Benjamin Z. Webb

Academic Positions

Fall 2014- **Assistant Professor**, *Department of Mathematics, Brigham Young University*.

Fall 2012-2014 **Postdoctoral Associate**, *Laboratory of Statistical Physics, Rockefeller University*.

Fall 2011-2012 **Visiting Assistant Professor**, *Department of Mathematics, Brigham Young University*.

Education

2011 **Ph.D. in Mathematics**, *Georgia Institute of Technology*, Atlanta, Georgia.
Dissertation: *Isospectral Network Transformations, Estimates of Matrices' Spectra, and Eventual Negative Schwarzian Systems*. Advisor: Leonid Bunimovich.

2004 **M.S. in Mathematics**, *Brigham Young University*, Provo, Utah.
Thesis: Problems Related to the Extended Zermelo Model. Advisor: Christoper Grant.

2002 **B.S. in Mathematics** & **B.A. in German**, *Brigham Young University*, Provo, Utah.
Minor in Philosophy

Research Interests

My research interests are in the application and development of the theory of dynamical systems, specifically as it relates to the interplay of system structure and dynamics. This includes the study of network dynamics, specifically understanding how the evolving structure of a network influences its underlying dynamical behavior, and the study of particle systems in which particles more through and interact with various media. A particular focus in this research is understanding how the spectral properties of such systems are effected by changes in a system's structure. This had lead to a new area of research termed isospectral transformation theory, which has a number of applications in theoretical and applied mathematics.

Publications: (students are in bold font)

1. **Joseph Jamieson**, **D. J. Passey**, Benjamin Webb, and **Joseph Wilkes**, Learning Using Thinned Networks: A Crowdsourcing Phenomena in Reservoir Computing, submitted to *Journal of Machine Learning Research 2*, 2023.
2. Zachary Boyd, Nick Callor, **Taylor Gledhill**, **Abby Jenkins**, **Raelynn Wonnacott**, Robert Snellman and Benjamin Webb, The Persistent Homology of Genealogical Networks, submitted to *Applied Network Science*, 2022.
3. **Clark Brown**, **Scout Callens**, **Sam Carpenter**, Joel Cohen and Benjamin Webb, Taylor's Law for an Exponential Metapopulation Model with Internal Migration, submitted to *Theoretical Population Biology*, 2022.

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4. **Erik Hannesson**, **Jordan Sellers**, **Ethan Walker**, and Benjamin Webb, Network Specialization: A Topological Mechanism for the Emergence of Cluster Synchronization, *Physica A*, Vol. 600, 2022.
5. **Camille Carter**, **Jacob Murri**, **David Reber**, and Benjamin Webb, A Simple Stability Criteria for Dynamical Systems with Stochastic Switching and/or Stochastic Time-Delays, *Nonlinearity*,Vol. 35, Num. 12 2022.
6. Emily Evans, **Rebecca Jones**, **Joseph Leung**, and Benjamin Webb, Using Social Networks to Improve Group Transition Prediction in Professional Sports, https://doi.org/10.1371/journal.pone.0268619 *PLOS ONE*, 2022.
7. **Darren Lund**, **Joseph Drapeau**, and Benjamin Webb, Fourier decompositions of graphs with symmetries and equitable partitions, *Journal of Linear Algebra and its Applications*, Vol. **627**, 2021.
8. John Sinkovic, Mark Kempton, **Dallas Smith**, and Benjamin Webb, Characterizing Cospectral Vertices via Isospectral Reductions, *Journal of Linear Algebra and its Applications*, Vol. **594**, 2020.
9. Leonid Bunimovich, **DJ Passey**, **Dallas Smith**, and Benjamin Webb, Spectral and Dynamic Consequences of Network Specialization, International Journal of Bifurcation and Chaos, 2020.
10. **Stewart McGinnis** and Benjamin Webb, Multiparticle dynamics on the triangular lattice in interacting media, *Journal of Physics A: Mathematical and Theoretical*, 2020.
11. **D. Reber** and B. Z. Webb, Intrinsic Stability: Stability of Dynamical Networks and Switched Systems with any Type of Time-Delays, *Nonlinearity*, **33**, 2020.
12. A. Francis, **D. C. Smith**, and B. Z. Webb, General Equitable Decompositions for Graphs with Symmetries, *Journal of Linear Algebra and its Applications*, Vol. **577**, 287-316, 2019.
13. **D. C. Smith** and B. Z. Webb, Hidden Symmetries in Real and Theoretical Networks, *Physica A*, Vol. **514**, 2019.
14. L. A. Bunimovich, **D. C. Smith**, and B. Z. Webb, Finding Hidden Structures, Hierarchies, and Cores in Networks via Isospectral Reduction, 4(1), 231–254, 2019.
15. L. A. Bunimovich, **D. C Smith**, and B. Z. Webb, Specialization Models of Network Growth, *Journal of Complex Networks*, cny024, https://doi.org/10.1093/comnet/cny024, 2018.
16. L. A. Bunimovich, **C.-J. Wang**, **S. Chae**, and B. Z. Webb, Uncovering Hierarchical Structure in Social Networks Using Isospectral Reductions, 2018 IEEE/ACM International Conference on Advances in Social Networks Analysis and Mining (ASONAM), 1199-1206, 2018.
17. **B. Pachev** and B. Z. Webb, Fast link prediction for large networks using spectral embedding, *Journal of Complex Networks*, Vol. **6**, Iss. 1, 79–94, https://doi.org/10.1093/comnet/cnx021, 2018.
18. A. Francis, **D. C. Smith**, **D. Sorenson**, and B. Z. Webb, Extensions and Applications of Equitable Decompositions on Graphs with Symmetries, *Linear Algebra and its Applications* Vol. **532**, 432-462, 2017.

19. L. A. Bunimovich, B. Z. Webb, Intrinsic Stability, Time Delays and Transformations of Dynamical Networks. In: Aranson I., Pikovsky A., Rulkov N., Tsimring L. (eds) Advances in Dynamics, Patterns, Cognition. Nonlinear Systems and Complexity, Vol. **20**. Springer, Cham, 2017.
20. W. Barrett, A. Francis, and B. Z. Webb, Equitable Decompositions of Graphs with Symmetries, *Linear Algebra and its Applications*, Vol. **513**, 409-434, 2017.
21. E. G. D. Cohen, S. Mishra, **S. Bhattacharya**, and B. Z. Webb, Subdiffusion, anomalous diffusion and propagation of a particle moving in random and periodic media, *J. Stat. Phys.*, Vol. **162**, Iss. 4, 855–868, 2016.
22. E. G. D. Cohen and B. Z. Webb, Self-limiting trajectories of a particle moving deterministically in a random medium, (with E. Cohen) *J. Phys. A: Math. and Theor.*, Vol. **48**, Num. 48, 2015.
23. F. Guevara Vasquez and B. Z. Webb, Pseudospectra of Isospectrally Reduced Matrices, *Numer. Linear Algebra with Appl.*, Vol. **22**, Iss. 1, 145-174, 2015.
24. E. G. D. Cohen and B. Z. Webb, Self-Avoiding Modes of Motion in a Deterministic Lorentz Lattice Gas, (with E. Cohen) *J. Phys. A: Math. and Theor.*, Vol. **47**, Num. 31, 2014.
25. L. A. Bunimovich and B. Z. Webb, Improved Estimates of Survival Probabilities via Isospectral Transformations. In: W. Bahsoun, C. Bose, and G. Froyland (eds) Ergodic Theory, Open Dynamics, and Coherent Structures, Springer New York, 2014.
26. L. A. Bunimovich and B. Z. Webb, Restrictions and Stability of Time-Delayed Dynamical Networks, *Nonlinearity*, Vol. **26**, Num. 8, 2131-2156, 2013.
27. L. A. Bunimovich and B. Z. Webb, Isospectral Compression and Other Useful Isospectral Transformations of Dynamical Networks (with L. Bunimovich) *Chaos* Vol. **22**, Iss. 3 1429-1457, 2012
28. L. A. Bunimovich and B. Z. Webb, Isospectral Graph Reductions and Improved Estimates of Matrices' Spectra, *Linear Algebra and its Applications*, Vol. **437**, Iss. 7, 1429-1457, 2012.
29. L. A. Bunimovich and B. Z. Webb, Structural Transformations and Stability of Dynamical Networks, In: Chaos, CNN, Memristors and Beyond, Adamatzky A. and Chen R. (eds), *World Scientific*, 2012.
30. L. A. Bunimovich and B. Z. Webb, Isospectral Graph Transformations, Spectral Equivalence, and Global Stability of Dynamical Networks, *Nonlinearity* Vol. **25**, Num. 1, 211-254, 2012.
31. G. Conner, C. Grant, and B. Z. Webb, Resistance and Conductance in Structured Zermelo Tournaments. *Advances in Applied Mathematics* Vol. **44**, 37-52, 2010.
32. Dynamics of Functions with an Eventual Negative Schwarzian Derivative. *Discrete and Continuous Dynamical System Ser. A*, Vol. **24**, 1393-1408, 2009.

Book(s) and Other Publications

33. L. A. Bunimovich and B. Z. Webb, Isospectral Transformations: A New Approach to Analyzing Multidimensional Systems and Networks, Springer Monographs in Mathematics, 2014.

Scientific/Academic Honors and Grants:

2022 *Mentoring Award*, College of Physical and Mathematical Sciences, Brigham Young University.

2022 NSF Grant in Applied Mathematics.

2021 *Distinguished Research Award*, Department of Mathematics, Brigham Young University.

2020 Simons Foundation Grant.

2017 NSF Grant: Beyond Uniform Hyperbolicity Conference Provo, UT.

2016 *Distinguished Mentoring Award*, Department of Mathematics, Brigham Young University.

2016 *Self-limiting trajectories of a particle moving deterministically in a random medium* (co-written by E. Cohen) was selected for inclusion in the *Journal of Physics A Highlights of 2015*.

2017 NSF Grant: Rocky Mountain Dynamical Systems Conference Provo, UT.

2015 Recipient of a *Mentoring Environment Grant* (MEG) from Brigham Young University.

2011 Recipient of the *2011 Top Graduate Student Award*, School of Mathematics, Georgia Institute of Technology.

2010 Recipient of the *Festa Fellowship*, School of Mathematics, Georgia Institute of Technology.

2009 Recipient of the *Bob Price Research Award*, School of Mathematics, Georgia Institute of Technology.

Selected Conference and Seminar Talks:

November 2022 The 12th International Conference on Complex Networks and their Applications, Palermo, Italy

October 2022 AMS Fall Western Sectional Meeting at the University of Utah

July 2021 SIAM Conference on Linear Algebra 2021, Online

May 2021 SIAM Conference on Discrete Mathematics 2021, Online

October 2020 Fifth Symposium on Spatial Networks, University of Bristol, England.

May 2019 NetSci19, University of Vermont, Burlington, VT.

May 2019 SIAM Conference on Applications of Dynamical Systems 2019, Snowbird, UT.

April 2019 MAA 2019 Intermountain Section Spring Meeting at SUU.

April 2019 Dynamical Systems Seminar, School of Mathematics, Georgia Institute of Technology.

Aug. 2018 IEEE/ACM International Conference on Advances in Social Networks Analysis and Mining, Barcelona Spain, 2018

Mar. 2018 MAA 2018 Intermountain Section Annual Conference at Utah State University, UT.

Jan. 2018 Joint Mathematical Meetings, Matrices and Matroids, San Diego, CA.

Nov. 2017 Colloquium Series Talk, University of Tennessee at Chattanooga Chattanooga, TN.

Oct. 2017 SIAM central states section meeting, Colorado State University, CO.

Aug. 2017 Second USA-Uzbekistan Conference on Analysis and Mathematical Physics, Dynamical Systems Section, Urgench, Uzbekistan

Jan. 2017	Joint Mathematical Meetings, Dynamical Systems and Ergodic Theory, Atlanta, GA.
Aug. 2016	Dynamical Systems Seminar, School of Mathematics, South China University of Technology.
July 2016	International Conference on Statistical Properties of Nonequilibrium Dynamical Systems, Southern University of Science and Technology, Shenzhen, China.
April 2016	AMS Western Sectional Meeting, Ergodic Theory and Dynamical Systems, Salt Lake City, Utah.
April 2016	Ergodic Theory Seminar, Department of Mathematics, Ohio State University.
April 2016	Topology, Geometry, and Data Analysis (TGDA) Seminar, Ohio State University.
Dec. 2015	114th Statistical Mechanics Conference, Rutgers, New Jersey.
Oct. 2015	Math Physics Seminar, School of Mathematics, Georgia Institute of Technology.
May 2015	The Dynamical Systems, Ergodic Theory, and Probability Conference Dedicated to Nikolai Chernov, University of Alabama at Birmingham.
May 2015	Applied Analysis and Computation Seminar, Department of Mathematics & Statistics, University of Massachusetts Amherst.
Feb. 2015	Dynamical Systems Seminar, Department of Mathematics, University of Houston.
Nov. 2014	Applied Math Seminar, Department of Mathematics, University of Utah.
Nov. 2014	Condensed Matter Physics Seminar, Department of Physics and Astronomy, BYU.
Jun. 2014	Dynamical Systems Seminar, Courant Institute, New York University.
May 2014	111th Statistical Mechanics Conference, Rutgers, New Jersey.
Mar. 2014	Dynamical Systems Seminar, Courant Institute, New York University.
Dec. 2013	110th Statistical Mechanics Conference, Rutgers, New Jersey.
Oct. 2012	Mathematics Colloquium, Department of Mathematics, Drexel University
Apr. 2012	2012 Workshop in Dynamical Systems and Related Topics, University of Maryland.
Feb. 2012	Applied Math Seminar, Department of Mathematics, University of Utah.
Feb. 2012	Math Biology Seminar, University of Nebraska Lincoln.
Aug. 2011	Mini Workshop - Trends on Power Scaling in High Powered Lasers, Oak Ridge National Laboratory.
Mar. 2011	Math Department Colloquium, Brigham Young University.
Oct. 2010	Center for Computational Mathematics and Applications Seminar, Department of Mathematics, Penn. State University.
Nov. 2010	Math Department Colloquium, Augusta State University.
Apr. 2010	2010 Workshop in Dynamical Systems and Related Topics, University of Maryland.
Mar. 2010	Southeast SIAM Student Conference, Georgia Institute of Technology.

Professional Activity

Editor for the journals *PLOS ONE* and *Frontiers in Network Physiology*.

Referee for the journals *Nonlinearity*, *Chaos*, *Linear Algebra and its Applications*, *Mathematical Biosciences*, *Discrete and Continuous Dynamical Systems*, *Algorithms*, *J. Phys. A: Math. Theor.*, *Applied Mathematical Modeling*, and *Conference Proceedings with Springer*, *Journal of Science Advances*, Communications in Contemporary Mathematics, *Journal of Statistical Physics*.

Fall 2018- Discrete Mathematics seminar co-organizer, Department of Mathematics, Brigham Young University

Fall 2014- Dynamical Systems seminar co-organizer, Department of Mathematics, Brigham Young University

Fall 2022 Co-organizer for the Special Session on Graphs and Matrices at the Fall Western AMS meeting, (in-person).

Fall 2020 Co-organizer for the Special Session on Graphs and Matrices at the Fall Western AMS meeting, (online).

Summer 2017 Co-organizer for the Second USA-Uzbekistan Conference on Analysis and Mathematical Physics, Urgench, Uzbekistan.

Summer 2017 Co-organizer for the Society for Mathematical Biology (SMB) 2017 Annual Meeting, University of Utah, Utah.

Spring 2017 Co-organizer for the Dynamics Beyond Hyperbolicity 2017 International Conference, Provo, Utah.

Spring 2015 Co-organizer for the Rocky Mountain Dynamical Systems Conference, Provo, Utah.

Fall 2011-2012 Dynamical Systems seminar co-organizer, Department of Mathematics, Brigham Young University

Fall 2010-Fall 2011 President of the SIAM student chapter and organizer of the SIAM student seminar for the School of Mathematics, Georgia Institute of Technology

Summer 2010 Co-adviser as part of the NSF Research Experience for Undergraduates (REU)

Spring 2009 Co-organizer for the Southeast SIAM Student Conference at the School of Mathematics, Georgia Institute of Technology

Fall 2009-Fall 2010 Vice-President of the SIAM student chapter for the School of Mathematics, Georgia Institute of Technology

Fall 2008-Spring 2010 Organizer of the Graduate Instructor seminar for the School of Mathematics, Georgia Institute of Technology

Courses Taught

Courses: Network Theory, Algorithm Design and Optimization I and II, Theory of Differential Equations, Dynamical Systems, Matrix Analysis, Complex Analysis, Intro. to Dynamical Systems, Differential Equations, Linear Algebra, Multivariable Calculus, Survey of Calculus, Calculus I-II, Finite Mathematics, College Algebra, Introduction to Calculus, Fundamentals of Mathematics.