

**Zachary M. Boyd**  
Assistant Professor  
Department of Mathematics  
Brigham Young University  
2021 to present

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## Education

- **University of North Carolina at Chapel Hill** 2018–2021  
*Postdoctoral Research Associate*  
Advisor: Peter J. Mucha
- **University of California, Los Angeles** 2014–2018  
*Ph.D. Mathematics*  
NDSEG Fellow  
Advisor: Andrea L. Bertozzi
- **Brigham Young University** 2008–2014  
*M.S. Mathematics, B.S. Mathematics*  
Monson Presidential Scholar  
Advisor: Michael Dorff

## Publications

### • Journal Articles

15. Zachary M. Boyd, Nicolas Fraiman, Jeremy L. Marzuola, Peter J. Mucha, and Braxton Osting, *An escape time formulation for subgraph detection and partitioning of directed graphs*. Under review.
14. Zachary M. Boyd, et al. *The persistent homology of genealogical networks*, in review.
13. A. L. McGowan, et al., *Dense sampling approaches for psychiatry research: Combining scanners and smartphones*, Biological Psychiatry.
12. D. Cosme et al. *Study protocol: Social health impact of network effects (SHINE) study*, under review.
11. M. Jovanova, et al., *Psychological distance intervention reminders reduce alcohol consumption frequency in daily life*, under review.
10. McGowan, A.L., Boyd, Z.M., Kang, Y., Bennett, L., Mucha, P.J., Ochsner, K.N., Bassett, D.S., Falk, E.B., & Lydon-Staley, D.M. (in review). Within-person temporal associations among self-reported physical activity, sleep, and wellbeing in college students. Preprint: [10.31234/osf.io/q4jn3](https://doi.org/10.31234/osf.io/q4jn3).
9. Zachary M. Boyd\*, Kayvan Miri Lavassani\*, Zachary M. Boyd, and Bahar Movahedi, *Ten-tier and multi-scale supply chain network analysis of medical equipment: Random failure and intelligent attack analysis*, Int. J. Prod. Res., 2022.
8. Zachary M. Boyd, Nicolas Fraiman, Jeremy L. Marzuola, Peter J. Mucha, Braxton Osting, and Jonathan Weare, *A metric on directed graphs based on hitting probabilities*, SIAM J. Math. Data Sci., 3(2), pp. 467–493.

7. Zachary M. Boyd, Emma M. Schmidt, Scott D. Ramsey, and Roy S. Baty, *Converging shocks and collapsing cavities in non-ideal materials*, Qu. J. Mech. Appl. Math., 74 (2019), pp. 501–520.
6. Zachary M. Boyd, Mason A. Porter, and Andrea L. Bertozzi, *Stochastic block models are a discrete surface tension*, J. Nonlinear Sci., 2019.
5. Zachary M. Boyd, Egil Bae, Xue-Cheng Tai, and Andrea L. Bertozzi, *Simplified energy landscape for modularity using total variation*, SIAM J. Appl. Math., 78 (2018), pp. 2439–2464.
4. Scott D. Ramsey, Emma M. Schmidt, Zachary M. Boyd, Jennifer F. Lillieholm, and Roy S. Baty, *Converging shock flows for a Mie-Grüneisen equation of state*, Phys. Fluids, 30 (2018), 046101. (Editor’s choice article.)
3. Zachary M. Boyd, Scott D. Ramsey, and Roy S. Baty, *On the existence of self-similar converging shocks for arbitrary equation of state*, Qu. J. Mech. Appl. Math., 70 (2017), pp. 401–417.
2. Scott D. Ramsey, Zachary M. Boyd, and Sarah Burnett, *Solution of the Noh Problem using the universal symmetry of the gas dynamics equations*, Shock Waves, 27 (2017), pp. 477–485.
1. Zachary M. Boyd, Michael Dorff, Maria Nowak, Matthew Romney, and Magdalena Woloszkiwicz, *Univalence of convolutions of harmonic mappings*, Appl. Math. Comp., 234C (2014), pp. 326–332.

- **Conference Paper**

1. Jacob D. Moorman, Qinyi Chen, Thomas K. Tu, Zachary M. Boyd, and Andrea L. Bertozzi, *Filtering Methods for Subgraph Matching on Multiplex Networks*, Proc. GTA3 workshop, IEEE Conference on BIG DATA, Seattle, 2018, pp. 3979–3984.

- **Book Chapter—Original Research**

1. Zachary M. Boyd, Michael Dorff, Rachel Messick, Matthew Romney, and Ryan Viertel, *Harmonic univalent mappings with singular inner function dilatation*, in 60 years of analytic functions in Lublin—In memory of our professors and friends Jan G. Krzyz, Zdislaw Lewandowski and Wojciech Szapiel, Jan Szynal, ed., Monogr. Univ. Econ. Innov. Lublin, Innovatio Press Scientific Publishing House, Lublin, 2013, pp. 191–200.

- **Book Chapter—Survey**

1. Zachary M. Boyd and Michael Dorff, *Harmonic univalent mappings and minimal graphs*, in Current topics in pure and computational complex analysis, S. Joshi, M. Dorff, and I. Lahiri, eds., Springer, 2014, pp. 21–46.

- **Technical Reports**

2. Zachary M. Boyd and Joanne Wendelberger, *An integrated approach to parameter learning in infinite dimensional space*, Los Alamos technical report LA-UR-17-28326, 2017.
1. Zachary M. Boyd, Scott D. Ramsey, and Roy S. Baty, *Symmetries of the Euler compressible flow equations for general equation of state*, Los Alamos technical report LA-UR-15-28034, 2015.

- **Theses and Dissertations**

2. Zachary M. Boyd. Community detection using total variation and surface tension. PhD dissertation. University of California, Los Angeles, 2018.

1. Zachary M. Boyd. Convolutions and convex combinations of harmonic mappings of the disk. Master's thesis. Brigham Young University, Provo, 2014.

- **Unpublished Manuscript**

1. Zachary M. Boyd and Andrea Bertozzi, PageRank Modularity MBO, 2015.

## Grants

- DoD MURI: Multiscale Integration of Neural, Social, and Network Theory to Understand and Predict Transitions from Illness to Wellness, PIs Falk, Bassett, Ochsner, Mucha, Lydon-Staley, Boyd, 2021-2023.
- BYU CHIRP: Optimal document collection strategies for large-scale genealogical tree discovery, PI Webb, co-PI Boyd, 2021.
- NSF LEAPS-MPS: Structure and Dynamics of Global Supply Chain Networks, PI Boyd, 2022-2023.
- UNC CARES: Global Supply Chain of Medical Equipment: Vulnerability Assessment, Emergency Response Tool, and Financial Impact Analysis, PI Lavassani, partner Boyd, 2020.

## Presentations

- **Conferences and workshops**

23. (Invited) Missing and uncertain network data, Networks and Quantum Information (WINQ) workshop on Complex Dynamical Networks, Stockholm, 2022.
22. A metric on directed graph nodes based on hitting probabilities, SIAM Annual Meeting, 2021.
21. A metric on directed graph nodes based on hitting probabilities, SIAM Conference on Discrete Math, 2021.
20. A metric on directed graph nodes based on hitting probabilities, SIAM Conference on Applied and Computational Discrete Algorithms, 2021.
19. Resiliency of Global Medical Equipment Supply Chains, French Regional Conference on Complex Systems, 2021.
18. A metric on directed graph nodes based on hitting probabilities, French Regional Conference on Complex Systems, 2021.
17. Resiliency of Global Medical Equipment Supply Chains, Networks, 2021.
16. (Invited) Resiliency of Global Medical Equipment Supply Chains, SysPlatform, 2021.
15. Resiliency of Global Medical Equipment Supply Chains, Northeast regional conference on complex systems, 2021. (poster)
14. (Invited) A metric on directed graph nodes based on hitting probabilities, AMS Southwest Sectional Meeting, 2021.
13. A metric on directed graph nodes based on hitting probabilities, Complex Networks 2020.
12. (Invited) Community detection using total variation and surface tension, Theory and Algorithms of Graph-based Learning, IMA, 2020.
11. A metric on directed graph nodes based on hitting probabilities, NetSci 2020.

10. SBM is discrete surface tension, CompleNet, 2018. (poster)
9. SBM is discrete surface tension, BiFi, 2018.
8. Formulations of community detection in terms of total variation and surface tension, Flows, mappings, and shapes, Isaac Newton Institute, 2017.
7. (Invited) Modularity as a balanced cut or total variation problem, ISODS, NetSci, Indianapolis, 2017.
6. Existence of solutions to the Guderley implosion problem in arbitrary media, APS Division of Fluid Dynamics, Portland, 2016.
5. Self-similarity in an arbitrary flow medium, APS Division of Fluid Dynamics, Boston, 2015.
4. Convolutions of harmonic maps, BYU Spring Research Conference, 2013.
3. Harmonic mappings with singular inner function dilatation, International Workshop on Complex Analysis and its Applications. Walchand College of Engineering, 2012.
2. Harmonic mappings with singular inner function dilatation, AMS Western Sectional Meeting, 2012.
1. Harmonic mappings with singular inner function dilatation, Brigham Young University, Spring Research Conference, 2012.

• **Seminars, colloquia, and other talks**

17. The math of mental health, SIAM-ESA Machine Learning Event, BYU, 2022.
16. The math of mental health, BYU Hawaii Mathematics Seminar, 2022.
15. Stability of the global supply chain, COVID information commons seminar, 2022.
14. Structure of complex networks, BYU theoretical Physics seminar, 2022.
13. Graph structures, control theory, and game theory, BYU IDEA Lab seminar, 2021.
12. Open problems in networks and data science, BYU graduate student open house, 2021.
11. Metrics and learning on directed graphs, and some open problems relating to robustness, University of Utah Applied Mathematics Seminar, 2021.
10. A metric on directed graph nodes based on hitting probabilities, Seminar in Network Analysis at Carolina, 2020.
9. The Structure of Complex Networks, Mathematics department colloquium, Brigham Young University, 2019.
8. Stochastic block models are a discrete surface tension, Applied math collective, University of Utah, 2018.
7. Community detection using total variation and surface tension, Mucha group meeting, University of North Carolina at Chapel Hill, 2018.
6. Formulations of community detection in terms of total variation and surface tension, AI seminar, USC Information Science Institute, 2018.
5. Surface tension dynamics on networks, Brigham Young University dynamical systems seminar, 2017.
4. Community detection by variational methods, National Geospatial Intelligence Agency anticipatory analytics seminar, 2017.
3. Stochastic block model maximum likelihood estimation as a balanced cut or total variation minimization problem, UCLA network science seminar, 2017.
2. Modularity optimization as a balanced cut or total variation minimization problem, UCLA numerical methods seminar, 2017.

1. PageRank Modularity MBO, Hughes Research Labs seminar, 2016.

- **Media Spotlights**

1. *Numbers and networks: How can we use mathematics to assess the resilience of global supply chains?*, Futurum: Inspiring the Next Generation, Issue 15, July 2022.

## Other Scholarly Activities

- US promotion chair, Complex Networks Conference, 2022-3
- Faculty affiliate, BYU Record Linking Lab, 2021.
- BYU Committees
  - Graduate Committee
  - Applied math undergraduate advising
  - Applied math committee
  - Undergraduate Advising
  - Online College Algebra
- Session chair for
  - Complex Networks 2021, 2022
  - Networks 2021
- Participant, “Data Science in the Social and Behavioral Sciences,” Statistical and Applied Mathematical Sciences Institute (SAMSI), 2021
- Program committee member, 8th Annual SIAM Workshop on Network Science (NS20), Toronto, 2020
- Organizer for
  - “Recent global challenges in economic and financial networks” satellite at Conference on Complex Systems, 2022
  - “Networks and dense matrices: applications and theory” minisymposium at SIAM Conference on the Mathematics of Data Science (MDS20), 2020 (canceled due to COVID)
- Consulting
  - Robinson Bradshaw, 2019
  - Upright Spine, 2022
  - Chris Hair
- Graduate mentor, UCLA Applied Mathematics Research Experience for Undergraduates
- Volunteer, Engineering Department, FamilySearch research, 2017–2020
- Referee at
  - Proc. Nat. Acad. Sci.

- SIAM J. Data Sci.
- SIAM J. Appl. Math.
- SIAM J. Matrix Anal.
- EPJ Data Science
- Network Neuroscience
- Applied Network Sci.
- J. Math. Imag. Vis.
- Discrete Cont. Dyn. Sys. Ser. B
- PLOS One
- Qu. J. Mech. Appl. Math.
- Imaging, Vision and Learning Based on Optimization and PDEs (workshop)
- Lecturer, Open Source Macroeconomics Laboratory at the University of Chicago, Summer 2017
- Graduate Research Assistant, Los Alamos National Laboratory, Summers 2015-2017
- Organizer, PDE and machine learning seminar, UCLA, Fall 2015
- Contributor, Foundations of Applied Mathematics, vol. 1, by J. Humphreys, T. J. Jarvis, and Emily Evans, 2017, Springer, Summer 2014
- Contributor, Labs for Foundations of Applied Mathematics. J. Humphreys, & T. J. Jarvis, eds. Available at <https://github.com/Foundations-of-Applied-Mathematics/Labs>

## Teaching

- **Instructor**
  - Math 404, Modeling with Uncertainty and Data II, Winter 2023
  - Math 402, Modeling with Uncertainty and Data I, Fall 2022
  - Math 313, Linear Algebra, Winter 2022, Fall 2022
  - Math 320, Algorithm design and optimization, Fall 2021
  - Math 564, Mathematical modeling in the life sciences, Winter 2020
  - Math 564, Mathematical modeling in the life sciences, Winter 2019
  - Math 102, Quantitative reasoning, Spring 2013
- **Teaching assistant**
  - Math 134, Systems of differential equations, Spring 2015
  - Math 135, Ordinary differential equations, Winter 2015
  - Math 33A, Linear algebra and applications, Fall 2014
  - Math 112, Calculus II, Fall 2014
  - Math 541, Linear analysis, Winter 2014
  - Math 371, Group theory, Spring, 2013
  - Math 330, Elementary linear algebra, Fall 2013
  - Math 221, Careers in math, Winter 2014
  - Math 343, Elementary linear algebra, Winter 2013
- **Curriculum development**
  - Brigham Young University, online calculus curriculum development assistant, Fall 2013

## **Student mentoring**

- Graduate students: 11
- Undergraduate students: 32
- REU students: 9
- Department distinguished mentor award, 2022

## **Citizenship**

United States