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# Hans Riess, Ph.D.

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*Applied Mathematician*

COMPLEX SYSTEMS, MACHINE LEARNING, APPLIED ALGEBRA, TOPOLOGICAL DATA ANALYSIS

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## EDUCATION

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**Doctor of Philosophy**

**2017 - 2022**

*Department of Electrical & Systems Engineering, University of Pennsylvania*

THESIS: "LATTICE THEORY IN MULTI-AGENT SYSTEMS"; ADVISOR: ROBERT GHRIST



**Bachelor of Science**

**2013 - 2017**

*Department of Mathematics, Duke University*

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## ACADEMIC APPOINTMENTS

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**Postdoctoral Associate**

**2022 - Present**

*Department of Electrical and Computer Engineering, Duke University*

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## AWARDS & FELLOWSHIPS

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**Legget Family Endowed Fellowship**, University of Pennsylvania **2014**

**Ganster Fellowship**, University of Pennsylvania **2013**

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## REFEREED-PUBLICATIONS

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1. C. Battiloro, Z. Wang, H. Riess, P. Di Lorenzo, A. Ribeiro, (2023) "Tangent bundle convolutional learning: from manifolds to cellular sheaves and back", submitted to *IEEE Transactions on Signal Processing*.

2. R. Ghrist, H. Riess, (2022) "Cellular sheaves of lattices and the Tarski Laplacian", *Homotopy Homology, & Applications*, 24(1), 325-345.
3. M. Cantazaro, J. Curry, J. Lazovskis, G. Malen, H. Riess, B. Wei, M. Zabka, (2020) "Moduli spaces of Morse functions for persistence", *Applied & Computational Topology*, 4(3), 353-385.

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## CONFERENCE PROCEEDINGS

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1. M. Hayhoe, H. Riess, M. Zavlanos, V. Preciado, A. Ribeiro, (2023) "Transferable hypergraph neural networks via spectral similarity", submitted.
2. H. Riess, M. Munger, M. Zavlanos, (2023) "Max-plus synchronization in decentralized trading systems", to appear in proceedings of *62st IEEE Conference on Control & Decision Systems (CDC)*.
3. C. Battiloro, Z. Wang, H. Riess, P. Di Lorenzo, A. Ribeiro, (2022) "Tangent bundle filters and neural networks: from manifolds to cellular sheaves and back", proceedings of *IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP)*.
4. H. Riess, R. Ghrist, (2022) "Diffusion of information on networked lattices by gossip", proceedings of *61st Conference on Control & Decision Systems (CDC)*.
5. H. Riess, Y. Kantaros, G. Pappas, R. Ghrist, (2021) "A temporal-logic based hierarchical network connectivity controller", proceedings of *2021 SIAM Control Theory Conference*.

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## PREPRINT/NON-ARCHIVAL

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1. H. Riess, J. Hansen, (2020) "Multidimensional persistence module classification via lattice-theoretic convolutions", *34th Neural Information Processing Systems (NeurIPS)*, Workshop on Topological Data Analysis and Beyond.
2. A. Parada-Mayorga, H. Riess, A. Ribeiro, R. Ghrist, (2020), "Quiver signal processing", *arXiv preprint arXiv:2010.11525*.

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## INVITED TALKS

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- ▶ "Negotiating tasks in multi-agent systems with max-plus algebra", Science of Autonomy, Office of Naval Research (ONR) annual program review (August 2023; Alexandria, Virginia).
- ▶ "Social information: perspectives from max-plus algebra and lattice theory", Socio-Mathematics Program Review (BRO-SOMAI), US Department of Defense Basic Research Office (April 2023; Arlington, Virginia).
- ▶ "The Tarski Laplacian and beyond", University of Florida Topological Data Analysis Conference (February 2023; Gainesville, Florida).
- ▶ "Lattice theory in social choice and multi-agent systems", Applications of Hodge Theory on Networks, Banff International Research Station for Mathematical Innovation and Discovery (February 2023; Banff, Alberta, Canada).

- ▶ “Towards geometry of lattice-valued sheaves”, Topology Geometry, & Data Analysis Seminar, Ohio State University (November 2022; Columbus, Ohio).
- ▶ “Lattice-valued network sheaves”, Conference on Applied, Combinatorial, and Toric Topology (July 2022; online).
- ▶ “A sheaf Laplacian for lattice-valued sheaves”, CIMAT Applied Geometry and Topology Seminar (June 2022; online).
- ▶ “Cellular sheaves of lattices and the Tarski Laplacian”, Joint Mathematics Meeting (JMM), AMS Special Session on Statistics and Machine Learning Using Topology and Geometry, (April 2022; online).
- ▶ “Lattices and metapreference”, Socio-Mathematics Program Review (BRO-SOMAI), US Department of Defense Basic Research Office (April 2022; Arlington, Virginia).
- ▶ “Semantics and syntactics”, Socio-Mathematics Program Review (BRO-SOMAI), US Department of Defense Basic Research Office (April 2022; Arlington, Virginia).
- ▶ “Lattice theory in multi-agent systems”, Workshop on Algebraic Combinatorics and Category Theory in Topological Data Analysis (March 2022; online).
- ▶ “Network sheaves valued in categories of adjunctions”, Applied Category Theory Conference (July 2021; online).
- ▶ “A lattice-theoretic Laplacian for cellular sheaves”, SIAM Computational Science and Engineering Conference (July 2021; online).
- ▶ “Tarski sheaves”, Applied Topology in Albany Seminar (February 2021; online).
- ▶ “Cellular sheaves and the Tarski Laplacian”, Quantum Group Seminar, University of Oxford (July 2020; online).
- ▶ “Cellular sheaves and the Tarski Laplacian”, SIAM Mathematics of Data Science Conference (May 2020; online).

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## TEACHING

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- ▶ “Video Production for Mathematics”, Univ. of Pennsylvania, Teaching Assistant (Fall 2021).
  - ▶ “Introduction to Probability & Statistics”, U. Penn., Teaching Assistant (Summer 2018).
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## SERVICE

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- ▶ Peer review, SIAM Journal of Applied and Computational Geometry.
- ▶ Peer review, IEEE Transactions on Automatic Control.
- ▶ Peer review, Neural Information Processing Systems (NeurIPS).
- ▶ Organizer, GRASP Lab Game Theory Seminar.
- ▶ Organizer, Graduate Research Seminar in Applied Topology.
- ▶ Volunteer, Duke Alumni Admissions Advisory Committee.