances in quantum walks*. In: AMS Joint Mathematics Meetings, Colorado Convention Center, Denver, CO, United States, January 15 - 18, 2020.
9. *State transfer via orthogonal polynomials*. In: AMS Sectional Meeting, University of Wisconsin-Madison, Madison, WI, United States, September 14 - 15, 2019.
10. *Quantum state transfer in the algebra of the Johnson scheme*. In: CMS Summer Meeting, University of Regina, Regina, SK, Canada, June 7 - 10, 2019.
11. *Some elegant results in algebraic graph theory*. In: Canadian Discrete and Algorithmic Mathematics Conference, Simon Fraser University, Vancouver, BC, Canada, May 28 - 31, 2019.
12. *Quantum walks, orthogonal polynomials, and spectral graph theory*. In: Quantum Walks and Information Tasks, Banff International Research Station for Mathematical Innovation and Discovery, Banff, AB, Canada, April 21 - 26, 2019.
13. *Generating entanglement using quantum walks*. In: David A. Walsh Seminar Series, Clarkson University, Potsdam, NY, United States, February 8, 2019.
14. *Some open problems in discrete quantum walks*. In: Algebraic Graph Theory and Quantum Walks, University of Waterloo, Waterloo, ON, Canada, April 23 - 27, 2018.
15. *Recent progress in discrete quantum walks*. In: AMS Sectional Meeting, Northeastern University, Boston, MA, United States, April 21 - 22, 2018, 2018.
16. *Graph covers and equiangular frames*. In: AMS Sectional Meeting, Ohio State University, Columbus, OH, United States, March 16 - 18, 2018.
17. *From covers to tight frames*. In: AMS Sectional Meeting, College of Charleston, Charleston, SC, United States, March 10 - 12, 2017.
18. *Spectra of discrete quantum walks*. In: CMS Summer Meeting, University of Alberta, Edmonton, AB, Canada, June 24 - 27, 2016.
19. *Lines and covers of complete graphs 2*. In: Systems of Lines: Applications of Algebraic Combinatorics, Worcester Polytechnic Institute, Worcester, MA, United States, August 10 - 14, 2015.
20. *Some open problems in uniform mixing*. In: Summer Research Program, Clarkson University, Potsdam, NY, United States, July 20, 2015.

#### Mini-Course

21. *Introduction to discrete quantum walks*. In: CMS Winter Meeting, Chelsea Hotel, Toronto, ON, Canada, December 2 - 5, 2022.

#### Contributed Talks

22. *Discrete quantum walk search on graphs*. In: Coast Combinatorics Conference 2023, SFU Harbour Centre, Vancouver, BC, Canada, March 4 - 5, 2023.
23. *How far can the quantum walker go*. In: 9th International Conference on Quantum Simulation and Quantum Walks, Centre International de Rencontres Mathématiques, Marseille, Bouches-du-Rhone, France, January 20 - 24, 2020.

24. *Discrete quantum walks on Cayley graphs*. In: CMS Winter Meeting, Chelsea Hotel, Toronto, Toronto, ON, Canada, December 6 - 9, 2019.
25. *The vertex-face walk*. In: Finite Geometry and Extremal Combinatorics, University of Delaware, Newark, DE, United States, August 21 - 24, 2019.
26. *Combinatorial aspects of quantum walks*. In: Prairie Discrete Math Workshop, Brandon University, Brandon, MB, Canada, June 12 - 15, 2018.
27. *Discrete-time quantum walks and graph embeddings*. In: CMS Winter Meeting, University of Waterloo, Waterloo, ON, Canada, December 8 - 11, 2017.
28. *Quantum walks and mixing*. In: Algebraic and Extremal Graph Theory, University of Delaware, Newark, DE, United States, August 7 - 10, 2017.
29. *Discrete-time quantum walks and graph structures*. In: Canadian Discrete and Algorithmic Mathematics Conference, Ryerson University, Toronto, ON, Canada, June 12 - 15, 2017.
30. *Uniform mixing in quantum walks*. In: 22nd Ontario Combinatorics Workshop, York University, Toronto, ON, Canada, May 16 - 17, 2014.

#### TEACHING EXPERIENCE

##### **Simon Fraser University, Vancouver, BC, Canada**

- Instructor Spring 2023  
MACM 201: Discrete Mathematics II (class size: 180)
- Instructor Summer 2022  
MATH 240: Algebra I: Linear Algebra (class size: 90)

##### **Online Graduate Courses, International**

- Instructor Winter 2021  
Combinatorics and Quantum Walks (class size: 20; recordings available)

##### **York University, Toronto, ON, Canada**

- Instructor Winter 2020, Fall 2020  
MATH 1014: Applied Calculus II (class size: 180 - 280)

##### **University of Waterloo, Waterloo, ON, Canada**

- Instructor Winter 2018  
MATH 135: Algebra for Honors Mathematics (class size: 60)
- Substitute Instructor Winter 2017  
CO 444/644: Algebraic Graph Theory (class size: 20)

#### FUNDING, AWARDS AND DISTINCTIONS

##### **Funding for Conferences Organized**

- Algebraic Graph Theory and Quantum Information 2021

##### **Awards and Distinctions from University of Waterloo**

- *University Finalist for the Governor General's Gold Medal* 2019  
Purpose: a medal awarded to nominees for the Governor General's Gold Medal

Type and Source	Amount in CAD	Purpose
Fields Institute	\$14250	travel funding for non-US invited speakers, at least \$5000 towards ECRs, females, postdocs, students
NSF, via Fields Institute	\$10000	travel funding for US invited speakers, at least 2/3 towards ECRs, females, postdocs, students
York University, via Office of Vice-President Research and Innovation	\$2000	registration fees for students and postdocs

Table 1: Funding for Algebraic Graph Theory and Quantum Information

- *Inaugural Mathematics Doctoral Prize, First Prize (\$1500)* 2019  
Purpose: a prize awarded to recognize the achievement of graduating doctoral students in the Faculty of Mathematics
- *Outstanding Achievement in Graduate Studies* 2015  
Purpose: an honor awarded to three University of Waterloo Master's students for their outstanding achievement in graduate studies
- *Cotton Family Women in Mathematics Graduate Scholarship (\$9000)* 2014, 2016, 2017  
Purpose: a scholarship awarded to a full-time female graduate student on the basis of academic excellence in their studies and research
- *Robin K. Banks Scholarship (\$750)* 2011 - 2012  
Purpose: a scholarship awarded to a full-time student in the Faculty of Arts who have achieved the highest overall average at the end of Year Three
- *Faculty of Arts Upper-Year Scholarship (\$500)* 2011 - 2012  
Purpose: a scholarship awarded to outstanding full-time and part-time students in the Faculty of Arts on the basis of overall average
- *Dean's Honours List* 2011 - 2012

## SERVICE

### Conference, Workshop and Seminar Organizer

- Algebraic Graph Theory and Quantum Information, Fields Institute 2021  
Co-organizers: Ada Chan, Gabriel Coutinho, Krystal Guo, Christino Tamon, Luc Vinet
- Quantum Information on Graphs, CMS Winter Meeting Dec 6 - 9, 2019  
Co-organizers: Ada Chan, Christino Tamon
- Discrete Mathematics Seminar, York University Fall 2019  
Co-organizer: Justin M. Troyka

### Seminar Chair

- Algebraic Graph Theory Seminar, University of Waterloo Spring 2016, Fall 2017

### Journal Reviewer

- Quantum Information Processing 2022-2023
- Algebraic Combinatorics 2022
- Discrete Mathematics 2021 - 2022
- Linear Algebra and Its Applications 2016, 2019 - 2022
- Journal of Combinatorial Theory, Series A 2021
- Electronic Journal of Combinatorics 2017 - 2021
- Linear and Multilinear Algebra 2019 - 2020
- Communications in Algebra 2019
- Journal of Physics A: Mathematical and Theoretical 2019

#### **Conference Reviewer**

- Sampling Theory and Applications 2019
- International Colloquium on Automata, Languages and Programming 2018