Katherine Morrison

Academic Positions:

University of Northern Colorado
Department of Mathematical Sciences
Associate Chair – July 2022 to Present
Full Professor – August 2023 to Present
Associate Professor – August 2017 to July 2023
Assistant Professor – August 2012 to July 2018

Pennsylvania State University
Department of Mathematics
Research Associate (Mathematical Neuroscience) -- July 2015 to December 2015

Education:

University of Nebraska-Lincoln, Lincoln, NE
2012 PhD, 2008 MS
Mathematics with Electrical Engineering minor (Algebraic Coding Theory)
Advisor: Dr. Judy Walker

Swarthmore College, Swarthmore, PA
2005 BA
Mathematics and Psychology

Publications:

Publications:

K. Morrison, A. Degeratu, V. Itskov, C. Curto. Diversity of emergent dynamics in competitive threshold-linear networks. *SIAM Journal of Applied Dynamical Systems*, 23(1), 2024.

C. Curto, J. Geneson, K. Morrison. Stable fixed points of combinatorial threshold-linear networks. *Advances in Applied Mathematics*, 154, 2023.

C. Curto and K. Morrison. Graph rules for recurrent network dynamics. *Notices of the American Mathematical Society*, 70(4), 2023.

C. Parmelee, J. Londono Alvarez, C. Curto*, K. Morrison*. Sequence generation in inhibition-dominated neural networks. *The Dynamical Systems Web Magazine*, October, 2022. (* equal last authors)

C. Parmelee, J. Londono Alvarez, C. Curto*, K. Morrison*. Sequential attractors in combinatorial threshold-linear networks. *SIAM Journal of Applied Dynamical Systems*, 21(2), 2022. (* equal last authors)

D. Egas Santander, S. Ebli, A. Patania, N. Sanderson, F. Burtscher, K. Morrison*, C. Curto*. Nerve theorems for fixed points of neural networks. In *Research in Computational Topology 2*, Assoc. Women Math. Ser. 30, E. Gasparovic, V. Robins, and K. Turner, eds., Springer, Cham, 2022. (* equal last authors)

C. Parmelee, S. Moore, K. Morrison*, C. Curto*. Core motifs predict dynamic attractors in combinatorial threshold-linear networks. *PLOS ONE*, 17(3): e0264456, 2022. (* equal last authors)

C. Curto and K. Morrison. Relating network connectivity to dynamics: opportunities and challenges for theoretical neuroscience. *Current Opinion in Neurobiology*, Vol 58, 11-20, 2019.

C. Curto, E. Gross, J. Jeffries, K. Morrison*, Z. Rosen, A. Shiu, N. Youngs. Algebraic signatures of convex and non-convex codes. *J. of Pure and Appl. Algebra*, Vol. 223, No. 9, 3919-3940, 2019. (* corresponding author)

C. Curto, J. Geneson, K. Morrison. Fixed points of competitive threshold-linear networks. *Neural Computation*, Vol 33, No. 1, 94-155, 2019.

K. Morrison and C. Curto. Predicting neural network dynamics via graphical analysis. Book chapter in *Algebraic and Combinatorial Computational Biology*. R. Robeva, M. Macaulay (Eds) 2018.

A.M. Burzynski, S.W. Anderson, K. Morrison, M.R. Patrick, T. Orr, W. Thelen, Lava lake thermal pattern classification using self-organizing maps and relationships to eruption processes at Kīlauea Volcano, Hawai'i. Chapter in *Field Volcanology: A Tribute to the Distinguished Career of Don Swanson*. M.P. Poland, M. O. Garcia, V. E. Camp, A. Grunder (Eds) 2018.

C. Curto, E. Gross, J. Jeffries, K. Morrison, M. Omar, Z. Rosen, A. Shiu, N. Youngs. What makes a neural code convex? *SIAM J. Appl. Algebra Geometry*, Vol 1, 222-238, 2017.

C. Curto and K. Morrison. Pattern completion in threshold-linear networks. *Neural Computation*. Vol 28, 2825-2852, 2016.

G. Karakok, K. Morrison, C. Craviotto. Lessons Learned from a Math Teachers' Circle. In *Association for Women in Mathematics Series*: *Mathematics Education,* Vol. 7, J. Dewar, P. Hsu, H. Pollatsek (Eds), 2016.

K. Morrison. Enumeration of Equivalence Classes of Self-Dual Matrix Codes. *Advances in Mathematics of Communication.* Vol 9, No. 4, 415-436, 2015.

H. Gluesing-Luerssen, K. Morrison, C. Troha. Cyclic Orbit Codes and Stabilizer Subfields. *Advances in Mathematics of Communication.* Vol 9, No. 2, 177-197, 2015.

H. Gluesing-Luerssen, K. Morrison, C. Troha. On the Cardinality and Distance of Cyclic Orbit Codes based on Stabilizer Subfields. *Proceedings of the 21st International Symposium on Mathematical Theory of Networks and Systems,* 2014.

K. Morrison. Equivalence for rank-metric and matrix codes and automorphism groups of Gabidulin codes. *IEEE Transactions on Information Theory.* Vol 60, Issue 11, pp. 1-12, 2014.

C. Curto, V. Itskov, K. Morrison, Z. Roth, J. L. Walker. Combinatorial neural codes from a mathematical coding theory perspective. *Neural Computation.* Vol 25, pp. 1891-1925, 2013.

N. Axvig, K. Morrison, E. Psota, D. Turk, L. C. Pérez, J. L. Walker. Analysis of connections between pseudocodewords. *IEEE Transactions on Information Theory.* Vol 55, Issue 9, pp. 4099-4107, 2009.

N. Axvig, K. Morrison, E. Psota, D. Turk, L. C. Pérez, J. L. Walker. Towards universal cover decoding. *Proceedings of International Symposium on Information Theory and Its Applications.* December 2008.

N. Axvig, K. Morrison, E. Psota, D. Turk, L. C. Pérez, J. L. Walker. Average min-sum decoding of LDPC codes. *Proceedings of International Symposium on Turbo Codes and Related Topics.* September 2008.

Funded Projects:

Improving Productive Mathematical Dispositions of Pre-Service Elementary Teachers
NSF IUSE Program, DUE 2235588 ($299,947): 2023 – 2026. Senior personnel.

Math + Neuroscience: Strengthening the interplay between theory and mathematics
Semester-long program at **The Institute for Computational and Experimental Research in Mathematics** (ICERM) in Fall 2023. Lead co-organizer.

Collaborative Research: Emergent sequences from recurrent network motifs
NSF Mathematical Biology Program, DMS-1951599 ($319,340 total – $163,211 for UNC): 2020 – 2023. Lead PI; collaborative research grant with co-PI C. Curto (Penn State)

Emergent Dynamics from Network Connectivity: A Minimal Model
NIH BRAIN Initiative, R01 EB022862 ($1.1 million total – $203,879 UNC subaward): 2016 – 2019. Sole co-PI with PI C. Curto.

Honors and Awards:

Nominated by College of Natural and Health Sciences for the UNC Office of Research and Sponsored Programs (ORSP) **Outstanding Achievement in Research Award**: 2024.

College-wide Excellence in Scholarship Award: 2017.

First Year Scholars Outstanding Faculty & Staff Award: 2013.

Outstanding Graduate Teaching Award: 2009-2010.

Professional Presentations:

Invited/Juried (since 2017)

- International Conference on Mathematical Neuroscience in Dublin, Ireland 2024
- Mathematics Department Colloquium at Creighton University 2024.
- Applied Algebraic Topology Research Network online seminar 2024.
- Dynamics Seminar at Boston University 2023.
- Open Problems Seminar at ICERM in Providence, RI 2023.
- Computational and Systems Neuroscience (COSYNE) conference in Montreal, Canada 2023.
- 13th Americas Conference on Diff. Equations and Nonlinear Analysis in São Carlos, Brazil 2023.

- Mathematical Modeling Seminar at Rochester Institute of Technology 2021.
- Brain Networks & Behavior Lab at Indiana University 2020.
- Plenary at Southeast Center for Mathematics and Biology annual symposium in Atlanta, GA 2020.
- Keynote at Pikes Peak Regional Undergraduate Mathematics Conference in Pueblo, CO 2020.
- International Conference on Mathematical Neuroscience in Copenhagen, Denmark in June 2019.
- SIAM Applied Algebra and Geometry Conference in Bern, Switzerland 2019.
- SIAM Dynamical Sys. Conference in Snowbird, UT 2019.
- AMS Southeastern Sectional Meeting in Auburn, AL 2019.
- Theoretical Biology seminar at Penn State University 2019.
- Joint Math Meetings in Baltimore, MD 2019.
- Clemson Mini-Conference on Discrete Mathematics and Algorithms 2018.
- BRAIN Initiative Investigators Meeting in Bethesda, MD 2018.
- Colloquium at James Madison University in 2018.
- Joint Math Meetings in in San Diego, CA in 2018.
- SIAM Conference on Applied Algebraic Geometry in Atlanta, GA 2017.
- Mathematical Congress of the Americas in Montreal, Canada 2017.
- SIAM national meeting in Pittsburgh, PA 2017.
- International Conference on Mathematical Neuroscience in Boulder, CO 2017.

Teaching:

2024 *Math 185: Number Sense and Algebra*
2024 *Math 422/622: Proofs in Algebra directed study*
2021 *Math 321: Abstract Algebra I*
2020 *Math 709: Abstract Algebra I*
2020, 2021 *Math 221: Linear Algebra*
2019 *Math 795 Graduate Topics Course: Applied Algebraic and Discrete Methods in Mathematical Biology*
2017, 2019, 2022, 2024 *Math 286: Elements of Discrete Mathematics*
2015, 2017, 2021, 2022, 2023, 2024 *Math 391: Introduction to Number Theory*
2016, 2017, 2019, 2020, 2021, 2022 *Course coordinator for Math 181 and Math 182 – the Math for Future Elementary Teachers sequence*
2013, 2014, 2016, 2017, 2020 *Math 181: Fundamentals of Mathematics I – Numbers and Operations*
2015, 2016 *Math 182: Fundamentals of Mathematics II – Algebra, Probability, and Data Analysis*

Students Advised/Co-advised on Research:
Juliana Londono Alvarez. Summer 2020 to Spring 2024.
Devon Olds. Fall 2020 to Spring 2022.
Kylie Schnoor. Fall 2021 to Spring 2022.
Christopher Langdon. Summer 2017 to Summer 2019.
Jessalyn Bolkema. Fall 2013 to Summer 2018.
Jesse Geneson. Summer 2017 to Summer 2018.
David Falk. Summer 2017 to Summer 2018.
Karen Haar, Maggie Carly, Quanqui Hu, and Shanglun Li. Summer 2017.
Samantha Moore. Spring 2016 to Spring 2017.
Carolyn Shaw. Spring 2016 to Fall 2016.
Amy Burzynski. Fall 2013 to Spring 2015.

National Service:

Lead co-organizer of *Math + Neuroscience: Strengthening the interplay between theory and mathematics:* 2021 - 2023
Co-organizer of semester-long program at the Institute for Computational and Experimental Research in Mathematics (ICERM) to run in Fall 2023

Served on an NSF grant review panel: 2020, 2022

Served as reviewer of abstracts for Computational and Systems Neuroscience (CoSyNe) annual conference: 2022

Associate Editor of *Journal of Math Circles*: 2019 - 2021

Member of the MAA Council on Outreach: 2015 - 2017

Past-Chair, Chair, Chair-Elect of the SIGMAA MCST: 2014 - 2016

Co-director of the Northern Colorado Math Circle: 2013 to Present

Community Service:

Co-organizer of Celebration of Mind: October 2019, 2021, 2022

Judge for project-based learning presentations at Northglenn HS: 2023

Mathematics Enrichment at the Rodarte Center: Spring 2022