Curriculum Vitae   Michael J. Catanzaro

Department of Mathematics
Iowa State University   mjcatanz@iastate.edu
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Employment

- Assistant Professor, Iowa State University, August 2018 - present.

- Postdoctoral research associate, University of Florida, August 2016 - July 2018.
  Mentor: Peter Bubenik.

Education

- Ph.D. Mathematics, Wayne State University, March 2016.
  Advisors: Dr. John R. Klein, Department of Mathematics, and
          Dr. Vladimir Y. Chernyak, Department of Chemistry.

- M.A. Mathematics, Wayne State University, December 2011.
  Advisor: Dr. Robert R. Bruner, Department of Mathematics.

- B.S. Physics, Wayne State University, December 2010.

- B.S. Mathematics, Wayne State University, December 2010.

Research Interests

- Topological data analysis, multiparameter persistence, multiparameter persistence modules.

- Stochastic currents, random walks, stochastic calculus on manifolds, higher Reidemeister torsion, combinatorial Hodge theory, Cerf theory.

Publications

Submitted articles

4. Catanzaro, Michael J.; Wang, Bei; Zabka, Matthew; Zhou, Youjia. *MVF Designer: Design and Visualization of Morse Vector Fields*. Submitted to Eurographics Conference on Visualization.

3. Catanzaro, Michael J.; Chernyak, Vladimir Y.; Klein, John R. *On fluctuations of cycles in a finite CW complex*. Submitted to Random Structures & Algorithms. arxiv.org/abs/1710.07995

2. Catanzaro, Michael J.; Zabka, Matthew J. *A Model for Random Chain Complexes*. Submitted to Topology and It's Applications. arxiv.org/abs/1901.00964

1. Salch, Andrew; Regalski, Adam; Abdallah, Hassan; Suryadevara, Raviteja; Catanzaro, Michael J.; Diwadkar, Vaibhav A. *Why Topological Data Analyses (TDA) should be used for functional discovery in fMRI data*. Submitted to PLOS Computational Biology.

Peer-reviewed articles

10. Catanzaro, Michael J.; Curry, Justin; Fasy, Brittany Terese; Lazovskis, Janis; Malen, Greg; Riess, Hans; Wang, Bei; Zabka, Matthew. *Moduli Spaces of Morse Functions for Persistence*. Journal of Applied and Computational Topoloy **4** (2020), 353–385. doi:10.1007/s41468-020-00055-x arxiv.org/abs/1909.10623

9. Catanzaro, Michael J.; Chernyak, Vladimir Y.; Klein, John R. *Exciton Scattering via Algebraic Topology*. Journal of Topology and Analysis **11** (2019), 251–272. doi:10.1142/S1793525319500110 arXiv:1505.02365.

8. Catanzaro, Michael J.; Chernyak, Vladimir Y.; Klein, John R. *A higher Boltzmann Distribution*. Journal of Applied and Computational Topology **1** (2017), 215–240. doi:10.1007/s41468-017-0006-9 arXiv:1506.06775

7. Catanzaro, Michael J.; Chernyak, Vladimir Y.; Klein, John R. *Stochastic Dynamics of Extended Objects in Driven Systems: I. Higher-Dimensional Currents in the Continuous Setting*, Chemical Physics **481** (2016), 5–18. doi:10.1016/j.chemphys.2016.08.021 arxiv:1609.00336

6. Catanzaro, Michael J.; Chernyak, Vladimir Y.; Klein, John R. *Stochastic Dynamics of Extended Objects in Driven Systems II: Current Quantization in the Low-Temperature Limit*, Chemical Physics **481** (2016), 19–27. doi:10.1016/j.chemphys.2016.08.020 arxiv:1609.00334

5. Catanzaro, Michael J.; Shi, Tian; Tretiak, Sergei; Chernyak, Vladimir Y. *Counting the number of excited states in organic semiconductors systems using topology*, J. Chem. Phys **142** 084113 (2015), 1–12. doi:10.1063/1.4908560 arxiv:1612.03434

4. Catanzaro, Michael J.; Chernyak, Vladimir Y.; Klein, John R. *Kirchhoff's theorems in higher dimensions and Reidemeister torsion*, Homology, Homotopy, and Applications **17** (2015), 165–189. doi:10.4310/HHA.2015.v17.n1.a8 arxiv:1206.6783

3. Li, Hao; Catanzaro, Michael J.; Tretiak, Sergei; Chernyak, Vladimir. *Excited-state structure modifications due to molecular substituents and exciton scattering in conjugated molecules*, Journal of Physical Chemistry Letters **5** (2014), 641–647. doi:10.1021/jz4027198 arxiv:1612.03523

2. Catanzaro, Michael J.; Chernyak, Vladimir Y.; and Klein, John R. *On Kirchhoff's theorems with coefficients in a line bundle*, Homology, Homotopy, and Applications **15** (2013), 267–280. doi:10.4310/HHA.2013.v15.n2.a16 arxiv:1207.2822

1. Catanzaro, Michael J. *Generalized Tonnetze*, J. Math. Music **5** (2011), 117–139. doi:10.1080/17459737.2011.614448 arxiv:1612.03519

Books, In progress

1. Bruner, Robert R.; Catanzaro, Michael J.; May, J. Peter. *Characteristic Classes*. pp 97. Draft available at math.uchicago.edu/∼may/CHAR/charclasses.pdf.

Other publications

3. Catanzaro, Michael J. *A Topological Study of Stochastic Dynamics on CW Complexes*. Wayne State University Dissertations **1433** (2016). Available at digitalcommons.wayne.edu/oa_dissertations/1433/.

2. Catanzaro, Michael J. *Finitely Presented Modules over the Steenrod Algebra in Sage.* Master's thesis, Wayne State University, December 2011. Available at
people.clas.ufl.edu/catanzaro/files/Essayfinal.pdf

1. Catanzaro, Michael J. *A user's guide: Dynamics and fluctuations of cellular cycles on CW complexes*, available at mathusersguides.com/enchiridion-vol-2-2016-mike-catanzaro/

Service

- Local organizer for the Underrepresented Students in Algebra and Topology Research Symposium (USTARS) at Iowa State University, April 2019.

Undergraduate Research

- Iowa State University, Aug. 2019 - present: Mentoring Brantley Vose on computing harmonic chain representatives of persistent homology classes, including coding and developing a visualization package.

- Iowa State University, May 2019 - present: Mentoring Kate Lyon on the use of Mapper to study world happiness and greenhouse gas emissions from developed countries.

- University of Florida, Jan. 2017 - April 2018: Mentored Samuel Rizzo on applying Persistence Landscapes to study task modulation with fMRI data.

- University of Florida, Jan. 2017 - April 2017: Mentored Samuel Swanson on computing Hodge decompositions for persistent homology classes.

- Wayne State University, Nov. 2015 - Dec. 2016: Mentored Raviteja Suryadevara on an application of persistent homology to an fMRI study.

Teaching Experience

As the primary instructor, I developed syllabi, quizzes, and tests for the following courses (course levels in parantheses).

- Graduate Abstract Algebra I and II (504 & 505): Fall 2019 and Spring 2020.

- Directed study on Algebraic Topology (500): Fall 2019.

- Topology (503): Spring 2019.

- Advanced Topics in Topology: Differential Topology, Vector Bundles, and Characteristic Classes (7396): Fall 2017.

- Advanced Calculus for Engineers and Physical Scientists I (4102/5104): Winter 2017.

- Algebra with Trigonometry (1050): Winter 2015, Fall 2014, Summer 2011, and Fall 2011.

- Linear Algebra (2250): Summer 2015.

- Elementary Statistics (1020): Summer 2014.

- Mathematics in Today's World (1000): Summer 2013.

- Pre-Calculus (1800): Winter 2011.

As the primary lecturer, I taught the following courses.

- Calculus 1 (165): Fall 2020 and Fall 2019.

- Calculus 3 (2313): Fall 2016 and Fall 2018.

Presentations

- *Stochastic Dynamics of Cellular Cycles*, Applied Topology Seminar. EPFL Lausanne (virtual talk), October 2020.

- (Postponed) *Geometric perspectives on multiparameter persistence*. Workshop on Topological Data Analysis. Fields Institute, Toronto, Canada, June 2020.

- *Geometric perspectives on multiparameter persistence*, 6th CIMAT TDA workshop and winter school. Guanajuato, Mexico, January 2020.

- *Multiparameter Persistence via Geometric Topology*, SIAM Conference on Applied Algebraic Geometry. Bern, Switzerland, July 2019.

- *Topological Data Analysis*, Midwest Big Data Summer School. Ames, Iowa, May 2019.

- *Geometric multiparameter persistence*, Computational and Applied Math Seminar, Iowa State University, April 2019.

- *An Introduction to Topological Data Analysis*, Mathematical Association of America, Northwest Sectional Meeting. Southwest Minnesota State University, October 2018.

- *Combining sub-level and let set persistence*, Multiparameter Persistent Homology, CMO, Oaxaca, Mexico, August 2018.

- *Multiparameter persistence via geometric topology*, Algebraic Topology: Methods, Computation and Science 8, IST Austria, June 2018.

- *Multiparameter persistence via geometric topology*, Bridging Statistics and Sheaves, Institute for Mathematics and its Applications, May 2018.

- *Geometric multiparameter persistence*, Topology and Dynamics Seminar, University of Florida, December 2017.

- *Stochastic Dynamics on CW complexes*, Applied Math and Analysis Seminar, Duke University, November 2017.

- *Stochastic Dynamics of Cellular Cycles*, Geometry, Topology, and Data Seminar, The Ohio State University, September 2017.

- *Stochastic Dynamics on CW Complexes*, Applied Topology in Bedlewo 2017, Bedlewo, Poland, June 2017.

- *Exciton Scattering for Topologists*, Topology and Dynamics Seminar, University of Florida, March 2017.

- *Stochastic Dynamics on CW Complexes*, two presentations given in Topology and Dynamics Seminar, University of Florida, October 2016.

- *The Topology of Higher-Dimensional Currents and Langevin Processes*, Non-Equilibrium Statistical Physics, Telluride, CO, July 2016.

- *Kirchhoff's laws in higher dimensions and Reidemeister torsion*, Topology Seminar, Brandeis University, November 2015.

- *On the Boltzmann distribution and Hodge theory*, Young Topologists' Meeting, EPFL, July 2015.

- *A generalization of the Boltzmann distribution & Hodge theory*, Graduate Student Topology and Geometry Conference, University of Illinois, March 2015.

- *Counting Electronic Excitations In Organic Systems Using Algebraic Topology*, Topology Seminar, Johns Hopkins University, April 2014.

- *Constructions in ∞-categories*, Talbot Workshop, 2014.

- *Counting Electronic Excitations In Organic Systems Using Algebraic Topology*, Topology Seminar, Wayne State University, February 2014.

- *Counting The Number Of Electronic Excitations In Branched Conjugated Molecules Using Algebraic Topology*, Physical Chemistry Seminar, Wayne State University, November 2013.

- *Kirchhoff's theorems in higher dimensions and Reidemeister Torsion*, Topology Seminar, Wayne State University, October 2013.

- *Counting Electronic Excitations using Cohomology*, Graduate Student Geometry and Topology seminar, University of Illinois Urbana-Champaign, May 2013.

- *Jet and Minijet Contributions to Transverse Momentum Correlations in High Energy Collisions*, The Undergraduate Physics Research Conference, Wayne State University, November 2009.

- *The Topology of Spaces of Triads*, The Undergraduate Mathematics Seminar, University of Michigan Dearborn, March 2010.

- *The Topology of Spaces of Triads and Generalized Tonnetze*, The Undergraduate Research Conference, Wayne State University, November 2009.

- *The Topology of Spaces of Triads*, The Young Mathematicians Conference, The Ohio State University, August 2009.

Research Experience

- Graduate Research Assistant in Mathematics, WSU. Performed dissertation study and research, January 2012 - August 2014.

- Organizer of WSU Mathematics Student Seminar. Organized weekly undergraduate meetings and seminars, Fall 2011 - Spring 2013.

- Graduate Research Assistant, Los Alamos National Laboratory. Performed research on power grids and related algorithms, May 2012- August 2012.

- Research Assistant in Physics, WSU. Helped derive observable and performed high energy physics simulations, May 2009 - July 2010.

Technical skills

- Proficient in Python, C/C++, and Bash scripting.

- Written code for Sage, Pythia, Hijing, and Root.

- A sample of the code I've written is available on github: github.com/catanzaromj.

Awards

- *Anderson Scholar Faculty Honoree*, University of Florida, College of Liberal Arts and Sciences, December 2017.

- *Bertram Eisenstadt Award for Outstanding Achievement in PhD Program*, Wayne State University, Department of Mathematics, May 2016.

- *Robert Irvan Endowed Mathematics Scholarship*, Wayne State University, Department of Mathematics, May 2015.

- *M.F. Janowitz Endowed Mathematics Scholarship*, Wayne State University, May 2014.

- *Maurice Zelonka Endowed Scholarship*, Wayne State University, Department of Mathematics, May 2013.

- *Outstanding Teaching Service*, Wayne State University, Department of Mathematics, May 2012.

- *Outstanding Undergraduate Award*, Wayne State University, Department of Mathematics, May 2010.

- *M.F. Janowitz Endowed Mathematics Scholarship*, Wayne State University, May 2010.

- *George B. Beard Student Prize for Excellent Presentation of Research*, Wayne State University, Department of Physics, November 2009.

- *Robert Irvan Endowed Mathematics Scholarship*, Wayne State University, Department of Mathematics, May 2009.

- *Vaden W. Miles Outstanding Undergraduate Award*, Wayne State University, Department of Physics, March 2009.

- *Undergraduate Scholarship*, Wayne State University, Department of Mathematics, May 2008.

- *Presidential Scholarship*, Wayne State University, June 2005.