Hans Riess

Research Scientist II
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Research Interests

multi-agent systems; co-design of systems; distributed optimization and control; applied sheaf theory; applied category theory; geometric deep learning; rough path theory

Education

Doctor of Philosophy, Electrical and Systems Engineering 2022
University of Pennsylvania, Philadelphia, Pennsylvania, United States

Bachelor of Science, Mathematics 2016
Duke University, Durham, North Carolina, United States

Appointments

Research Scientist II Feb 2025 – Present
School of Electrical and Computer Engineering, Georgia Institute of Technology, Atlanta, Georgia

Adjunct Instructor Aug 2024 – Dec 2024
Department of Mathematics and Statistics, College of Charleston, Charleston, South Carolina

Postdoctoral Associate Nov 2022 – Feb 2025
Electrical and Computer Engineering, Duke University, Durham, North Carolina

Graduate Research Assistant Aug 2017 – Nov 2022
Department of Electrical and Systems Engineering, University of Pennsylvania, Philadelphia, Pennsylvania

Sponsored Research

Funded Projects

[G3] **AFRL VFRP: Emergent Behavior in SoS with Category Theory** Jun 2026 – Jul 2026
Air Force Research Lab, FA8750-20-3-1004. Role: Principal Investigator. Total award: $10,921.

[G2] **DIGICAMS CODAC AFRL/AFOSR Center of Excellence** Apr 2026 – Apr 2031
Air Force Office of Scientific Research, FA9550-26-1-B039. Role: Key Personnel. Total award: $3,500,000.

[G1] **Sheaf Enriched Autonomous Multi-Agent Netwoks** Aug 2025 – Aug 2026
Defense Advanced Research Projects Agency, HR0011-25-3-0235. Role: Principal Investigator. Total award: $180,687.

TEACHING AND MENTORING

Teaching

Tutorial on applied sheaf theory (tutorial), American Control Conference — Summer 2026
Instructor of Record. Attendance: 20.

Elementary Statistics (MATH 103), College of Charleston — Fall 2024
Instructor of Record. Enrollment: 30.

Video Production for Mathematics (MATH 810), University of Pennsylvania — Fall 2022
Teaching Assistant. Enrollment: 10.

Fuzzy Type Theory for Opinion Dynamics, Adjoint School — Summer 2022
Teaching Assistant. Enrollment: 4.

Introduction to Probability and Statistics (ENM 503), University of Pennsylvania — Summer 2018
Teaching Assistant. Enrollment: 10.

Student Mentoring

Joana Bou Barcelo, PhD student, University of Florida — Jun 2026 – Jul 2026
Summer intern. Research topic: robotics and sheaves. Advisor of record: James Fairbanks.

William Kunzendorf, Undergraduate student, University of Florida — May 2026 – Jul 2026
Summer intern. Research topic: Total asynchrony and sheaves.

Nivar Anwer, Masters student, Georgia Tech — Apr 2026 – Jul 2026
Research topic: System identification and sheaves.

Yichen "James" Zhao, PhD student, Georgia Tech — Feb 2025 – Sep 2025
Research topic: Morse theory; partial asynchrony and sheaves. Advisor of record: Patricio Vela.

Xenia Konti, PhD student, Duke University — Aug 2023 – Dec 2025
Research topic: Distributionally robust federated learning. Advisor of record: Michael Zavlanos.

PUBLICATIONS

† Authors listed alphabetically. ‡ Shared first authorship.

Journal Articles

[J3] Claudio Battiloro, Zhiyang Wang, **Hans Riess**, Paolo Di Lorenzo, Alejandro Ribeiro, "Tangent bundle convolutional learning: from manifolds to cellular sheaves and back," *IEEE Transactions on Signal Processing*, vol. 72, pp. 1892-1909, 2024. [Online]. Available: https://ieeexplore.ieee.org/abstract/document/10476636.

[J2] †Robert Ghrist, **Hans Riess**, "Cellular sheaves of lattices and the Tarski Laplacian," *Homology, Homotopy and Applications*, vol. 24, no. 1, pp. 325-345, 2022. [Online]. Available: https://link.intlpress.com/JDetail/1805805679917023234.

[J1] †Michael Catanzaro, Justin Curry, Brittany Fasy, Jānis Lazovskis, Greg Malen, **Hans Riess**, Bei Wang, Matthew Zabka, "Moduli spaces of Morse functions for persistence," *Journal of Applied and Computational Topology*, vol. 4, no. 3, pp. 335-385, 2020. [Online]. Available: https://link.springer.com/article/10.1007/s41468-020-00055-x.

Refereed Conference Proceedings

[C13] **Hans Riess**, Yujun Huang, Matthew Klawonn, Gioele Zardini, Matthew Hale, "Quantale-enriched co-design: toward a framework for quantitative heterogeneous system design," in *IEEE 65th Conference on Decision and Control*, 2026. [Online]. Available: https://arxiv.org/pdf/2603.29921.

[C12] Nivar Anwer, **Hans Riess**, Matthew Hale, "Multi-agent system identification with nonlinear sheaf diffusion," in *Asilomar Conference on Signals, Systems, and Computers*, 2026. [Online]. Available: https://arxiv.org/abs/2605.11204.

[C11] †Shreya Arya, Greta Coraglia, Paige Randall North, Juli O'Connor, Ana Luiza Tenorio, **Hans Riess**, "Fuzzy type theory," in *Asian Symposium on Programming Languages and Systems (APLAS)*, 2026, to appear. [Online]. Available: https://aplas26.hotcrp.com/doc/aplas26-final65.pdf.

[C10] ‡Yichen Zhao, Tyler Hanks, **Hans Riess**, Samuel Cohen, Matthew Hale, James Fairbanks, "Asynchronous nonlinear sheaf diffusion for multi-agent coordination," in *American Control Conference*, 2026. [Online]. Available: https://arxiv.org/abs/2510.00270.

[C9] Tyler Hanks, **Hans Riess**, Samuel Cohen, Trevor Gross, Hatthew Hale, James Fairbanks, "Distributed multi-agent coordination over cellular sheaves," in *IEEE 64th Conference on Decision and Control*, 2025. [Online]. Available: https://arxiv.org/abs/2504.02049.

[C8] **Hans Riess**, Gergory Henselman-Petrusek, Michael Munger, Robert Ghrist, Zachary Bell, Michael Zavlanos, "Network preference dynamics using lattice theory," in *American Control Conference (ACC)*, pp. 2802-2808, 2024. [Online]. Available: https://ieeexplore.ieee.org/abstract/document/10645007.

[C7] Xenia Konti, **Hans Riess**, Manos Giannopoulos, Yi Shen, Michael Pencina, Nicoleta Economou, Michael Zavlanos, "Distributionally robust clustered federated learning: a case study in healthcare," in *IEEE 63rd Conference on Decision and Control (CDC)*, pp. 4164-4172, 2024. [Online]. Available: https://ieeexplore.ieee.org/abstract/document/10886134.

[C6] ‡Mikhail Hayhoe, **Hans Riess**, Michael Zavlanos, Victor Preciado, Alejandro Ribeiro, "Transferable hypergraph neural networks via spectral similarity," in *The Second Learning on Graphs Conference*, 2023. [Online]. Available: https://proceedings.mlr.press/v231/hayhoe24a.html.

[C5] Claudio Battiloro, Zhiyang Wang, **Hans Riess**, Paolo Di Lorenzo, Alejandro Ribeiro, "Tangent bundle filters and neural networks: from manifolds to cellular sheaves and back," in *IEEE International Conference on Acoustics, Speech, and Signal Processing (ICASSP)*, 2023. [Online]. Available: https://ieeexplore.ieee.org/abstract/document/10096934.

[C4] **Hans Riess**, Michael Munger, Michael Zavlanos, "Max-plus synchronization in decentralized trading systems," in *62nd IEEE Conference on Decision and Control (CDC)*, pp. 221-227, 2023. [Online]. Available: https://ieeexplore.ieee.org/abstract/document/10383918.

[C3] **Hans Riess**, Robert Ghrist, "Diffusion of information on networked lattices by gossip," in *IEEE 61st Conference on Decision and Control (CDC)*, pp. 5946-5952, 2022. [Online]. Available: https://ieeexplore.ieee.org/abstract/document/9992539.

[C2] **Hans Riess**, Yiannis Kantaros, George Pappas, Robert Ghrist, "A temporal logic-based hierarchial network connectivity controller," in *SIAM Conference on Control and its Applications*, pp. 17-24, 2021. [Online]. Available: https://epubs.siam.org/doi/abs/10.1137/1.9781611976847.3.

[C1] **Hans Riess**, Jakob Hansen, Robert Ghrist, "Multidimensional persistence module classification via lattice-theoretic convolutions," in *NeurIPS Topological Data Analysis and Beyond Workshop*, 2020. [Online]. Available: https://arxiv.org/abs/2011.14057.

Papers Under Review

[S1] **Hans Riess**, "Toward functorial sheaf signal processing," 2027. Submitted to *2027 IEEE International Conference on Acoustics, Speech, and Signal Processing*. [Online]. Available: https://hansriess.s3.amazonaws.com/static/references/papers/icassp2027-1.pdf.

Preprints

[P4] †Robert Ghrist, Miguel Lopez, Paige Randall North, **Hans Riess**, "Categorical diffusion of weighted lattices," 2026. [Online]. Available: https://arxiv.org/abs/2501.03890.

[P3] †Robert Ghrist, Julian Gould, Miguel Lopez, **Hans Riess**, "Clearing sections of lattice liability networks," 2025. [Online]. Available: https://arxiv.org/abs/2503.17836.

[P2] **Hans Riess**, Manolis Veveakis, Michael Zavlanos, "Path signature and graph neural networks for slow earthquake analysis," 2024. [Online]. Available: https://arxiv.org/abs/2402.03558.

[P1] Alejandro Parada-Mayorga, **Hans Riess**, Robert Ghrist, Alejandro Ribeiro, "Quiver signal processing," 2020. [Online]. Available: https://arxiv.org/abs/2010.11525.

PRESENTATIONS

Invited Talks

[T20] **H. Riess**, "Compositional Optimization for DIGICAMS," presented at *Kickoff for CODAC University Center of Excellence*, Arlington, VA, September 2026.

[T19] **H. Riess**, "Category Theory for Systems-of-Systems," poster presented at *Information Institute Poster Session*, Rome, New York, July 2026.

[T18] **H. Riess**, "Sheaf Theory for Defense Systems of Systems," presented at *AFRL/RFC Technical Interchange Meeting*, Rome, NY, July 2026.

[T17] **H. Riess**, "From Local to Global: Sheaf Theory for Defense Systems of Systems," presented at *Griffiss Institute Tech Talks*, Rome, New York, June 2026.

[T16] **H. Riess**, "Categories & Sheaves for Optimization: From Compositional to Distributed," presented at *INFORMS Optimization Society Conference*, Atlanta, Georgia, March 2026. [Online]. Available: https://submissions.mirasmart.com/OptimizationSociety2026/Itinerary/EventDetail.aspx?evt=120.

[T15] **H. Riess**, "Sheaf Laplacians for systems engineering," presented at *NCR & GATAS Lab, University of Florida*, Gainesville, Florida, November 2025.

[T14] **H. Riess**, "Sheaf Laplacians for systems engineering," presented at *Zardini Lab, MIT*, Online, October 2025.

[T13] **H. Riess**, "Spatiotemporal deep learning with path signatures and graph neural networks," presented at *Rough Path Interest Group, University of Oxford*, Online, June 2025. [Online]. Available: https://datasig.ac.uk/event/hans-riess.

[T12] **H. Riess**, "Categories of sheaves for optimization: from multi-stage to distributed," presented at *IMS-NTU Joint Workshop on Applied Geometry for Data Sciences (Part II)*, Singapore, June 2025. [Online]. Available: https://ims.nus.edu.sg/events/applied-geometry-for-data-sciences-part-ii/.

[T11] **H. Riess**, "Towards categorical diffusion," presented at *Toposes in Mondovi, Grothendieck Institute*, Mondovi, Italy, September 2024. [Online]. Available: https://ctta.igrothendieck.org.

[T10] **H. Riess**, "Algebraic foundations of planning in multi-agent systems," presented at *Joint Mathematics Meeting (JMM)*, San Francisco, California, January 2024. [Online]. Available: https://meetings.ams.org/math/jmm2024/meetingapp.cgi/Session/7624.

[T9] **H. Riess**, "The Tarski Laplacian and beyond," presented at *University of Florida Topological Data Analysis Conference*, Gainesville, Florida, February 2023. [Online]. Available: https://people.clas.ufl.edu/peterbubenik/uftda2023/.

[T8] **H. Riess**, "Lattice theory in social choice and multi-agent systems," presented at *Applications of Hodge Theory on Neworks, Banff International Research Station (BIRS)*, Banff, Canada, February 2023. [Online]. Available: https://www.birs.ca/events/2023/5-day-workshops/23w5116.

[T7] **H. Riess**, "Towards geometry of lattice-valued sheaves," presented at *Topology Geometry and Data Analysis Seminar, Ohio State University*, Columbus, Ohio, November 2022. [Online]. Available: https://math.osu.edu/events/towards-geometry-lattice-valued-sheaves.

[T6] **H. Riess**, "Lattice-valued network sheaves," presented at *Conference on Applied, Combinatorial, and Toric Topology, Institute for Mathematical Sciences*, Online, July 2022. [Online]. Available: https://ims.nus.edu.sg/events/applied-topology-in-frontier-sciences/.

[T5] **H. Riess**, "A sheaf Laplacian for lattice-valued sheaves," presented at *CIMAT Applied Geometry and Topology Seminar*, Online, June 2022. [Online]. Available: https://sites.google.com/view/arieser/conferences-and-seminars/cimat-applied-geometry-and-topology-seminar.

[T4] **H. Riess**, "Cellular sheaves of lattices and the Tarski Laplacian," presented at *Joint Mathematics Meeting*, Online, April 2022. [Online]. Available: https://meetings.ams.org/math/jmm2022/meetingapp.cgi/Paper/9254.

[T3] **H. Riess**, "Network sheaves valued in categories of adjunctions and their Laplacians," presented at *Applied Category Theory*, Cambridge, UK, July 2021. [Online]. Available: https://www.cl.cam.ac.uk/events/act2021/.

[T2] **H. Riess**, "A lattice-theoretic Laplacian for cellular sheaves," presented at *SIAM Computational Science and Engineering Conference*, Online, March 2021. [Online]. Available: https://meetings.siam.org/sess/dsp_programsess.cfm?SESSIONCODE=70073.

Contributed Talks and Posters

[T1] **H. Riess**, "A novel graph Laplacian for lattice-valued sheaves," presented at *SIAM Conference on Mathematics of Data Science*, Online, May 2020. [Online]. Available: https://meetings.siam.org/sess/dsp_programsess.cfm?SESSIONCODE=68737.

HONORS AND AWARDS

Leggett Family Fellowship, University of Pennsylvania August 2017 - September 2022
Doctoral fellowship supporting the entirety of Ph.D. study.

Nominee, Roberto Tempo Best Paper Award, 61st IEEE Conference on Decision and Control 2022
Nominated through the conference's independent review process.

Ganster Engineering Fellowship, University of Pennsylvania 2017
Doctoral fellowship.

SERVICE

Editorial Service and Journal Reviewing

Reviewer, Automatica, 2026 (1 manuscript).

Reviewer, IEEE Control Systems Letters (L-CSS), 2026 (1 manuscript).

Reviewer, Journal of Mathematical Sociology, 2026 (1 manuscript).

Reviewer, Quantum Reports, 2025 (1 manuscript).

Reviewer, Mathematics, 2024 (1 manuscript).

Reviewer, IEEE Transactions on Automatic Control (TAC), 2020 (1 manuscript).

Conference Organization and Session Chairs

Organizer, Workshop on Applied Category Theory for Compositional Decision Making, 2026 American Control Conference, New Orleans, May 2026 – Present.

Co-Chair, Regular Session: Game Theory, 61st IEEE Conference on Decision and Control, 2022.

Other Professional Service

Organizer, GRASP Game Theory Seminar, University of Pennsylvania, May 2020 – Aug 2020.

Organizer, Graduate Research Seminar in Applied Topology, University of Pennsylvania, Aug 2018 – May 2019.

Community Service

Volunteer, Duke Alumni Admissions Advisory Committee, Duke University Alumni Association, Feb 2018 – Feb 2022.