Chad Giusti

Curriculum Vitae

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Department of Mathematical Sciences 501 Ewing Hall, U. Delaware Newark, DE 19716 USA

Research focus

Topological neuroscience; computation and coding in neural systems; development of topological, algebraic, and geometric methods for scientific applications; topology of spaces of configurations and embeddings

Academic employment

2017 –	Assistant Professor Department of Mathematical Sciences, University of Delaware Affiliations: Center for Applications of Mathematics in Medicine, Data Science Institute
2014 – 2017	Warren Postdoctoral Fellow Warren Center for Network and Data Science, University of Pennsylvania
2012 – 2014	Postdoctoral Researcher Department of Mathematics, University of Nebraska – Lincoln
2010 – 2012	Visiting Assistant Professor Mathematics Department, Willamette University

Education

2010	Ph.D.	University of Oregon, Mathematics Advisor: Dev Sinha

Published or submitted articles

17. **Chad Giusti** and Dev Sinha
Mod-two cohomology rings of alternating groups
Crelle's Journal (Journal für die reine und angewandte Mathematik), 2020
16. **Chad Giusti** and Darrick Lee
Path space cochains and population time series analysis
Proceedings of the Abel Symposium, 2020
15. Evelyn Tang, Marcelo Mattar, **Chad Giusti**, Sharon Thomson-Schill, and Danielle S. Bassett
Effective learning is accompanied by increasingly efficient dimensionality of whole-brain responses
Nature Neuroscience, 2019
14. Joshua Cruz, **Chad Giusti**, Vladimir Itskov, and William Kronholm
On open and closed convex codes
Discrete and Computational Geometry, 2019
13. Ann Sizemore, Elizabeth A. Karuza, **Chad Giusti**, and Danielle S. Bassett
Knowledge gaps in the early growth of semantic feature networks
Nature Human Behavior, 2018
12. Ann Sizemore, **Chad Giusti**, Richard F. Betzel and Danielle S. Bassett
Cliques and cavities in the human connectome
Journal of Complex Networks, 2017
11. Evelyn Tang, **Chad Giusti**, Graham Baum, Shi Gu, Ari E. Kahn, David Roalf, Kosha Ruparel, Ruben C. Gur, Raquel E. Gur, Theodore D. Satterthwaite, and Danielle S. Bassett
Developmental increases in white matter network controllability support a growing diversity of brain dynamics
Nature Communications, 2017

10. **Chad Giusti**, Lia Papadopoulos, Eli T. Owens, Karen E. Daniels, and Danielle S. Bassett
Topological and geometric measurements of force chain structure
Physical Review E, 2016
9. Ann Sizemore, **Chad Giusti**, and Danielle S. Bassett
Classification of weighted networks through mesoscale homological features
Journal of Complex Networks, 2016
8. **Chad Giusti**, Robert Ghrist, and Danielle S. Bassett
Two's company, three (or more) is a simplex: algebraic-topological tools for understanding higher order structure in neural data
Journal of Computational Neuroscience, 2016
7. Zitong Zhang, Qawi K. Telesford, **Chad Giusti**, Kelvin O. Lim, and Danielle S. Bassett
Choosing wavelet methods, filters, and lengths for functional brain network construction
PLoS ONE, 2016
6. **Chad Giusti**, Eva Pastalkova, Carina Curto, and Vladimir Itskov
Clique topology reveals intrinsic geometric structure in neural correlations
Proceedings of the National Academy of Sciences USA, 2015
5. **Chad Giusti** and Vladimir Itskov
A no-go theorem for one-layer feedforward networks
Neural Computation, 2014
4. **Chad Giusti** and Dev Sinha
Fox-Neuwirth cell structures and the cohomology of symmetric groups
Configuration Spaces: Geometry, Combinatorics and Topology, 2012
3. **Chad Giusti**
Unstable Vassilev theory
arXiv:1107.4717v1 [math.AT]
2. **Chad Giusti**, Paolo Salvatore, and Dev Sinha
The mod-two cohomology rings of symmetric groups
Journal of Topology, 2012
1. **Chad Giusti**
Plumbers' knots
arXiv:0811.2215v3 [math.AT]

Funding

2. NSF DMS 1854683, Lead PI, Jul. 2019 – Jun 2022, Total Funding: $559,902, PI Giusti: $351,990
Collaborative PIs: Gregory Henselman-Petrusk (Princeton), Lori Ziegelmeier (Macalaster)
Exact Homological Algebra for Computational Topology
1. AFRL BAA FA8750-17-S-7003, Sole PI, Aug. 2018 – Aug. 2019, Total Funding: $84,946
Clique and Independence Complex Structures for Sensor Network Analysis

Press

2019	Nov.	What's Happening in the Mathematical Sciences, AMS "The Shape of Data" (section on topological neuroscience)
2016	Aug.	MIT Technology Review "How the Mathematics of Algebraic Topology is Revolutionizing Brain Science"
2015	Dec.	Forbes "There's a Geometric Structure Hidden Inside the Brains of Rats"
	Oct.	Neuroscience News "New Math Method Reveals Structure of Neural Activity"

Recent and Upcoming Invited Talks

2020	Apr.	Oregon State U., Applied Topology Seminar (virtual)
	Jan.	U. North Carolina – Chapel Hill, Mathematics Colloquium
2019	Dec.	Boston U., Mathematics Colloquium
	Nov.	AMS Fall Southeastern Section Meeting, Special Session on Applied Topology: Theory and Applications
	Sep.	Union College Math Conference, Special Session on Applied Topology
	Jul.	International Conference on Industrial and Applied Mathematics 2019, Minisymposium on Topological Data Analysis and Deep Learning
	Jul.	Equidiff 2019, Minisymposium on Topological Data Analysis of Dynamical Systems
	Apr.	National Institute on Drug Abuse, Invited Special Seminar
	Mar.	AMS Spring Southeastern Section Meeting, Special Session on Algebraic and Discrete Methods in Mathematical Biology
2018	Nov.	École Polytechnique Fédérale de Lausanne, Workshop on Topology and Neuroscience
	Oct.	NSF/Boston U. Workshop: Integrating Neurophotonics, Statistical Physics, and Control Theory for Advancing Neuroscience
	Jun.	Norwegian Mathematical Society, Abel Symposium
	May	U. Houston, Networks Seminar
	Feb.	U. South Florida, Mathematics Colloquium
2017	Sep.	SIAM Central States Section Meeting, Mini-symposium on Applications of Algebraic Topology
	Sep.	AMS Fall Southeastern Section Meeting, Special Session on Mathematics of Biomolecules: Discrete, Algebraic and Topological
	Jul.	Foundations of Computational Mathematics 2017, Computational Topology and Geometry Workshop
	May	Hausdorff Research Institute for Mathematics, International Conference on Applied and Computational Topology
	Feb.	Brown U., Brown Institute for Brain Science Colloquium
	Jan.	Michigan State U., CMSE Colloquium
	Jan.	U. Delaware, Mathematical Sciences Colloquium
	Jan.	Joint Mathematics Meetings, AMS Special Session on Statistical Methods in Computational Topology and Applications
2016	Dec.	Florida State U., Mathematics Colloquium
	Nov.	Princeton U., Princeton Neuroscience Institute/Intel Collaboration Seminar
	Oct.	Brown U., Applied Topology Seminar
	Oct.	Broad Institute of MIT and Harvard, Models, Inference and Algorithms Initiative
	Oct.	SIAM Central States Section Meeting, Applied and Computational Topology Mini-symposium
	Sep.	Ohio State U., MBI, Workshop on Topological, Geometric and Statistical Techniques in Biological Data Analysis
	Jul.	U. Tennessee, NIMBioS, Algebraic Mathematical Biology: Research and Education
	Apr.	Princeton U., IAS, Applied Topology Seminar
	Apr.	Columbia U., NY Metropolitan Area Discussion Group in Mathematics and Oncology
	Apr.	Applied Algebraic Topology Research Network Seminar
	Mar.	U. at Buffalo, Mathematics Colloquium
	Mar.	U. at Buffalo, Computation and Data-Enabled Science and Engineering Days (tutorial)
	Mar.	SAMSI, Mathematics of Neural Networks and Neural Codes Workshop
	Mar.	U. Oregon, Neuroscience Seminar
	Mar.	U. Oregon, Geometry/Topology Seminar
2015	Nov.	Janelia Research Campus, Theoretical Neuroscience Workshop (talk and tutorial)
	Nov.	Fall Eastern Sectional AMS Meeting, AMS Special Session on Topological Data Analysis
	Oct.	École Polytechnique Fédérale de Lausanne, Applied Topology Seminar
	Oct.	53rd Annual Allerton Conference, Geometric And Topological Methods in Learning and Data Analysis
	Aug.	Princeton U., Project 6 Seminar
	May	SIAM Dynamical Systems, Applications of Algebraic Topology to Neuroscience
	May	SIAM Workshop on Network Science
	Apr.	Princeton U., IAS, Workshop on Topology: Identifying Order in Complex Systems

Workshops and conference sessions organized

2021 May	Hot Topics Workshop: Topological Insights in Neuroscience, MSRI
2019 –	Workshop on Topology: Identifying Order in Complex Systems Every semester, location rotates (U. Delaware, U. Pennsylvania, Princeton U. Rutgers U.)
2018 Oct.	AMS Fall Eastern Sectional Meeting 2018, U. Delaware Special Session on Applied Algebraic Topology
2016 Jan.	Warren Center Workshop, U. Pennsylvania Algebraic and Topological Methods for Biological Networks (two days)
2015 May	SIAM Dynamical Systems 2015, Featured Minisymposium Applications of Algebraic Topology to Neuroscience

Current students and trainees

Postdoc	Haibin Hang (U. Delaware) TBD (associated with the NSF-funded ExHACT project)
Postdoc	Iris Yoon (U. Pennsylvania, co-advised with R. Ghrist) Topological measures of structure in multi-region neural recordings
PhD	Guiliamaria Menara (U. Delaware) TBD
PhD	Jerome Roehm (U. Delaware) Euclidean embedding dimensions for neural activation sequences
PhD	Melinda Kleczynski (U. Delaware) Persistent homology analysis of fMRI in rat models of nicotine addiction
MS	Colin Horgan (U. Delaware, MSDS)

Former students and trainees (IS = Indepenent Study, SS = Summer Scholars, GEMS = Groups Exploring the Math. Sciences)

2020	SS, IS	Kaitlin Canalichio (U. Delaware) Merge tree analysis for classification of tear film videos
	GEMS	Skylar Hudson and Auguste Gezalyan (U. Delaware) Closed convex codes that are not open convex codes
	IS	Colin Horgan (U. Delaware) Computational models of EEG in TMS and causality analysis
2019	MS	Alex Dishong (U. Delaware) Reduction techniques for the persistent homology transform on digital images
2018	GEMS	Corey Holcomb and Alex Dishong (U. Delaware) Topological statistics for image analysis
	SS	Miguel Fuentes (U. Delaware) Perceptron geometries in 2-layer feed-forward networks
2015	MS	Ann Sizemore (U. Pennsylvania, co-advised with D. Bassett) Persistent homology of network models and structural human brain networks

Teaching (at U. Delaware since 2017)

2020 Fall	Vector Spaces (Math 672)
2019 Fall	Honors Linear Algebra (Math 349)
2019 Spring	Topological Data Analysis (Math 667, new graduate data science course)
2018 Fall	Linear Algebra (Math 349), Vector Spaces (Math 672)
2018 Spring	Algebraic Topology (Math 829, new graduate mathematics course)
2017 Fall	Topology and Its Applications (Math 567, new undergraduate mathematics course)
2003 – 2013	38 undergraduate courses at U. Oregon, Willamette U. and U. Nebraska – Lincoln, including: Differential Geometry, Linear Algebra, Several Variable Calculus, Intro to Differential Equations, Honors Differential Equations, Discrete Math, Probability and Statistics, Calculus, Calculus for Life Sciences, Business Calculus, Elementary Functions, College Algebra, Intermediate Algebra, Contemporary Mathematics

Public Talks

2016	Jun.	U. Pennsylvania, Penn Network Visualization Program
2012	May	Willamette U., U Think

Posters

2014	Feb.	Cosyne 2014
2013	Dec.	Topological Structures in Computational Biology, IMA
	Nov.	Neuroscience 2013
	Oct.	Modern Applications of Homology and Cohomology, IMA

Awards

2017	FOCM 2017 NSF Early Career Travel Award
2015	SIAM Network Science 2015 NSF Early Career Travel Award
2010	Project NExT Fellowship
2009	Jack and Peggy Borsting Award for Scholastic Achievement in Graduate Mathematics
2008	Johnson Fellowship

Seminars and working groups led

2020	Summer	RAMP Computational Workshop, U. Delaware
2019	Summer	RAMP Linear Algebra Workshop, U. Delaware
2018	Summer	RAMP Computational Workshop, U. Delaware Week-long prep workshops for incoming graduate students.
2015	Spring	Applied Topology in Neuroscience, U. Pennsylvania Cross-disciplinary graduate/faculty working group for identifying problems in neuroscience which are candidates for algebraic-topological solutions.
2014	Fall	Topological Methods for Complex Systems, U. Pennsylvania Graduate/faculty lecture series on topological and categorical structures for use with graphs and networks.
2013	Fall	Algebraic Topology Seminar, U. Nebraska – Lincoln Graduate lecture series on the fundamentals of computations of homotopy groups, as a companion to seminars given by M. Hopkins that semester
2013	Summer	Applied Topology, U. Nebraska – Lincoln Graduate/faculty lecture series on persistent homology.
2007	Summer	Graduate Student Summer "Pre-School", U. Oregon Two-week course for incoming graduate students covering fundamentals of algebra, analysis and topology.

Software

2. *CliqueTop*, Matlab package for computation of clique topology of symmetric matrices
   `https://github.com/nebneuron/clique-top`
1. *CalBlitz*, Fast, modular, low-memory calcium imaging ROI/trace extaction pipeline
   `https://github.com/agiovann/CalBlitz`

Other publications

1. Chad Giusti
   Review of NICHE HIERARCHY: STRUCTURE, ORGANIZATION AND ASSEMBLY IN NATURAL SYSTEMS
   SIAM Review, 2018

Service activities

2020 –	Natural Sciences Diversity/Equity/Inclusion Taskforce, U. Delaware
2020	Mathematical Sciences Math Alliance Working Group, U. Delaware
2019	Mathematical Sciences Advisory Committee, U. Delaware
2019 – 2020	Neuroscience PhD Program Development Committee, U. Delaware
2018 –	Co-organizer, Topology: Identifying Order in Complex Systems
2018 – 2019	Mathematical Sciences Development Committee, U. Delaware
2017 – 2019	Data Science Foundations Cluster Search Committee, U. Delaware
2017 – 2018	Mathematical Sciences Undergraduate Research Coordinator, U. Delaware
2017 – 2018	Mathematical Sciences Undergraduate Affairs Committee, U. Delaware
2017	Program Committee, International Conference on Mathematical Neuroscience (2017)
2016 –	Abstract Reviewer, COSYNE (2017, 2020)
2010 – 2018	AWM Mentor Network, Mentor

Research visits, workshops, and training programs

2018 Fall	NSF/BU Workshop: Integrating Neurophotonics, Statistical Physics, and Control Theory for Advancing Neuroscience
2015 Summer	Neurotechnologies for Analysis of Neural Dynamics, Princeton University
2014 Spring	Long-term visitor, Scientific and Engineering Applications of Algebraic Topology, IMA, U. Minnesota
2013 – 2014	Visiting scientist, "Development of a mathematical tool for rigorous analysis of neural activity sequences", Janelia Research Campus, HHMI
2012 Summer	Summer course in mining and modeling of neuroscience data, Redwood Center for Theoretical Neuroscience, U. California at Berkeley
2010 Summer	Homotopy Theory of Moduli Spaces, WCATSS, U. Oregon
2009 Fall	Homology Theories of Knots and Links, MSRI

Current Professional memberships

AWM, AMS, SIAM

Reviewer/Referee for Academic Publications

SIAM Applied Geometry and Algebra; PLoS Computational Biology; PLoS ONE; Neural Computation; Network Neuroscience; Journal of Computational Chemistry; Journal of Computational Physics; Journal of Neuroscience Methods; Journal of the Royal Society Interface; Brain Topography; Cerebral Cortex; Applied Network Science; IEEE Transactions on Network Science and Engineering; Oxford University Press; CRC Press