

RESEARCH INTERESTS

Data-driven model selection and system identification; Koopman eigenfunctions and analytical solutions of polynomial ODEs; *C. elegans* neural dynamics and whole-brain neuron identification; reduced-order modeling of biological networks

ACADEMIC APPOINTMENTS

Department of Applied Mathematics, Illinois Institute of Technology Assistant Professor	Chicago, IL 2024–present
Courant Institute, New York University NSF Mathematical Sciences Postdoctoral Research Fellow, Mentor: Lai-Sang Young	New York, NY 2021–2024

EDUCATION

University of Washington Ph.D. in Applied Mathematics, Advisor: J. Nathan Kutz Dissertation title: <i>From worms to wars, modeling and controlling networked dynamical systems</i>	Seattle, WA 2021
Western Washington University B.S. in Applied Mathematics and Behavioral Neuroscience	Bellingham, WA 2016

PUBLICATIONS

- [1] **M. Morrison** and L.-S. Young, “A data-driven biology-based network model reproduces *C. elegans* premotor neural dynamics”, *PLOS Computational Biology*, vol. 21, no. 12, e1013818, Dec. 2025.
- [2] **M. Morrison** and J. N. Kutz, “Solving nonlinear ordinary differential equations using the invariant manifolds and Koopman eigenfunctions”, *SIAM Journal on Applied Dynamical Systems*, vol. 23, no. 1, pp. 924–960, Mar. 2024.
- [3] **M. Morrison**, J. N. Kutz, and M. Gabbay, “Transitions between peace and systemic war as bifurcations in a signed network dynamical system”, *Network Science*, vol. 11, no. 3, pp. 458–501, Sep. 2023.
- [4] **M. Morrison** and L.-S. Young, “Chaotic heteroclinic networks as models of switching behavior in biological systems”, *Chaos: An Interdisciplinary Journal of Nonlinear Science*, vol. 32, no. 12, 123102, Dec. 2022.
- [5] **M. Morrison**, C. Fieseler, and J. N. Kutz, “Nonlinear control in the nematode *C. elegans*”, *Frontiers in Computational Neuroscience*, vol. 14, 616639, 2021.
- [6] **M. Morrison** and J. N. Kutz, “Nonlinear control of networked dynamical systems”, *IEEE Transactions on Network Science and Engineering*, vol. 8, no. 1, pp. 174–189, Jan. 2021.

- [7] **M. Morrison** and M. Gabbay, “Community detectability and structural balance dynamics in signed networks”, *Physical Review E*, vol. 102, no. 1, 012304, Jul. 2020.
- [8] **M. Morrison**, P. M. Maia, and J. N. Kutz, “Preventing neurodegenerative memory loss in Hopfield neuronal networks using cerebral organoids or external microelectronics”, *Computational and Mathematical Methods in Medicine*, vol. 2017, e6102494, Sep. 2017.

SUBMITTED PAPERS

- [1] **M. Morrison** and S. Petrović, “Analytical solutions for some quadratic ODEs found via linear rational eigenfunctions and the rational eigenfunction variety”, submitted to *SIAM Journal on Applied Dynamical Systems*, arXiv:2605.06950, May 2026.

PAPERS IN PREPARATION

- **M. Morrison** and R. Prasad*, “Model selection for dynamical systems in the sparse-data, large-library regime”, to be submitted to *Proceedings of the Royal Society A*
- M. Trejo* and **M. Morrison**, “Vector field conjugacy applied to Koopman eigenfunction transport”, to be submitted to *Qualitative Theory of Dynamical Systems*
- **M. Morrison** and H. Liao, “A learning-free, calibrated pipeline with a Gromov–Wasserstein refinement to identify *C. elegans* neurons from whole-brain activity and behavior”, to be submitted to *PLOS Computational Biology*
- **M. Morrison** and S. Petrović, “Analytical solutions for quadratic ODEs via rational eigenfunctions”, to be submitted to *SIAM Journal on Applied Dynamical Systems*

*Student advisee

GRANTS

AWARDED

- **REU Site: Summer Undergraduate Research Experience (SURE) at Illinois Tech** 2026–2029
National Science Foundation, Award #2548498, \$464,995. Role: Co-PI (PI: Yuhan Ding)
- **NSF Mathematical Sciences Postdoctoral Research Fellowship** 2021–2024
Project: Discovery and control of biological dynamical systems. National Science Foundation, Award #2103239, \$150,000. Role: PI (sponsoring scientist: Lai-Sang Young)

PENDING

- **Analytical solutions to polynomial ODEs using rational eigenfunctions** Submitted April 2026
National Science Foundation, CMMI Dynamics, Control and System Diagnostics, Proposal #2623291, \$587,696 requested. Role: PI (Co-PI: Sonja Petrović)

FELLOWSHIPS AND AWARDS

- **PNNL Data Science Training Program** 2020–2021
Pacific Northwest National Laboratory and University of Washington fellowship, \$35,000
- **Boeing Research Award** 2020
Department of Applied Mathematics, University of Washington
- **Big Data for Genomics and Neuroscience Training Grant** 2016–2019
NIH fellowship, \$24,324

INVITED TALKS

- IMSI Workshop: Dimension Reduction for Network-Related Dynamics, Chicago June 2027 (scheduled)
Title: Community detection and dimensionality reduction for models of C. elegans premotor neural dynamics
- Joint Mathematics Meetings (JMM 2027) January 2027 (scheduled)
AMS Special Session on Identifiability and Indistinguishability in Dynamical Systems
Title: Model selection for dynamical systems in the sparse-data, large-library regime
- HADES Seminar, University of Illinois Urbana-Champaign October 2026
Title: Model selection for dynamical systems in the sparse-data, large-library regime
- SIAM Conference on the Life Sciences July 2026
Minisymposium: Case Studies in Data-Driven and Data-Informed Modeling of Biological Systems
Title: Reproducing C. elegans premotor neural dynamics with a biology-based network model
- AMS Spring Central Sectional Meeting, Special Session on Mathematics Inspired by Biology April 2026
Title: Community detection and dimensionality reduction for models of C. elegans premotor neural dynamics
- Dynamics Days US 2026, University of Arizona, Tucson January 2026
Title: Reproducing C. elegans premotor neural dynamics with a biology-based network model
- Computational Neuroscience Seminar, Courant Institute, New York University September 2025
Title: Reproducing C. elegans premotor neural dynamics with a biology-based network model
- Stephens Group Seminar, Vrije Universiteit Amsterdam April 2025
Title: C. elegans neural network dynamics underlying locomotion
- Mathematical Biology Seminar, University of Illinois Urbana-Champaign March 2025
Title: Reproducing C. elegans premotor neural dynamics and decisions with a biophysical network model
- LDS Seminar Series, Purdue University Fort Wayne February 2025
Title: Reproducing C. elegans premotor neural dynamics and decisions with a biophysical network model
- Bio Dynamics Days, LMAH-Le Havre, Normandie and Courant Institute June 2023
Title: Chaotic heteroclinic networks as models of switching behavior in biological systems

CONTRIBUTED TALKS

- NITMB Work-in-Progress Seminar, National Institute for Theory and Mathematics in Biology February 2026
Title: Community detection and dimensionality reduction for models of C. elegans premotor neural dynamics
- SIAM Great Lakes Section Annual Meeting September 2025
Title: Low-dimensional model of C. elegans premotor network activity
- SIAM Great Lakes Section Annual Meeting October 2024
Title: A data-driven biophysical network model reproduces C. elegans premotor neural dynamics
- SIAM Conference on the Life Sciences June 2024
Title: Foraging and decision-making in C. elegans: a biophysical and data-driven model
- 24th International C. elegans Conference June 2023
Title: Simulating subnetworks and graph theory
- SIAM Conference on Applications of Dynamical Systems May 2023
Title: Chaotic heteroclinic networks as models of switching behavior in biological systems
- Satellite on Signed Networks and their Applications July 2022
Title: Transitions between peace and systemic war as bifurcations in a signed network dynamical system

- SIAM Workshop on Network Science July 2020
Title: Structural balance dynamics in insurgent networks
- SIAM Conference on Mathematics of Data Science June 2020
Title: Nonlinear control in C. elegans
- SIAM Conference on Applications of Dynamical Systems and SIAM Workshop on Network Science May 2019
Title: Community detectability and structural balance in signed networks

TEACHING

ILLINOIS INSTITUTE OF TECHNOLOGY

- MATH 332: Elementary Linear Algebra Fall 2026
- MATH 593: Seminar in Applied Mathematics and Statistics (organizer) Fall 2026
- MATH 477, 577: Numerical Linear Algebra, Computational Mathematics I Fall 2025, Fall 2026
- MATH 439, 539: Network Modeling and Statistics Spring 2026
- MATH 488, 515: Ordinary Differential Equations and Dynamic Systems Spring 2025
- MATH 251: Multivariate and Vector Calculus Fall 2024

NEW YORK UNIVERSITY

- MATH-UA 262: Ordinary Differential Equations Spring 2024
- MATH-UA 120: Discrete Mathematics Fall 2022, Fall 2023
- MATH-UA 140: Linear Algebra Spring 2023

COURSE DEVELOPMENT

- MATH 439, 539: Network Modeling and Statistics Spring 2026
Designed and first taught new cross-listed undergraduate/graduate course
- Ordinary Differential Equations and Data-Driven Methods for Dynamical Systems 2026
Designed course (not yet offered); redesign of MATH 488, 515 adding numerical methods, model selection, reduced-order modeling, DMD and Koopman analysis, control, and machine learning for dynamical systems

STUDENTS SUPERVISED

PH.D.

- **Rahul Prasad**, Ph.D. student in Applied Mathematics, Illinois Institute of Technology September 2025–present
Project: Data-driven model selection for biological dynamical systems; developing strategic sampling methods that maximize information for model selection

MASTER'S AND UNDERGRADUATE

- **Dahee Chung**, M.S. project, Illinois Institute of Technology Fall 2025
Project: Parameter identification for systems of ordinary differential equations using the SINDy algorithm
- **Manuel Trejo**, Undergraduate researcher, Illinois Institute of Technology July 2025–present
Project: Vector field conjugacy applied to Koopman eigenfunction transport; developed a method to construct mappings between polynomial ODEs with exact rational eigenfunctions

SERVICE

PROFESSIONAL SERVICE

- Journal reviewer 2021–present
SIAM Journal on Applied Dynamical Systems, SIAM Journal on Mathematics of Data Science, PLOS Computational Biology, Physical Review E, Journal of the Royal Society Interface, npj Systems Biology and Applications, Nonlinearity, Physica Scripta, Journal of Complex Networks, Journal of Computational Science
- Grant proposal reviewer 2022–present
NITMB Research Trainee Program, external reviewer (2026); Dutch Research Council (NWO) Talent Programme, Applied and Engineering Sciences (2022)
- Minisymposium co-organizer for SIAM Conference on Applications of Dynamical Systems 2025
*Minisymposium topic: “Connectome-constrained network dynamics from *C. elegans* neural activity”*
- Book proposal reviewer for the Society for Industrial and Applied Mathematics (SIAM) 2024
- Minisymposium co-organizer for SIAM Conference on the Mathematics of Data Science 2020
Minisymposium topic: “Machine Learning and Control Theory for Whole Brain Activity”

DEPARTMENT AND UNIVERSITY SERVICE, ILLINOIS INSTITUTE OF TECHNOLOGY

- External member, Ph.D. committee, Department of Chemical and Biological Engineering 2026–present
Doctoral committee and qualifying exam for Faezeh Rasti Boroujeni (advisor: Mudassir Rashid); mathematical modeling of Type 2 diabetes
- Ph.D. qualifying exam committee, Computational Mathematics Spring 2025–present
Write and grade the Applied Mathematics Ph.D. qualifying exam in computational mathematics each semester
- Co-organizer of the Applied Math Colloquium 2025–2026
Organized the department colloquium series, coordinated speaker travel, and publicized talks; colloquium became the MATH 593 Seminar in Applied Mathematics and Statistics in Fall 2026
- Co-founder and co-organizer of the Applied Math Research Collaboratorium 2024–2025
Co-founded a monthly event connecting students with faculty research; recruited and organized speakers

MENTORING

- Mentor for SURE and AM-SURE, New York University 2022
Mentored and co-mentored three undergraduate students in applied math summer research projects
- Mentor for the Undergraduate Data Science Initiative, New York University 2022
Worked with two groups of undergraduate students introducing them to data science research

PROFESSIONAL AFFILIATIONS

- National Institute for Theory and Mathematics in Biology, Affiliate Member 2025–present
- Society for Industrial and Applied Mathematics, Member 2017–present