Mark Kempton – Curriculum Vitae

Department of Mathematics
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EMPLOYMENT

Brigham Young University, Mathematics Department
Assistant Professor, Fall 2018–Present

Harvard University, Center of Mathematical Sciences and Applications
Postdoctoral Research Fellow, July 2015–May 2018
   Research Mentor: Shing-Tung Yau
Teaching Fellow, Fall 2016

EDUCATION

University of California, San Diego
Ph.D. Mathematics, June 2015
   Advisor: Fan Chung Graham
Brigham Young University
M.S. Mathematics, August 2010
   Advisor: Wayne Barrett
B.S. Mathematics, April 2008 (Magna Cum Laude)

RESEARCH INTERESTS

Spectral graph theory, algebraic graph theory, combinatorial matrix theory, geometry of graphs, linear algebra, combinatorics. Specifically random walks and quantum walks on graphs, resistance distance in graphs, graph homology and curvature, embeddings of graphs, connection graphs, minimum rank and inverse eigenvalue problems.

PUBLICATIONS

1. Isospectral reductions and quantum walks on graphs (with John Tolbert). Submitted, pre-print: https://arxiv.org/abs/2212.00172.

2. Effects of Backtracking on PageRank (with Cory Glover, Tyler Jones, and Alice Oveson). Submitted, pre-print: https://arxiv.org/abs/2211.13353.

3. Unicyclic graphs and the inertia of the distance squared matrix (with Christian Howell, Kellon Sandall, and John Sinkovic). Submitted, pre-print: https://arxiv.org/abs/2211.13341.

4. On the Laplacian spread of digraphs (with Wayne Barrett, Thomas R. Cameron, Emily Evans, and H. Tracy Hall). Submitted, pre-print: https://arxiv.org/abs/2206.15410.

5. Kemeny's constant for non-backtracking random walks (with Jane Breen, Nolan Faught, Cory Glover, Adam Knudson, and Alice Oveson). Accepted to *Random Structures and Algorithms*, pre-print: https://arxiv.org/abs/2203.12049.

6. Fundamentals of fractional revival in graphs (with Ada Chan, Gabriel Coutinho, Whitney Drazen, Or Eisenberg, Chris Godsil, Gabor Lippner, Christino Tamon, and Hanmeng Zhan). *Linear Algebra and its Applications*, 655 (2022) 129-158.

7. New conjectures on algebraic connectivity and the Laplacian spread of graphs (with Wayne Barrett, Emily Evans, and H. Tracy Hall). *Linear Algebra and its Applications*, 648 (2022) 104-132.

8. SpectralFly: Ramanujan graphs as flexible and efficient interconnection networks (with Stephen Young, Sinan Aksoy, Jesun Firoz, Roberto Gioiosa, Tobias Hagge, Juan Escobedo, and Mark Raugas). *2022 IEEE International Parallel and Distributed Processing Symposium (IPDPS)*, (2022), 1040-1050.

9. A 1-Separation Formula for the Graph Kemeny Constant and Braess Edges (with Nolan Faught and Adam Knudson). *Journal of Mathematical Chemistry*, 60 (2022) no. 1, 49-69.

10. A homology vanishing theorem for graphs with positive curvature (with Florentin Münch and Shing-Tung Yau). *Communications in Analysis and Geometry*, 29 (2021) no. 6, 1449-1473.

11. Pretty good quantum fractional revival in paths and cycles (with Ada Chan, Whitney Drazen, Or Eisenberg, and Gabor Lippner). *Algebraic Combinatorics*, 4 (2021) no. 6, 989-1004.

12. Spectral Threshold for Extremal Cyclic Edge-Connectivity (with Sinan Aksoy and Stephen J. Young). *Graphs and Combinatorics*, 37 (2021), no. 6, 2079-2093.

13. Some spectral properties of the non-backtracking matrix of a graph (with Cory Glover). *Linear Algebra and its Applications*, 618 (2021), 37-57.

14. Resistance distance, Kirchhoff index, and Kemeny's constant in flower graphs (with Nolan Faught and Adam Knudson). *MATCH Communications in Mathematical and in Computer Chemistry*, 86 (2021), no. 2, 405-427.

15. Large scale Ricci curvature on graphs (with Gabor Lippner and Florentin Munch). *Calculus of Variations and Partial Differential Equations*, 59 (2020) no. 5, 1-17.

16. Characterizing cospectral vertices via isospectral reductions (with John Sinkovic, Dallas Smith, and Benjamin Webb). *Linear Algebra and its Applications*, 594 (2020), 226-248.

17. Spanning 2-forests and resistance distance in 2-connected graphs (with Wayne Barrett, Emily J. Evans, Amanda E. Francis, and John Sinkovic). *Discrete Applied Mathematics*, 284 (2020), 341-352.

18. Perfect state transfer on strongly regular graphs with an edge perturbation (with Chris Godsil, Krystal Guo, Gabor Lippner, and Florentin Munch). *Journal of Combinatorial Theory, Series A*, 172 (2020), 105181.

19. Pretty good quantum state transfer in asymmetric graphs via potential (with Or Eisenberg and Gabor Lippner). *Discrete Mathematics*, 342 (2019), no. 10, 2821-2833.

20. A non-backtracking Pólya's theorem. *Journal of Combinatorics*, 9 (2018), no. 2, 327-343.

21. Pretty good quantum state transfer in symmetric spin networks via magnetic field (with Gabor Lippner and Shing-Tung Yau). *Quantum Information Processing*, 16 (2017), no. 210, 1-23.

22. Perfect state transfer on graphs with a potential (with Gabor Lippner and Shing-Tung Yau). *Quantum Information and Computing*, 17 (2017), no. 3, 303-327.

23. Strong embeddings and 2-isomorphism (with Rani Hod, An Huang, and Shing-Tung Yau). *Notices of the International Congress of Chinese Mathematicians*, 4 (2016), no. 2, 5-13.

24. Non-backtracking random walks and a weighted Ihara's theorem. *Open Journal of Discrete Mathematics*, 6 (2016), no. 4, 207-226.

25. A local clustering algorithm for connection graphs (with Fan Chung). *Journal of Internet Mathematics*, 11 (2015), 333-351.

26. Ranking and sparsifying a connection graph (with Fan Chung and Wenbo Zhao). *Journal of Internet Mathematics*, 10 (2014), 87-115.

27. Decompositions of minimum rank matrices (with Wayne Barrett, Nicole Malloy, Curtis Nelson, William Sexton, and John Sinkovic). *Linear Algebra and its Applications*, 438 (2013), no. 10, 3913-3948.

28. Minimum rank of outerplanar graphs (with John Sinkovic). *Linear Algebra and its Applications*, 436 (2012), no. 9, 3701-3720.

29. The inverse eigenvalue and inertia problems for minimum rank two graphs (with Wayne Barrett, Seth Gibelyou, Nicole Malloy, Curtis Nelson, and John Sinkovic). *Electronic Journal of Linear Algebra*, 22 (2011), 389-418.

TEACHING EXPERIENCE

Brigham Young University. Assistant Professor, 2018-Present, taught Math 112 and 113 (Calculus 1 and 2), Math 213 (Linear Algebra), Math 570 (Matrix Analysis), Math 621 (Matrix Theory), Math 344 (Mathematical Analysis).

Harvard University. Teaching Fellow, Mathematics Department, Fall 2016, taught Calculus 1.

UC San Diego. Senior Teaching Assistant (training TA) 2014-2015. Associate Instructor, 2013–2014, taught Pre-calculus 2 semesters. Teaching Assistant, 2010-2014, TA for calculus, linear algebra, differential equations, vector calculus, combinatorics, applied algebra (graduate level).

Brigham Young University. Graduate Student Instructor 2009-2010, taught Calculus 1 two semesters, Calculus 2, and Quantitative Reasoning. Teaching Assistant, 2009-2010, TA for calculus and linear algebra.

OTHER EXPERIENCE

Center for Communications Research–La Jolla, California
Adjunct Researcher, Summer 2016, 2018 (SCAMP participant)

TALKS

1. "The Number of Distinct Eigenvalues of Joins of Graphs," Invited talk at JMM 2023, Boston MA, January 2023.

2. "Isospectral Reductions and Quantum Walks," Invited talk at CMS Winter Meeting, Toronto, Canada, December 2022.

3. "Algebraic Connectivity and the Laplacian Spread," invited talk at ILAS 2022, Galway, Ireland, June 2022.

4. "Quantum State Transfer in Graphs," invited talk at the PNNL Quantum Journal Club at Pacific Northwest National Lab (virtual), May 2022.

5. "Kemeny's Constant for Non-backtracking Random Walks," invited talk at the Discrete Math Seminar at the University of Delaware, April 2022.

6. "Fractional Revival and Generalizations," invited talk at the Fields Institute Workshop on Algebraic Graph Theory and Quantum Information, August 2021.

7. "Non-backtracking Random Walks on Graphs," invited talk at University of Delaware Discrete Math Seminar, April 2021.

8. "Inverse Eigenvalue Problems in Quantum State Transfer," invited talk at Southeastern Conference in Combinatorics, Graph Theory, and Computing, Florida Atlantic University, March 2021.

9. "Cospectral Vertices and Isospectral Reductions," invited talk at University of Waterloo Algebraic Graph Theory Seminar, February 2021.

10. "Spectral Bounds on Cyclic Edge-Connectivity," invited talk at JMM 2021 (virtual), January 2021.

11. "Cospectral Vertices and Isospectral Reductions," invited talk at AMS Western Sectional Meeting, University of Utah (virtual), October 2020.

12. "Approximate Quantum Fractional Revival in Paths," invited talk at the Canadian Mathematical Society Meeting, Toronto, Canada, December 2019.

13. "Cospectral Vertices and Isospectral Reductions," invited talk at Computing at PNNL Seminar Series, Pacific Northwest National Labs, August 2019.

14. "Approximate Quantum Fractional Revival in Paths," invited talk at ILAS 2019, Rio de Janeiro, Brazil, July 2019.

15. "Cospectral Vertices and Isospectral Reductions," invited talk at AMS Joint Sectional Meeting, Honolulu, HI, March 2019.

16. "The Power of Loops," invited talk at Workshop on Algebraic Graph Theory and Quantum Walks at the University of Waterloo, April 2018.

17. "Quantum Walks on Graphs," invited talk at Iowa State University Mathematics Department Colloquium, January 2018.

18. "Quantum Walks on Graphs," invited talk at Computing at PNNL Seminar Series, Pacific Northwest National Labs, January 2018.

19. "Perfect State Transfer in Perturbations of Strongly Regular Graphs," invited talk at AMS special session on Emerging Topics in Graphs and Matrices, JMM January 2018.

20. "Curvature and Homology of Graphs," invited talk at Massachusetts Institute of Technology Combinatorics Seminar, December 2017

21. "Quantum Walks on Graphs," invited talk at Brigham Young University Mathematics Department Colloquium, November 2017.

22. "Curvature and Homology of Graphs," invited talk at Northeastern University, Analysis and Geometry seminar, October 2017.

23. "Curvature and Homology on Graphs," Harvard CMSA Member's Seminar, Harvard University, September 2017.

24. "Quantum state transfer on graphs," invited talk in contributed minisymposium on Algebraic Graph Theory in Quantum Computing, Canadian Discrete and Algorithmic Mathematics Conference (CanaDAM), June 2017.

25. "Non-backtracking random walks and graph clustering," invited talk in special session on Graph Clustering, AMS Western Sectional Meeting, Pullman, WA, April 2017.

26. "Quantum state transfer on graphs," invited talk at Clarkson University Arts and Sciences Seminar, April 2017.

27. "Non-backtracking random walks and Pólya's recurrence theorem," invited talk at University of Rhode Island, Discrete Mathematics Seminar, March 2017.

28. "Quantum state transfer on graphs," invited talk at University of Waterloo Algebraic Graph Theory Seminar, March 2017.

29. "Quantum state transfer on graphs," invited talk at Massachusetts Institute of Technology Combinatorics Seminar, March 2017.

30. "Quantum state transfer on graphs," invited talk at Brandeis University Combinatorics Seminar, February 2017.

31. "Perfect state transfer on graphs," invited talk in special session on Graphs and Matrices, JMM, Atlanta, Jan. 2017.

32. "Perfect state transfer on graphs," invited talk at University of Delaware Combinatorics seminar, Nov. 2016.

33. "Variations on random walks," invited talk at Brigham Young University Mathematics Department Colloquium, Nov. 2016.

34. "Quntum tunneling on graphs," invited talk in special session on Analysis on Graphs and Spectral Graph Theory, AMS Fall Western Sectional Meeting University of Denver, October 2016.

35. "Quantum tunneling on graphs," Harvard CMSA Member's Seminar, Harvard University, Oct. 2016.

36. "Non-backtracking random walks on graphs," Harvard CMSA Member's Seminar, Harvard University, Nov. 2015.

37. "Non-backtracking random walks on graphs," UC San Diego Food for Thought Seminar, March 2015.

38. "The Spectrum of the connection Laplacian," invited talk at the Center for Communications Research, La Jolla California, Feb. 2015.

39. "The mixing rate of non-backtracking random walks," contributed talk at JMM, San Antonio, Jan. 2015.

40. "The spectrum of the connection Laplacian," invited talk at Brigham Young University Mathematics Department Colloquium, Dec. 2014.

41. "The mixing rate of non-backtracking random walks," Midwestern Graph Theory Conference, Fort Worth, Indiana, Oct. 2014.

42. "The Spectrum of the connection Laplacian," Southeastern Conference in Combinatorics, Graph Theory, and Computing, Florida Atlantic University, March 2014.

43. "Spectral graph theory and a higher dimensional generalization," UC San Diego Food for Thought Seminar, Feb. 2014.

44. "A local clustering algorithm for connection graphs," Workshop on Algorithms and Models for the Web Graph, Cambridge, MA, Dec. 2013.

45. "Eigenvalues of a connection graph," Graduate Student Combinatorics Conference, Twin Cities, Minnesota, April 2013.

46. "Ranking and sparsifying a connection graph," Midwestern Graph Theory Conference, Iowa, Sept. 2012.

47. "Ranking and sparsifying a connection graph," Workshop on Algorithms and Models for the Web Graph, Halifax, June 2012.

48. "Minimum rank of outerplanar graphs," AMS Central Section Meeting, St. Paul, MN, April 2010.

OTHER CONFERENCES

1. "Conference on Graph Theory and its Applications: a Tribute to Professor Fan Chung" at Tsinghua International Mathematics Forum, Dec. 2019.

2. CMSA Workshop on Probabilistic Combinatorics, Harvard University, Feb. 2017.

3. CMSA Workshop on Additive Combinatorics, Harvard University, Oct. 2017.

4. Charles River Probability Lectures, Microsoft Research, Cambridge, Oct. 2017/2015.

5. Algorithms for Threat Detection Kickoff Workshop, American University, Washington D.C., Sept. 2017.

6. Harvard University "Big Data" Conference, August 2017/2016/2015.

7. "Networked Lives" Conference honoring career of Fan Chung and Ron Graham, UC San Diego, Feb. 2016.

8. NSF-CBMS Regional Research Conference on Combinatorial Zeta and L-functions, Brigham Young University, June 2014.

9. Joint Mathematics Meetings, San Diego, Jan 2013.

10. SIAM Discrete Mathematics Conference, Dalhousie University, June 2012.

11. Joint Mathematics Meetings, San Diego, Jan 2008; participated in undergraduate poster session.

PROFESSIONAL SERVICE

- ❏ Refereed papers for *Discrete Mathematics*, *Linear Algebra and its Applications*, *Linear and Multilinear Algebra*, *Journal of Combinatorics*, *Electronic Journal of Combinatorics*, *Journal of Combinatorial Theory Series B*, *SIAM Journal on Applied Dynamical Systems*, *Network Science*, *Letters in Mathematical Physics*, *Australasian Journal of Combinatorics*, *Electronic Journal of Linear Algebra*, *Discrete Applied Math*, *Rocky Mountain Journal of Mathematics*, *European Journal of Combinatorics*, *Analysis and Mathematical Physics*, *Vietnam Journal of Mathematics*, *SIAM Journal on Applied Algebra and Geometry*, *Special Matrices*, *Journal of Information Warfare*, *Rose-Hulman Undergraduate Mathematics Journal*.
- ❏ Reviewer for MathSciNet Mathematical Reviews.
- ❏ Organizer of BYU Discrete Math Seminar, Fall 2018–present.
- ❏ Co-Organizer of special session "Graphs and Matrices," AMS Fall Western Sectional Meeting, University of Utah, October 2020 and October 2022.
- ❏ Co-organizer of special session "Extremal Graph Theory and Quantum Walks on Graphs," AMS Spring Eastern Sectional Meeting, Northeastern University, April 2018.
- ❏ Co-Organizer of CMSA Member's Seminar, Harvard University, Fall 2017–Spring 2018.

MENTORING

- ❏ Masters Students: Adam Knudson (September 2022-Present), Kellon Sandall (September 2022-Present), Tyler Jones (September 2020-December 2020), Cory Glover (September 2019-August 2021)
- ❏ Undergraduates Mentored:
  - at BYU: Dallin Seyfried (June 2022-Present), John Warnock (June 2022-Present), Nolan Ison (September 2021-Present), James Larsen (July 2021-Present), Christian Howell (January 2021-Present), Gwen Johnson (November 2021-February 2022), Alice Oveson (January 2021-December 2021), John Tolbert (April 2020-August 2022), Kellon Sandall (April 2020-August 2022), Adam Knudsen (April 2019-August 2022), Nolan Faught (April 2019-April 2022), Tyler Jones (October 2019-August 2020), Cory Glover (February-August 2019)
  - at Harvard: Or Eisenberg (June 2017-June 2018), Fiona Young (January-May 2018)

HONORS AND AWARDS

- ❏ Distinguished Mentoring Award, Brigham Young University, Department of Mathematics, December 2021.
- ❏ Teaching Assistant Excellence Award, UCSD, Mathematics Department, 2013-2014. Award given to 2-3 TAs each year.
- ❏ James B. Ax Fellow, UCSD, Mathematics Department, 2010-2011. Fellowship given to one incoming graduate student at UCSD each year.

TECHNICAL SKILLS

Proficient in use of Python, HTML, MATLAB, Mathematica, LATEX; experience with Java.