

Katherine Morrison

Academic Positions: August 2012 to Present
Assistant Professor
University of Northern Colorado, School of Mathematical Sciences

July 2015 to December 2015
Research Associate
Pennsylvania State University, Department of Mathematics

August 2006 to August 2012
University of Nebraska-Lincoln
Graduate Teaching Assistant

Education: 2012 PhD, 2008 MS
University of Nebraska-Lincoln, Lincoln, NE
Mathematics with Electrical Engineering minor

2005 BA
Swarthmore College, Swarthmore, PA
Mathematics and Psychology

Research Areas/Interests: Neural coding and neural networks
Algebraic coding theory
Mathematical education of teachers

Publications: **Manuscripts in Progress:**
C. Curto, E. Gross, J. Jeffries, K. Morrison, Z. Rosen, A. Shiu, N. Youngs.
Algebraic signatures of convex and non-convex codes. In preparation.

K. Morrison, A. Degeratu, V. Itskov, C. Curto. *Diversity of emergent dynamics in competitive threshold-linear networks: a preliminary report*. Available at <https://arxiv.org/abs/1605.04463>

Peer-Reviewed Publications:
C. Curto, E. Gross, J. Jeffries, K. Morrison, M. Omar, Z. Rosen, A. Shiu, N. Youngs. What makes a neural code convex? Accepted by *SIAM Journal on Applied Algebra and Geometry*. Available at https://arXiv:1508.00150_v4

C. Curto, K. Morrison. Pattern completion in threshold-linear networks. *Neural Computation*. Vol 28, 2825-2852, 2016. Available at <https://arXiv:1512.00897>

G. Karakok, K. Morrison, C. Craviotto. Lessons Learned from a Math Teachers' Circle. *Association for Women in Mathematics Series: Mathematics Education*, Vol. 7, Jacqueline Dewar et al. (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*. July 7-11, 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. Dreher, 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. Dreher, 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. Dreher, 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:**

EXTERNAL FUNDING

NIH BRAIN Initiative Grant (\$1.1 million total -- \$204,000 UNC subaward): 2016 – 2020. Sole co-PI with PI Carina Curto. *Equal contribution to grant writing process

AWM Mentoring Travel Grant (\$3800): Summer 2016

COSYNE Travel Grant (\$800): 2016

Applied Algebra Days 2 Travel Grant (\$500): 2014

AWM Workshop Travel Grant (\$1100): 2012

INTERNAL FUNDING

Grant Writing Initiative Program (3-credit course release): Spring 2016

Summer Support Initiative (\$6000): Summer 2016

Summer Support Initiative (\$5000): Summer 2015

Research, Scholarship, and Creative Works (RSCW) (3-credit course release): Fall 2014

Summer Support Initiative (\$3000): Summer 2014

Honors and Awards:

First Year Scholars Outstanding Faculty & Staff Award: 2013

Outstanding Graduate Teaching Award: 2009-2010.

Professional Presentations:

Invited:

Emergent Dynamics from Network Connectivity: A Minimal Model

Poster at the 2016 BRAIN Initiative Investigators Meeting in Bethesda, MD.

Algebraic Signatures of Convex and Non-convex Neural Codes

20-minute talk at the Coding Theory special session of the 2016 AMS Fall Central Sectional Meeting in Minneapolis, MN.

Predicting Neural Network Dynamics from Graph Structure

1-hour presentation as well as 3 hours of hands-on materials for use in undergraduate curriculum given at the NIMBioS Algebraic Mathematical Biology workshop in Knoxville, TN.

Algebraic Methods for Determining Convexity of Neural Codes

20-minute talk at the 2016 *Spring Research Conference* in Chicago, IL.

Properties of Neural Codes Via the Neural Ring

20-minute talk at the 2015 *Joint Math Meetings* in San Antonio, TX.

Northern Colorado Math Teachers' Circle's Implementation of the Common Core State Standards

20-minute joint talk (with Gulden Karakok) at the 2015 *Joint Math Meetings* in San Antonio, TX.

Enumerating Equivalence Classes of Rank-Metric and Matrix Codes

50-minute talk at the Algebra Seminar at University of Kentucky in November 2013.

Neuroscience-Inspired Network Decoder

20-minute talk at the Seminar in Coding Theory in Dagstuhl, Germany in August 2013.

Combinatorial Neural Codes from a Mathematical Coding Theory Perspective

25-minute talk at the 2012 *Joint Math Meetings* in Boston, MA.

Juried:

Pattern Generation in Simple Inhibition-Dominated Networks

Poster at 2016 COSYNE Annual Meeting in Salt Lake City, UT.

Problem-Solving Tasks Fostering Mathematical Discourse

60-minute joint presentation with Gulden Karakok at the 2015 *National Council for Teachers of Mathematics* Annual Meeting in Boston, MA.

Combinatorial Neural Codes from a Mathematical Coding Theory Perspective

Poster at the 2012 COSYNE Annual Meeting in Salt Lake City, UT.

Non-juried:

Internally-generated dynamics in a simple inhibition-dominated neural network model

Poster at 2016 Modeling Neural Activity 2 conference in Waikoloa, Hawaii.

What Makes a Neural Code Convex?

20-minute talk at 2016 Midwest Mathl Biology Conference in La Crosse, WI.

Irreducible Cyclic Orbit Codes

20-minute talk at the Applied Algebra Days 2 conference in May 2014.

Problem Solving and Math Teachers' Circles

60-minute joint presentation with Gulden Karakok at Colorado Council of Teachers of Mathematics Annual Conference in October 2013.

Northern Colorado Math Teachers' Circle

15-minute joint talk with Gulden Karakok at MathFest in August 2013.

Teaching:

Courses Taught At University of Northern Colorado

2016 Course coordinator for Math 181 and Math 182

2013, 2014, 2016 Math 181: Fundamentals of Mathematics I
Numbers and Operations

2015, 2016 Math 182: Fundamentals of Mathematics II Algebra, Probability,
and Data Analysis

2015 Math 391: Elementary Number Theory

2013, 2014 Math 228: Discrete Mathematics

2014 Math 522: Reading Course in Linear Algebra

2012, 2014 Math 131: Calculus I

Other Teaching Experiences:

2015, 2016 Joint Rocky Mountain and Northern Colorado Math Teachers'
Circle Summer Institute

2013, 2014 Northern Colorado Math Teachers' Circle Summer Institute

2013 Math 804T (University of Nebraska-Lincoln MAT course):
Experimentation, Conjecture, and Reasoning

Students Advised:

Samantha Moore and Carolyn Shaw. Spring 2016 to Present.

Advising two undergraduates at UNC in study of neural networks.

Jessalyn Bolkema. Fall 2013 to Present.
Co-advising doctoral student at Univ. of Nebraska in coding theory.

Amy Burzynski. Fall 2013 to Spring 2015.
Co-advised masters student at UNC in application of artificial neural networks to problem in Earth Science.

**National
Service:**

Past-Chair, Chair, Chair-Elect of the SIGMAA MCST: 2014 - Present
Served as Chair-Elect, Chair, then Past-Chair of the *Special Interest Group of the MAA on Math Circles for Students and Teachers* (SIGMAA MCST). This involved organizing multiple events around math circles at both national meetings, the Joint Math Meetings and MathFest.

Member of the MAA Council on Outreach: 2015 - Present
Served on the MAA Council on Outreach Programs dedicated to promoting mathematics outreach in the community.

Sessions Organized

“My Favorite Math Circle Problem” Contributed Paper Session
Co-organized this Contributed Paper Session at MathFest in August 2016.

“The Broad Impact of Math Circles” Contributed Paper Session
Co-organized this Contributed Paper Session at the Joint Math Meetings in January 2016.

“Math Circle Problems Involving the Number 100 in Honor of the MAA’s 100th Anniversary” Contributed Paper Session
Co-organized this Contributed Paper Session at MathFest in August 2015.

“What Makes a Successful Math Circle” Contributed Paper Session
Co-organized this Contributed Paper Session at the Joint Math Meetings in January 2015.

“Coding Theory And ...” AMS-MAA Special Session
Co-organized this Special Session at MathFest in August 2013.

“Teaching Introductory Courses with Under-Prepared and/or Math-Anxious Students” panel for Project NExT
Co-organized this panel for Project NExT participants at MathFest in August 2013.

**University
Service:**

Presentations/Panels
Tips for Forming Inquiry-Based Learning Environments
50-minute joint presentation with Gulden Karakok at the UNC 2013 GTA Conference in August 2013.

Inquiry-Based Learning Environments and Teaching Ideas
90-minute joint presentation with Gulden Karakok in the CETL Faculty Forum series in October 2012.

COMMITTEE WORK

Math Education Faculty Search Committee Member: 2016-2017.

Policies and Procedures Committee Member: 2016-2017.

Supplemental Academic Instruction Comm. Member: 2014-2015.

Math Education Faculty Search Committee Member: 2014-2015.

PhD Admissions Committee Member: 2014-2015.

Web Committee Member: 2013-2014.

Math Placement Committee Member: 2013-2014.

Undergraduate Committee Member: 2012-2014.

**Professional
Development
Activities:**

Assistant Organizer for AMS Mathematics Research Communities: 2014

Center for Excellence of Teaching and Learning (CETL) Scholar in
Residence: 2012-2013.

Project NEXt Fellow: 2012-2013.

Faculty Mentorship through MCTP Fellowship: 2011.