

Bernardo Rivas

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Department of Mathematics and Statistics

University of Toledo

Toledo, OH 43606, USA

Research Interests

Rigorous study of nonlinear dynamical systems using computational and combinatorial methods, with emphasis on Conley index theory and topological dynamics. Current directions include data-driven and hybrid dynamical systems, with applications to systems biology, robotics and control.

Employment

University of Toledo

Postdoctoral Fellow, Department of Mathematics and Statistics

Supported by AFOSR MURI FA9550-23-1-0400 (PI: T. Lee, George Washington University;

co-PI: W. Kalies), in collaboration with the University of Michigan

Ohio, US

2025 – Present

Education

Rutgers University

PhD in Mathematics, Advisor: Konstantin Mischaikow

New Jersey, US

2019 – 2025

Universidade de São Paulo

MS and BS in Mathematics, MS Advisor: Marcio Gameiro

São Paulo, Brazil

2012 – 2019

Publications

Topological Dynamics via Learned Hybrid Systems

2026

B. Rivas, W. Kalies, K. Iwasaki, A. Bloch, M. Ghaffari

Proceedings of the 8th Annual Learning for Dynamics and Control Conference (L4DC),

[PMLR 331:1663–1674](#) [↗](#)

Preprints

Characterizing High-dimensional Dynamics by Combinatorial-Topological Methods on a Latent Space

2026

P. Bailon, M. Gameiro, B. Gelb, W. Kalies, M. Kramar, K. Mischaikow, **B. Rivas**, E. Vieira

[arXiv:2609.01509](#) [↗](#)

Conley Index Theory for Hybrid Systems

2026

B. Rivas, W. Kalies

[arXiv:2606.18501](#) [↗](#)

Boolean Models Coarsely Sample Continuous Dynamics of Regulatory Networks

2026

B. Cummins, M. Gameiro, T. Gedeon, K. Mischaikow, **B. Rivas**

[arXiv:2606.14925](#) [↗](#)

Global Dynamics of Ordinary Differential Equations: Wall Labelings, Conley Complexes, and Ramp Systems

2024

M. Gameiro, T. Gedeon, H. Kokubu, K. Mischaikow, H. Oka, **B. Rivas**, E. Vieira

[arXiv:2412.11078](#) [↗](#)

In Preparation

Learning Cycling Signatures of Hybrid Systems

D. Hien, K. Iwasaki, **B. Rivas**

Hybrid Attractor Lattices

W. Kalies, **B. Rivas**, T. Wehbe

Topological Validation of Parameter Inference in Gene Regulatory Networks

W. El Khateeb, **B. Rivas**, W. Kalies

Towards an Algorithmic Approach to Control of Dynamic Phenotypes

M. Gameiro, W. Kalies, K. Mischaikow, **B. Rivas**

Talks

Homological Dynamics	New Brunswick, NJ
Conference on Algebra, K-theory and Applications	2026
Computational Dynamics	Toledo, OH
UToledo Mathematics Colloquium	2026
Computational Conley Theory	Vitória, Brazil
UFES – Universidade Federal do Espírito Santo	2026
A computational topology approach to gene regulation	Austin, TX
Texas-Louisiana Section of SIAM 8th Annual Meeting	2025
Global dynamics in systems biology	Denver, CO
SIAM Dynamical Systems	2025
Computational dynamics of gene regulatory networks	Athens, OH
Dynamics Seminar	2025
Network dynamics via combinatorics, topology and homology	Toledo, OH
AMS Seminar	2025
Analytical bounds for combinatorial topological dynamics	Montreal, Canada
Workshop – Combinatorial topological framework for nonlinear dynamics	2024
A computational framework for dynamics of genetic regulatory networks	Washington, DC, US
AMS Spring Eastern Sectional Meeting	2024
Combinatorial topological method for gene regulatory networks	Leiden, Netherlands
Workshop – Computing combinatorial dynamics in high dim. biological networks	2023
Rigorous numerics of invariant manifolds	São Carlos, Brazil
Summer Meeting in Differential Equations	2019

Mentoring

Informal research mentoring (not thesis advisor of record):

Wael El-Khateeb (now Assistant Professor, Emporia State University)	University of Toledo
Topological validation of parameter inference in gene regulatory networks.	2025 – 2026
Tony Wehbe	University of Toledo
Computational Conley theory for hybrid systems.	2025 – Present

Software

MorseGraph-L4DC ↗ : Convex optimization and topological analysis for hybrid systems	Python
LatentDynamics ↗ : Topological analysis of learned dynamics on latent spaces	Python
DSGRN ↗ : Dynamic Signatures Generated by Regulatory Networks (core algorithms)	C++/Python
CMGDB ↗ : Conley-Morse Graph Database	C++/Python

Teaching

Instructor of Record

DATA4980 – Advanced Topics in Data Science	University of Toledo	Spring 2026
640:311 – Introduction to Real Analysis I	Rutgers University	Summer 2024
640:300 – Introduction to Mathematical Reasoning	Rutgers University	Summer 2023
640:252 – Elementary Differential Equations (online)	Rutgers University	Summer 2022
Minicourse on Differential Equations	ICMC-USP	Winter 2019

Teaching Assistant (Rutgers University)

640:311 – Introduction to Real Analysis I	Spring 2024
640:311 – Introduction to Real Analysis I	Fall 2023
640:244 – Differential Equations for Engineering and Physics	Spring 2023
640:481 – Mathematical Theory of Statistics	Fall 2022
640:421 – Advanced Calculus for Engineering	Fall 2022
640:244 – Differential Equations for Engineering and Physics	Spring 2022
640:135 – Calculus I for the Life and Social Sciences	Fall 2021

Poster Presentations

L4DC: Learning for Dynamics and Control, Los Angeles, CA, USA	2026
CBMS: Applied Mathematics and Machine Learning, Houston, TX, USA	2025
Workshop of Thesis and Dissertations, ICMC-USP, Brazil	2018
Algebraic Topology in Data and Dynamics, Montana State University, USA	2018

Conference & Workshop Participation

Id. of Gene Regulatory Network Function from Data, Providence, RI, USA	2022
International Congress in Mathematics, Rio de Janeiro, Brazil	2018
Summer Meeting in Differential Equations, ICMC-USP, Brazil	2017
GeoGebra Global Gathering, Linz, Austria	2015

Service

Referee, <i>Nonlinear Analysis: Hybrid Systems</i>	2026
Mentor, Directed Reading Program, Rutgers University	2024
Member, Graduate Student Liaison Committee, Rutgers University	2022 – 2025
Head Proctor, Rutgers University	2021 – 2023
Undergraduate representative, Mathematics Department Committee, USP	2015 – 2016

Fellowships

Research Internship Abroad , FAPESP – Rutgers University	2018
Master's Fellowship , FAPESP – Universidade de São Paulo	2017 – 2019
Science Without Borders , CNPq – Queen Mary University of London	2014 – 2015
Scientific Initiation Fellowship , FAPESP – Universidade de São Paulo	2013 – 2016