Christopher J. Tralie

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 ctralie

○ Contributions Since Starting At Ursinus

Research Interests

Geometric signal processing, applied topology, nonlinear time series analysis, music information retrieval, video processing, computer graphics

Academic Positions

8/1/2019 - Present	**Assistant Professor of Mathematics And Computer Science**, *Ursinus College. Collegeville, Pennsylvania*.
1/2019 - 6/2019	**Postdoctoral Fellow, Department of Chemical And Biomedical Engineering**, *Johns Hopkins University. Baltimore, Maryland*.
4/2017 - 12/2018	**Postdoctoral Associate, Department of Mathematics**, *Duke University. Durham, North Carolina*.

Education

2011 - 2017	**Ph.D.**, ***Duke University***, Durham, NC, *Electrical and Computer Engineering with Certificate in College Teaching*.
	Advisers: Guillermo Sapiro, John Harer
	Dissertation Title: "Geometric Multimedia Time Series"
2011 - 2013	**M.S.**, ***Duke University***, Durham, NC, *Electrical and Computer Engineering*.
2007 - 2011	**B.S.E.**, ***Princeton University***, Princeton, NJ, *Electrical Engineering with Certificate in Computer Science* (Cum Laude).

Honors and Awards

2018	Deezer Hacking Audio And Music Research (HAMR) Best Code Award, Paris, France
2016	Top 5% Teachers At Duke: Dean's award for ranking among top 5% (university wide) in student evaluations for *Quality of Course or Intellectual Stimulation*, Duke University, Spring 2016
2015	Duke University Department of Electrical Engineering Best Poster Award
2015	Duke University Bass Family Teaching Fellowship
2011	National Science Foundation Graduate Fellowship
2011	G. David Forney Jr. Prize in Signals and Systems at Princeton University
2009	Summer Undergraduate Fellowship in Robotics at Duke University: *Awarded through the National Science Foundation's Research Experience for Undergraduates (REU) Program*
2007	Lockheed Martin National Merit Scholar
2006	Pennsylvania Governor School for the Sciences, *Carnegie Mellon University*

Publications

(*) Denotes undergraduate co-author

Journal Publications

Paul Bendich, Ellen Gasparovic, John Harer, and Christopher J. Tralie. Scaffoldings and spines: Organizing high-dimensional data using cover trees, local principal component analysis, and persistent homology. *Research in Computational Topology*, 13, 2018.

Anh Phong Tran, Christopher J Tralie, José Reyes, Caroline Moosmüller, Zehor Belkhatir, Ioannis G Kevrekidis, Arnold J Levine, Joseph O Deasy, and Allen R Tannenbaum. Long-term p21 and p53 dynamics regulate the frequency of mitosis events and cell cycle arrest following radiation damage. *Cell Death & Differentiation*, pages 1–13, 2022.

Furkan Yesiler, Guillaume Doras, Rachel M Bittner, Christopher J Tralie, and Joan Serrà. Audio-based musical version identification: Elements and challenges. *IEEE Signal Processing Magazine*, 38(6):115–136, 2021.

Christopher J Tralie. Self-similarity based time warping. *arXiv preprint arXiv:1711.07513 (In Submission)*.

Christopher J. Tralie and Jose A. Perea. (quasi)periodicity quantification in video data, using topology. *SIAM Journal on Imaging Sciences*, 11(2):1049–1077, 2018.

Boyan Xu(*), Christopher J. Tralie, Alice Antia(*), Michael Lin(*), and Jose A. Perea. Twisty takens: A geometric characterization of good observations on dense trajectories. *Journal of Applied And Computational Topology (JACT)*, 2019.

Published Refereed Conference Proceedings

Caroline Moosmüller, Christopher. J Tralie, Mahdi Kooshkbaghi, Zehor Belkhatir, Maryam Pouryahya, Jose Reyes, Joseph O Deasy, Allen R Tannenbaum, and Ioannis G Kevrekidis. Periodicity scoring of time series encodes dynamical behavior of the tumor suppressor p53. In *Proceedings of The 24th International Symposium on Mathematical Theory of Networks and Systems (MTNS 2020)*, 2021 .

Francis Motta and Christopher J. Tralie. Hyperparameter optimization of topological features for machine learning applications. In *Proceedings of the 18th IEE International Conference on Machine Learning Applications (ICMLA 2019): 2019 Dec 16-18; Boca Raton, Florida, USA*, 2019 .

Christopher J. Tralie and Elizabeth Dempsey(*). Exact, parallelizable dynamic time warping alignment with linear memory. In *Proceedings of the 21st Conference of the International Society for Music Information Retrieval (ISMIR 2020)*. International Society for Music Information Retrieval (ISMIR), 2020.

Travis Deyle, Christopher J Tralie, Matthew S Reynolds, and Charles C Kemp. In-hand radio frequency identification (rfid) for robotic manipulation. In *IEEE International Conference on Robotics and Automation (ICRA), Karusruhe, Germany*, pages 1234–1241. IEEE, 2013.

Christopher J Tralie. Early mfcc and hpcp fusion for robust cover song identification. In *18th International Society for Music Information Retrieval (ISMIR), Suzhou, China*, 2017.

Christopher J Tralie. Cover song synthesis by analogy. In *19th International Society for Music Information Retrieval (ISMIR), Paris, France*, 2018.

Christopher J Tralie and Paul Bendich. Cover song identification with timbral shape sequences. In *16th International Society for Music Information Retrieval (ISMIR), Malaga, Spain*, pages 38–44, 2015.

Christopher J Tralie, Paul Bendich, and John Harer. Multi-scale geometric summaries for similarity-based sensor fusion. In *The 40th IEEE Aerospace Conference, Big Sky, Montana*, 2019.

Christopher J Tralie and Matthew Berger. Topological eulerian synthesis of slow motion periodic videos. In *IEEE International Conference on Image Processing, Athens, Greece*, 2018.

Christopher J Tralie and Brian McFee. Enhanced hierarchical music structure annotations via feature level similarity fusion. In *ICASSP 2019-2019 IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP)*, pages 201–205. IEEE, 2019.

Christopher J Tralie, Abraham Smith, Nathan Borggren, Jay Hineman, Paul Bendich, Peter Zulch, and John Harer. Geometric cross-modal comparison of heterogenous sensor data. In *Proceedings of The 39th IEEE Aerospace Conference, Big Sky, Montana*, 2018.

Furkan Yesiler, Chris Tralie, Albin Andrew Correya, Diego F Silva, Philip Tovstogan, Emilia Gómez Gutiérrez, and Xavier Serra. Da-tacos: A dataset for cover song identification and understanding. In *Proceedings of the 20th Conference of the International Society for Music Information Retrieval (ISMIR 2019): 2019 Nov 4-8; Delft, The Netherlands*. International Society for Music Information Retrieval (ISMIR), 2019.

Peer Reviewed Short Papers

Paul Bendich, Ellen Gasparovic, John Harer, and Christopher Tralie. Geometric models for musical audio data. In *Proceedings of the 32st International Symposium on Computational Geometry (SOCG), Boston, MA*, 2016.

Christopher Tralie, Nathaniel Saul, and Rann Bar-On. Ripser.py: A lean persistent homology library for python. *The Journal of Open Source Software (JOSS)*, 2018.

Christopher J Tralie. High dimensional geometry of sliding window embeddings of periodic videos. In *Proceedings of the 32st International Symposium on Computational Geometry (SOCG), Boston, MA*, 2016.

Peer Reviewed Abstracts

Jose Perea and Christopher Tralie. Sliding windows and persistence. *The Journal of The Acoustical Society of America (JASA), Boston, MA*, 2017.

Christopher Tralie and Amanda Lazarus. A head of our times: Reimagining the heads in the brummer collection via real-time face mapping. *The Age of Sensing 5th International Conference on Remote Sensing in Archeaology, Durham, NC*, 2014.

Christopher J. Tralie, Goodwin S. Matthew, and Guillermo Sapiro. Automated detection of stereotypical motor movements in children with autism spectrum disorder using geometric feature fusion. *International Society for Autism Research (INSAR), Rotterdam, The Netherlands*, 2018.

Whitepapers / Not Peer Reviewed

Christopher J Tralie and Parker Fairchild(*). `www.facejam.app`: Facial expressions for musical expression. In *22nd International Society for Music Information Retrieval (ISMIR), Late Breaking Session*, 2021.

Christopher J Tralie. Cover songs via sequences of local mfcc self-similarity matrices. In *Music Information Retrieval Evaluation Exchange (MIREX)*, 2015.

Christopher J Tralie. Cover song identification using similarity fusion of hpcps, mfccs, and mfcc ssms. In *Music Information Retrieval Evaluation Exchange (MIREX)*, 2017.

Christopher J Tralie. Graphditty: A software suite for geometric music structure visualization. In *19th International Society for Music Information Retrieval (ISMIR), Late Breaking Session*, 2018.

Christopher J Tralie and John Harer. Moebius beats: The twisted spaces of sliding window audio novelty functions with rhythmic subdivisions. In *18th International Society for Music Information Retrieval (ISMIR), Late Breaking Session*, 2017.

Undergraduate Research Supervised

2022   Sam Gregory, Kacey La. "Automated Identification of Bowhead Whales in Digital Images." Ursinus Summer Fellows, Summer 2020 (joint with Leslie New)

2022   Jose Arbelo, Tony Delgado, Charley Kirk (Juniata College), Zach Schlamowitz (Univeristy of Arizona). "Stable, Efficient, And Computable Metrics for Ordered Merge Trees." Ursinus MathCS NSF REU Summer 2022

2022	Will Gillette. '''A Data Driven Approach to Structure-Based Large Scale Audio Version Identification" Spring 2022 Indpendent Study
2022	Alexa Lewis. "Traveling Salesperson Tunes: A New Method for Image Musification" Spring 2022 Indpendent Study
2022	Seraiah Kutai. "Ursinus Smokestack 3D Annotation Interface in three.js." Spring 2022 Indpendent Study
2021-2022	Michael Tecce. "Augmented Reality for Counterpoint Education." Academic Year 2021 Independent Study.
2021	Seraiah Kutai, Thomas Boccuto. "Amplification of Hidden Periodic Motions in 3D Videos." Fall 2021 Independent Study.
2021	Seraiah Kutai, Thomas Boccuto, Samuel Kirk (Illinois State University), and Kristen Mosby (Spelman College). "Amplification of Hidden Periodic Motions in 3D Videos." Ursinus MathCS NSF REU Summer 2021
2021	Seraiah Kutai. "Ursinus Smokestack 3D Annotation Interface in three.js." Spring 2021 Indpendent Study
2021	Asberto (AJ) Alvero. "Web-Based Virtual Reality for Everyone." Spring 2021 Indpendent Study
2020	Ronsard Malonda. "Statistical Machine Translation of Lingala Facile." Fall 2020 Indpendent Study
2020	Michael Tecce. "Geometry Aided Sonification." Ursinus Summer Fellows, Summer 2020
2020	Tom Mease. "Dimension Reduction with Eilenberg-MacClane Coordinates in Javascript." Spring 2020 Indpendent Study
2020	Rachel Thornton. "Nonrigid Reconstruction of 3D Shapes." Spring 2020 Independent Study
2019	Elizabeth Dempsey. "Parallel Dynamic Time Warping for Musical Audio Synchronization." Fall 2019 independent study.
2019	Benjamin Klybor. "Self-Similarity Scattering Transforms for Large Scale Cover Song Identification." Fall 2019 independent study
2019	Parker Fairchild. "A Javascript/WebGL Implementation of FaceJam." Fall 2019 independent study
2017-2018	Alice Antia (Math), Michael Lin (Math), Boyan Xu (Math). "Twisty takens: A geometric characterization of good observations on dense trajectories." Summer@ICERM research project (also journal paper).
2017-2018	Dev Dabke (CS/Math), Erin Taylor (CS/Math). "Geometric Approaches for Basketball Player Trajectory Analysis." Duke Math senior honors thesis / academic writing mentorship.
2017	Biraj Pandey (Math), Tim Sudijno (Math). "Recurrence in Dynamic Networks." Summer@ICERM research project.
2015	Marshall Ratliff (Math). "Introducing the Cover tree to Music Information Retrieval." Duke Math senior honors thesis.
2014	Joy Patel (Math/CS). "Towards Automated Synapse Detection in Electron Microcopy Image." Semester long independent study
2014	Julia Ni (Math), Joy Patel (Math/CS), Courtney Bennett Smith (Math), Roger Zou (Math). "Mitochondria Detection in 3D Brain Images." Duke Data Plus summer project.

2014	Marshall Ratliff (Math), Derrick Nowak (Math). "Classifying Musical Genres: An Investigation into Sorting Music using Topology." Duke Data Plus summer project.

Teaching / Mentoring

2019-Present	Mentor in WiMIR: Women in Music Information Retrieval
2022	CS 174: Object Oriented Programming. `https://ursinus-cs174-f2022.github.io/CoursePage/`
2022	CS 271: Algorithms And Data Structures. `https://ursinus-cs271-f2022.github.io/CoursePage`
2022	CS 476: Computer Graphics. `https://ursinus-cs476-f2022.github.io/CoursePage/`
2022	CS 174: Object Oriented Programming. `https://ursinus-cs174-s2022.github.io/CoursePage/`
2022	CIE 200: Common Intellectual Experience. `https://ursinus-cie200i-s2022.github.io/CoursePage/`
2021	CS 371: Algorithms And Data Structures. `https://ursinus-cs371-s2022.github.io/CoursePage`
2021	CS 373: Theory of Computation. `https://ursinus-cs373-f2021.github.io/CoursePage`
2021	CS 477: Machine Learning And Artificial Intelligence (including a successful application for an "obligations" designation for teaching a substantial ethics component). `https://ursinus-cs477-f2021.github.io/CoursePage`
2021	CS 371: Algorithms And Data Structures. `https://ursinus-cs371-s2021.github.io/CoursePage`
2021	CS 472: Digital Music Processing (including a successful application for a recurring special topics course in Computer Science). `https://ursinus-cs472a-s2021.github.io/CoursePage`
2020	CS 174: Object Oriented Programming. `https://ursinus-cs174-f2020.github.io/CoursePage/`
2020	CS 476: Computer Graphics. `https://ursinus-cs476-f2020.github.io/CoursePage/`
2020	CS 173: Introduction To Computer Science. `http://www.ctralie.com/Teaching/CS173_S2020/`
2020	IDS 301: Problem Solving And Analysis with Python. `http://www.ctralie.com/Teaching/IDS301_S2020/index.html`
2019	MATH 111: Calculus 1. `www.ctralie.com/Teaching/MATH111_F2019`
2019	CS 476: Computer Graphics. `www.ctralie.com/Teaching/CS476_F2019`
2019	Invited to lead a workshop at WiMIR (Women in Music Information Retrieval) on "To What Extent Do Cyclic Inconsistencies Exist in Musical Preferences?" in Delft, The Netherlands
2018	Participant in the WiMIR: Women in Music Information Retrieval Workshop in Paris, France
2018	Co-Instructor At Summer School on Topological Data Analysis at Levico Terme, Italy. Labs found at `http://github.com/ctralie/TDALabs`

2018-Present	STEAM-Center / CyberPatriot Mentor at Lakeland Elementary/Middle School in Baltimore, Maryland
2017	Summer@ ICERM Topological Data Analysis Co-Instructor / Teaching Assistant
2016	Summer School Teaching Assistant At Technical University of Munich, Germany on "Topological Time Series Analysis - Theory And Practice"
2016	Instructor of Record of a new course I designed, CS/MATH 290: "Digital 3D Geometry," at Duke University. A ground up approach to 3D geometry with a statistics and signal processing focus. Assignments in Javascript/WebGL on sound modeling in virtual acoustic environments and modeling rotations. Assignments in numpy on 3D shape statistics, 3D shape alignment, and spectral mesh processing. `http://www.ctralie.com/Teaching/COMPSCI290`
2016-2018	Guest Lecturer on Topological Data Analysis at Duke University (three lectures: two for Dr. John Harer and one for Dr. Francis Motta)
2015	3D geometry and computer graphics independent study mentor to two high school students from North Carolina School for Science and Math
2014	Guest lecture / lab design in "Data Expeditions" on "Topology + Music Audio Data" and "Musical Pitches And Chroma Features," sponsored by the Information Initiative at Duke
2014	Mentor in 9 Week "Data and Brains" Undergraduate NSF Summer Research Program at Duke University sponsored by the math department
2013 - 2017	Member of Duke University Certificate in College Teaching (CCT) Program Participated in "College Teaching Practicum" spring 2013 and "Teaching Triangles" teaching evaluations spring 2016
2009 - 2011	Princeton University Engineering "Interactor" Assisted a faculty member and advised eight freshman engineering students with their courses
2008 - 2011	Princeton University Peer Math Tutor Tutored Undergraduate students one-on-one in Math 104: Calculus 2, Math 201: Multivariable Calculus, Math 203: Advanced Multivariable Calculus, and Math 202: Linear Algebra
2010	Princeton University Math Study Hall Facilitator Selected to lead a pilot weekly study hall program sponsored by the math department

Advising/Service

2022-Present	Participated in the at-risk student working group with the Ursinus Institute for Student Success
2021	Served on a search committee for a tenure track position in Computer Science
2021-Present	Member of the Ursinus Diversity Committee
2020-Present	Faculty adviser to the Ursinus ACM Club
2020-2021	Academic Adviser To ≈25 Computer Science majors
2021	Served on a search committee for a tenure track position in Mathematics
2021	Served on a search committee for a tenure track position in Statistics

2020   Computer Science representative for the Digital Liberal Arts (DLA) Working Group At Ursinus College

2020   Member of "STEM and racial injustice" group summer 2020 at Ursinus College Summer Fellows

2020   Member of reading group on "Campus Counterspaces: Black and Latinx Students' Search for Community at Historically White Universities" by Micere Keels, Summer 2020 At Ursinus

2020   Served on a search committee for a visiting position in Computer Science

2020   Served on the panel "AMS Panel Discussion: Mental Health in the Mathematics Profession" at the Joint Mathematics Meeting Conference

2019   Served on a search committee for a visiting position in Mathematics

Grants

2020   Applied as co-PI for CSSI: Collaborative Research: Elements NSF Grant on "DREiMac, A Software Suite for Dimensionality Reduction with Eilenberg-MacLane Coordinates"

2017   Helped write the Air Force Office of Scientific Research (AFOSR) grant "Geometric And Topological Methods for Multi-Modal Data Analysis And Fusion," which was successfully funded (joint with Paul Bendich and John Harer)

2014   Wrote the technical overview for the NSF Big Data Grant "Topological Data Analysis and Machine-Learning with Community-Accepted Features" (Award No. 1447491), which was successfully funded (joint with Paul Bendich and John Harer)

Invited Talks

2022   "Discovering And Perfecting Periodicity in Video Using Topological Autoencoders." Union College Mathematics Conference.

2021   "What Are These Shapes?? A Small Liberal Arts College Approach To Applied Geometry in Computer Science." Urinus College Summer Fellows Symposium.

2021   "p53 And Dynamic Networks: Applications of Topological (Quasi) Periodicity Quantification." SIAM Data Science Special Session on Topological Signal Processing.

2021   "Topological Signal Processing with Applications in Multimedia Data." University of South Carolina

2020   "Audio Version Identification in The 20s." Tutorial At The International Society for Information Retrieval (ISMIR) 2020. Joint with Joan Serrà and Furkan Yesiler

2020   "The Graph Laplacian And Some Applications in Multimedia Data Processing." Ursinus College AMS Group

2020   "What Are These Shapes?? A Small Liberal Arts College Approach To Applied Geometry in Computer Science." Duke University Data Dialogue

2020   "TDALabs: (Some of) TDA's Greatest Hits in Interactive Python." Florida Atlantic University Department of Mathematics

2020   "TDALabs: (Some of) TDA's Greatest Hits in Interactive Python." Applied Algebraic Topology Research Network Talk Series (AATRN)

2020   "Topology-Guided Analysis And Synthesis of (Quasi)Periodic Phenomena in Multimedia Data." University of Florida Applied Topology Seminar.

2019   "Designer Takens: A Tale of Twisted Time Series." Union College Mathematics Conference.

2019 "2-Torus And Beyond: (Spatio)Temporal Takens with A Twist." Workshop on Topology: Identifying Order in Complex Systems, University of Pennsylvania.

2019 "Audio Cover Song Identification: Beyond The Notes." Bryn Mawr College Computer Science Colloquium

2019 "Audio Cover Song Identification: Beyond The Notes." Northeast Music Information Special Interest Group (NEMISIG) Meeting, Brooklyn College

2019 "Topological Periodicity Analysis in Multimedia Time Series": Joint Math Meeting (JMM) Baltimore, MD

2018 "Geometric Audiovisual Signal Processing (GASP!): Video And Music Processing with A Twist": Telecom Paristech

2018 "Audio Cover Songs: Analysis And Synthesis": Duke University Data Dialogue Seminar

2017 "From Musical Rhythms To Vibrating Vocal Folds: Geometric (Quasi)Periodicity Quantification in Multimedia Time Series." NC State Department of Mathematics

2017 "Topological Rhythm Hierarchy Quantification in Musical Audio." SIAM Conference on Applied Algebraic Geometry, Georgia Tech.

2016 "Geometry Aided Music Structure Analysis And Cover Song Identification" (SAS)

2015 "Intro to the Duke Cluster and Data Hacks" (Duke University)

2014 "The Geometry and Topology of Musical Audio Data" (Duke University)

2014 "A Head of Our Times: Reimagining the Heads in the Brummer Collection via Real-Time Face Mapping" with Amanda Lazarus at "The Age of Sensing 5th International Conference on Remote Sensing in Archeaology"

Conference / Journal Reviewing

2022 IEEE Pattern Analysis And Machine Intelligence (PAMI) Journal

2021 Research in Computational Topology Journal

2020 21st International Society for Music Information Retrieval Conference (ISMIR)

2019 20th International Society for Music Information Retrieval Conference (ISMIR)

2019 Annals of Applied Statistics

2019 35th International Symposium on Computational Geometry (SOCG)

2018 19th International Society for Music Information Retrieval Conference (ISMIR)

2018 Journal of Information Fusion (INFUS)

2018 34th International Symposium on Computational Geometry (SOCG)

2016 EURASIP Journal on Audio, Speech, and Music Processing

2015 Iberoamerican Congress on Pattern Recognition (CIARP)

Other Scholarly Activity

2013 - Present Member of "Information Initiative at Duke" (IID)

2015-2017 MIREX Music Benchmarking Competition Task Captain in "Cover Song Identification"

2015 US Air Force Research Labs (AFRL) Visiting Faculty Research Program

Industry Experience

2008 Lockheed Martin Summer Internship in Software Development

Wrote an R&D project management plugin for the Eclipse IDE (contributed over 17k Lines of Code)

Programming Languages and Lab Experience

Programming Languages	C, C++, Java, Python, Javascript, Matlab, HTML, OpenGL/WebGL, Linux Tools, Java Applet Development, ROS robot operating system
Master's Project in Radar Signal Processing (2012)	Created a 2D positioner robot from scratch to move a K-band horn antenna in front of a 4'x4'x4' anechoic box, and used this apparatus to create SAR images
Undergraduate EE Core Lab (2010)	"Carlab" ELE 302 Junior Electrical Engineering Design Project. Replaced radio control systems on an RC-sized car with our own autonomous control circuits Programmed a DSP56800 series microprocessor to implement PID cruise control, PWM steering control, and line following using a C2 camera and the NTSC video standard

Spoken Languages

Native	English
Proficient	French