

BASTIAN ALEXANDER RIECK

Curriculum vitæ (13th October 2023)

Principal Investigator

AIDOS Lab, Helmholtz Munich

Junior Fellow

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👤 Bastian Rieck
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Our world is full of fascinating phenomena that occur at multiple scales. I am interested in studying them using methods that are situated at the intersection of geometry, topology, and machine learning, with a focus on healthcare applications.

ACADEMIC POSITIONS

10/2021–now	Principal Investigator , AIDOS Lab Institute of AI for Health and Helmholtz Pioneer Campus, Munich, Germany
01/2020–09/2021	Senior Assistant , <i>Machine Learning and Computational Biology Lab</i> (Prof. Dr. K. Borgwardt) ETH Zurich, Switzerland
01/2018–12/2019	Postdoctoral Researcher , <i>Machine Learning and Computational Biology Lab</i> (Prof. Dr. K. Borgwardt) ETH Zurich, Switzerland
11/2017–12/2017	Research Scientist , <i>Visual Computing</i> research group (Prof. Dr. F. Sadlo) Heidelberg University, Germany.
09/2015–10/2017	Research Scientist , <i>Visual Information Analysis</i> research group (Prof. Dr. H. Leitte) Kaiserslautern University, Germany
07/2011–08/2015	Research Scientist , <i>Computer Graphics and Visualization</i> research group (Prof. Dr. H. Leitte) Heidelberg University, Germany

EDUCATION

2011–2017	Ph.D. in Computer Science at Heidelberg University, Germany, final grade 1.0 (<i>summa cum laude</i>) <i>Persistent Homology in Multivariate Data Visualization</i>
2005–2011	M.Sc. ¹ in Mathematics at Heidelberg University, Germany, final grade 1.0 (<i>with distinction</i>) <i>Smoothness Analysis of Subdivision Algorithms</i>

GRANTS

2023	<ul style="list-style-type: none">• Co-Pi for a ‘MDSI Focus Topic Grant’ on <i>InterConnect: Interdisciplinary Research on Graphs, Networks, and Connectivity Structures</i> (140,000 EUR)• Helmholtz Visiting Researcher grant for hosting Kyriakos Soulios• Helmholtz Visiting Researcher grant for hosting Dr. Ariane Mora
2022	<ul style="list-style-type: none">• Helmholtz Visiting Researcher grant for hosting Davide Buffelli• Helmholtz Visiting Researcher grant for hosting Alexandros Keros• Helmholtz Visiting Researcher grant for hosting Alma Ademović Tahirović
2021	<ul style="list-style-type: none">• Helmholtz Principal Investigator Starting Grant (1,900,000 EUR)
2019	<ul style="list-style-type: none">• Principal Investigator Spark grant (100,000 CHF) from SNSF² for TOPAZ: Topology of Alzheimer’s. TOPAZ resulted in four distinct contributions to the scientific community: one NeurIPS publication, one ‘Machine Learning for Healthcare’ conference publication, one ‘Frontiers in Artificial Intelligence’ journal publication, and one ‘Machine Learning for Healthcare Workshop at NeurIPS’ contribution.

¹The German degree *Diplom* is equivalent to a master’s degree. It has now been superseded.

²Swiss National Science Foundation

HONOURS & AWARDS

- 2023
 - ELLIS Munich membership
- 2022
 - Top reviewer (top 10%) for NeurIPS 2022
 - Oral presentation (top 5% of all submissions) at LoG 2022
 - Highlighted reviewer (top 10%) for ICLR 2022
 - Spotlight presentation (top 5% of all submissions) at ICLR 2022
 - Co-director of the [Applied Algebraic Topology Research Network \(AATRN\)](#)[☞]
- 2021
 - ‘SIB Remarkable Output 2021’ award for the paper ‘Direct antimicrobial resistance prediction from clinical MALDI-TOF mass spectra using machine learning’.
 - TUM Junior Fellow
 - ELLIS membership
 - Outstanding reviewer (top 10%) and expert reviewer for ICML 2021
 - Outstanding reviewer (top 10%) for ICLR 2021
- 2020
 - Spotlight presentation (top 3% of all submissions) at NeurIPS 2020
 - Top reviewer for ICML 2020 (among the top 1000 reviewers)
- 2019
 - Outstanding reviewer for the ECML PKDD 2019 Journal Track
 - Spotlight presentation (top 3% of all submissions) at NeurIPS 2019
 - Outstanding reviewer (among the top 400 reviewers) for NeurIPS 2019
 - Outstanding reviewer (top 5%) for ICML 2019
- 2018
 - Outstanding reviewer (among the top 200 reviewers) for NeurIPS 2018
 - Outstanding reviewer (among the top 100 reviewers) for ICML 2018
- 2017
 - Award for the best extended abstract at *Topology-Based Methods in Visualization* (TopoInVis) 2017
- 10/2011–10/2014
 - Merit scholarship of the National German Science Foundation, awarded by the Heidelberg Graduate School of Mathematical and Computational Methods for the Sciences (HGS MathComp), Heidelberg University, Germany

PUBLICATIONS

Authors are usually ordered according to their contribution to a paper. Equal contributions by several authors are indicated using [†], while joint supervision is denoted using [‡]. When available, DOIs and links to preprints are provided. All publications, except the ones marked as ‘Submitted’ or ‘Preprints’, underwent peer-review.

CONFERENCE & JOURNAL PUBLICATIONS

- In press*
 1. J. Southern[†], J. Wayland[†], M. Bronstein, and **B. Rieck**: *Curvature Filtrations for Graph Generative Model Evaluation*. Advances in Neural Information Processing Systems (NeurIPS), Volume 36, 2023. arXiv: [2301.12906 \[cs.LG\]](#)[☞]. (In press)
 2. C. Coupette, J. Vreeken, and **B. Rieck**: *All the World’s a (Hyper)Graph: A Data Drama*. Digital Scholarship in the Humanities, 2023. arXiv: [2206.08225 \[cs.LG\]](#)[☞]. (In press)
- 2023
 3. D. J. E. Waibel, E. Röell, **B. Rieck**[‡], R. Giryes[‡], and C. Marr[‡]: *A Diffusion Model Predicts 3D Shapes from 2D Microscopy Images*. IEEE International Symposium on Biomedical Imaging (ISBI), 2023. DOI: [10.1109/ISBI53787.2023.10230752](#)[☞]. arXiv: [2208.14125 \[cs.CV\]](#)[☞]
 4. M. Moor[†], N. Bennet[†], D. Plecko[†], M. Horn[†], **B. Rieck**, N. Meinshausen, P. Bühlmann, and K. Borgwardt: *Predicting Sepsis Using Deep Learning Across International Sites: A Retrospective Development and Validation Study*. eClinicalMedicine 62, p. 102124, 2023. DOI: [10.1016/j.eclinm.2023.102124](#)[☞]. arXiv: [2107.05230 \[cs.LG\]](#)[☞]

5. J. von Rohrscheidt and **B. Rieck**: *Topological Singularity Detection at Multiple Scales*. Proceedings of the 40th International Conference on Machine Learning (ICML). Proceedings of Machine Learning Research 202, pp. 35175–35197, 2023. arXiv: [2210.00069](https://arxiv.org/abs/2210.00069) [cs.LG]
6. C. Coupette, S. Dalleiger, and **B. Rieck**: *Ollivier–Ricci Curvature for Hypergraphs: A Unified Framework*. International Conference on Learning Representations (ICLR), 2023. arXiv: [2210.12048](https://arxiv.org/abs/2210.12048) [cs.LG]
7. G. Huguet[†], A. Tong[†], **B. Rieck**[†], J. Huang[†], M. Kuchroo, M. Hirn[‡], G. Wolf[‡], and S. Krishnaswamy[‡]: *Time-Inhomogeneous Diffusion Geometry and Topology*. SIAM Journal on Mathematics of Data Science 5:2, pp. 346–372, 2023. DOI: [10.1137/21M1462945](https://doi.org/10.1137/21M1462945). arXiv: [2203.14860](https://arxiv.org/abs/2203.14860) [cs.LG]
8. M. Kuchroo[†], M. DiStasio[†], E. Song, E. Calapkulu, L. Zhang, M. Ige, A. H. Sheth, A. Majdoubi, M. Menon, A. Tong, A. Godavarthi, Y. Xing, S. Gigante, H. Steach, J. Huang, G. Huguet, J. Narain, K. You, G. Mourgos, R. M. Dhodapkar, M. J. Hirn, **B. Rieck**, G. Wolf, S. Krishnaswamy[‡], and B. P. Hafner[‡]: *Single-cell analysis reveals inflammatory interactions driving macular degeneration*. Nature Communications 14:1, p. 2589, 2023. DOI: [10.1038/s41467-023-37025-7](https://doi.org/10.1038/s41467-023-37025-7)
9. J. L. Moore[†], D. Bhaskar[†], F. Gao[†], C. Matte-Martone, S. Du, E. Lathrop, S. Ganesan, L. Shao, R. Norris, N. Campamà Sanz, K. Annusver, M. Kasper, A. Cox, C. Hendry, **B. Rieck**, S. Krishnaswamy[‡], and V. Greco[‡]: *Cell cycle controls long-range calcium signaling in the regenerating epidermis*. Journal of Cell Biology 222:7, e202302095, 2023. DOI: [10.1083/jcb.202302095](https://doi.org/10.1083/jcb.202302095)
10. D. Yoneoka and **B. Rieck**: *A Note on Cherry-Picking in Meta-Analyses*. Entropy 25:4, 2023. DOI: [10.3390/e25040691](https://doi.org/10.3390/e25040691)
11. R. Liu[†], S. Cantürk[†], F. Wenkel, D. Sandfelder, D. Kreuzer, A. Little, S. McGuire, L. O’Bray, M. Perlmutter[‡], **B. Rieck**[‡], M. Hirn[‡], G. Wolf[‡], and L. Rampásek^{†‡}: *Taxonomy of Benchmarks in Graph Representation Learning*. Proceedings of the First Learning on Graphs Conference. Proceedings of Machine Learning Research 198, 6:1–6:25, 2022. Accepted as an *oral* presentation at LoG (**top 5%** of all submissions). arXiv: [2206.07729](https://arxiv.org/abs/2206.07729) [cs.LG]
12. F. Graf, S. Zeng, **B. Rieck**, M. Niethammer, and R. Kwitt: *On Measuring Excess Capacity in Neural Networks*. Advances in Neural Information Processing Systems (NeurIPS), Volume 35, pp. 10164–10178, 2022. arXiv: [2202.08070](https://arxiv.org/abs/2202.08070) [cs.LG]
13. D. Bhaskar[†], K. MacDonald[†], O. Fasina, D. Thomas, **B. Rieck**, I. Adelstein[†], and S. Krishnaswamy[‡]: *Diffusion Curvature for Estimating Local Curvature in High Dimensional Data*. Advances in Neural Information Processing System (NeurIPS), 2022. arXiv: [2206.03977](https://arxiv.org/abs/2206.03977) [cs.LG]
14. D. J. E. Waibel, S. Atwell, M. Meier, C. Marr, and **B. Rieck**: *Capturing Shape Information with Multi-Scale Topological Loss Terms for 3D Reconstruction*. Medical Image Computing and Computer Assisted Intervention (MICCAI), pp. 150–159, 2022. DOI: [10.1007/978-3-031-16440-8_15](https://doi.org/10.1007/978-3-031-16440-8_15). arXiv: [2203.01703](https://arxiv.org/abs/2203.01703) [cs.CV]
15. M. Horn[†], E. De Brouwer[†], M. Moor, Y. Moreau, **B. Rieck**[‡], and K. Borgwardt[‡]: *Topological Graph Neural Networks*. International Conference on Learning Representations (ICLR), 2022. arXiv: [2102.07835](https://arxiv.org/abs/2102.07835) [cs.LG]
16. L. O’Bray[†], M. Horn[†], **B. Rieck**[‡], and K. Borgwardt[‡]: *Evaluation Metrics for Graph Generative Models: Problems, Pitfalls, and Practical Solutions*. International Conference on Learning Representations (ICLR), 2022. Accepted as a *spotlight* presentation (**top 5%** of all submissions). arXiv: [2106.01098](https://arxiv.org/abs/2106.01098) [cs.LG]
17. S. Horoi[†], J. Huang[†], **B. Rieck**, G. Lajoie, G. Wolf[‡], and S. Krishnaswamy[‡]: *Exploring the Geometry and Topology of Neural Network Loss Landscapes*. Advances in Intelligent Data Analysis XX, pp. 171–184, 2022. DOI: [10.1007/978-3-031-01333-1_14](https://doi.org/10.1007/978-3-031-01333-1_14). arXiv: [2102.00485](https://arxiv.org/abs/2102.00485) [cs.LG]
18. M. Kuchroo[†], J. Huang[†], P. Wong[†], J.-C. Grenier, D. Shung, A. Tong, C. Lucas, J. Klein, D. B. Burkhardt, S. Gigante, A. Godavarthi, **B. Rieck**, B. Israelow, M. Simonov, T. Mao, J. E. Oh, J. Silva, T. Takahashi, C. D. Odio, A. Casanovas-Massana, J. Fournier, Yale IMPACT Team, S. Farhadian, C. S. Dela Cruz, A. I. Ko, M. J. Hirn, F. P. Wilson[‡], J. G. Hussin[‡], G. Wolf[‡], A. Iwasaki[‡], and S. Krishnaswamy: *Multiscale PHATE identifies multimodal signatures of COVID-19*. Nature Biotechnology 40:5, pp. 681–691, 2022. biorXiv: [10.1101/2020.11.15.383661v1](https://doi.org/10.1101/2020.11.15.383661v1)
19. C. Weis, A. Cuénod, **B. Rieck**, O. Dubuis, S. Graf, C. Lang, M. Oberle, M. Brackmann, K. K. Søgaard, M. Osthoff, K. Borgwardt[‡], and A. Egli[‡]: *Direct antimicrobial resistance prediction from clinical MALDI-TOF mass spectra using machine learning*. Nature Medicine 28:1, pp. 164–174, 2022. biorXiv: [10.1101/2020.07.30.228411v2](https://doi.org/10.1101/2020.07.30.228411v2)

2021

20. S. C. Brüningk[†], F. Hensel[†], L. Lukas, M. Kuijs, C. R. Jutzeler[†], and **B. Rieck**[‡]: *Back to the basics with inclusion of clinical domain knowledge — A simple, scalable, and effective model of Alzheimer’s Disease classification*. Proceedings of the 6th Machine Learning for Healthcare Conference. Proceedings of Machine Learning Research 149, pp. 730–754, 2021.
21. L. O’Bray[†], **B. Rieck**[†], and K. Borgwardt: *Filtration Curves for Graph Representation*. Proceedings of the 27th ACM SIGKDD International Conference on Knowledge Discovery & Data Mining (KDD), pp. 1267–1275, 2021. DOI: [10.1145/3447548.3467442](https://doi.org/10.1145/3447548.3467442)[↗]
22. K. Ghalamkari, M. Sugiyama, L. O’Bray, **B. Rieck**, and K. Borgwardt: *Advances in Graph Kernels*. Japanese and English. Trans. by K. Ghalamkari and M. Sugiyama. Journal of the Japanese Society for Artificial Intelligence 36:4, pp. 421–429, 2021. This article constitutes an abridged translation of our survey ‘Graph Kernels: State-of-the-Art and Future Challenges’. DOI: [10.11517/jjsai.36.4_421](https://doi.org/10.11517/jjsai.36.4_421)[↗]
23. M. Moor[†], **B. Rieck**[†], M. Horn, C. R. Jutzeler[†], and K. Borgwardt[‡]: *Early Prediction of Sepsis in the ICU Using Machine Learning: A Systematic Review*. Frontiers in Medicine 8, 2021. DOI: [10.3389/fmed.2021.607952](https://doi.org/10.3389/fmed.2021.607952)[↗]
24. F. Hensel, M. Moor, and **B. Rieck**: *A Survey of Topological Machine Learning Methods*. Frontiers in Artificial Intelligence 4, 2021. DOI: [10.3389/frai.2021.681108](https://doi.org/10.3389/frai.2021.681108)[↗]
25. R. Vandaele, **B. Rieck**, Y. Saeys, and T. De Bie: *Stable Topological Signatures for Metric Trees through Graph Approximations*. Pattern Recognition Letters 147, pp. 85–92, 2021. DOI: [10.1016/j.patrec.2021.03.035](https://doi.org/10.1016/j.patrec.2021.03.035)[↗]
26. A. C. Gumpinger, **B. Rieck**, D. G. Grimm, International Headache Genetics Consortium, and K. Borgwardt: *Network-guided search for genetic heterogeneity between gene pairs*. Bioinformatics 37:1, pp. 57–65, 2021. DOI: [10.1093/bioinformatics/btaa581](https://doi.org/10.1093/bioinformatics/btaa581)[↗]
27. J. Born[†], N. Wiedemann[†], M. Cossio, C. Buhre, G. Brändle, K. Leidermann, J. Goulet, A. Aujayeb, M. Moor, **B. Rieck**, and K. Borgwardt: *Accelerating Detection of Lung Pathologies with Explainable Ultrasound Image Analysis*. Applied Sciences 11:2, 2021. DOI: [10.3390/app11020672](https://doi.org/10.3390/app11020672)[↗]. arXiv: [2009.06116](https://arxiv.org/abs/2009.06116) [cs.CV][↗]

2020

28. T. Gumbsch, C. Bock, M. Moor, **B. Rieck**, and K. Borgwardt: *Enhancing statistical power in temporal biomarker discovery through representative shapelet mining*. Bioinformatics 36:Supplement_2, pp. i840–i848, 2020. DOI: [10.1093/bioinformatics/btaa815](https://doi.org/10.1093/bioinformatics/btaa815)[↗]
29. **B. Rieck**[†], T. Yates[†], C. Bock, K. Borgwardt, G. Wolf, N. Turk-Browne[‡], and S. Krishnaswamy[‡]: *Uncovering the Topology of Time-Varying fMRI Data using Cubical Persistence*. Advances in Neural Information Processing Systems (NeurIPS), Volume 33, pp. 6900–6912, 2020. Accepted as a *spotlight* presentation at NeurIPS (**top 3%** of all submissions). arXiv: [2006.07882](https://arxiv.org/abs/2006.07882) [q-bio.NC][↗]
30. K. Borgwardt, E. Ghisu, F. Llinares-López, L. O’Bray, and **B. Rieck**: *Graph Kernels: State-of-the-Art and Future Challenges*. Foundations and Trends® in Machine Learning 13:5–6, pp. 531–712, 2020. DOI: [10.1561/22000000076](https://doi.org/10.1561/22000000076)[↗]. arXiv: [2011.03854](https://arxiv.org/abs/2011.03854) [cs.LG][↗]
31. C. D. Hofer, F. Graf, **B. Rieck**, M. Niethammer, and R. Kwitt: *Graph Filtration Learning*. Proceedings of the 37th International Conference on Machine Learning (ICML). Proceedings of Machine Learning Research 119, pp. 4314–4323, 2020. arXiv: [1905.10996](https://arxiv.org/abs/1905.10996) [cs.LG][↗]
32. M. Horn, M. Moor, C. Bock, **B. Rieck**, and K. Borgwardt: *Set Functions for Time Series*. Proceedings of the 37th International Conference on Machine Learning (ICML). Proceedings of Machine Learning Research 119, pp. 4353–4363, 2020. arXiv: [1909.12064](https://arxiv.org/abs/1909.12064) [cs.LG][↗]
33. M. Moor[†], M. Horn[†], **B. Rieck**[‡], and K. Borgwardt[‡]: *Topological Autoencoders*. Proceedings of the 37th International Conference on Machine Learning (ICML). Proceedings of Machine Learning Research 119, pp. 7045–7054, 2020. arXiv: [1906.00722](https://arxiv.org/abs/1906.00722) [cs.LG][↗]
34. C. R. Jutzeler[†], L. Bourguignon[†], C. V. Weis, B. Tong, C. Wong, **B. Rieck**, H. Pargger, S. Tschudin-Sutter, A. Egli, K. Borgwardt[‡], and M. Walter[‡]: *Comorbidities, clinical signs and symptoms, laboratory findings, imaging features, treatment strategies, and outcomes in adult and pediatric patients with COVID-19: A systematic review and meta-analysis*. Travel Medicine and Infectious Disease 37, p. 101825, 2020. DOI: [10.1016/j.tmaid.2020.101825](https://doi.org/10.1016/j.tmaid.2020.101825)[↗]. medRxiv: [10.1101/2020.05.20.20103804v1](https://doi.org/10.1101/2020.05.20.20103804v1)[↗]
35. C. Weis[†], M. Horn[†], **B. Rieck**[†], A. Cuénod, A. Egli, and K. Borgwardt: *Topological and kernel-based microbial phenotype prediction from MALDI-TOF mass spectra*. Bioinformatics 36:Supplement_1, pp. i30–i38, 2020. DOI: [10.1093/bioinformatics/btaa429](https://doi.org/10.1093/bioinformatics/btaa429)[↗]

36. S. L. Hyland[†], M. Faltys[†], M. Hüser[†], X. Lyu[†], T. Gumbsch[†], C. Esteban, C. Bock, M. Horn, M. Moor, **B. Rieck**, M. Zimmermann, D. Bodenham, K. Borgwardt[‡], G. Rätsch[‡], and T. M. Merz[‡]: *Early prediction of circulatory failure in the intensive care unit using machine learning*. *Nature Medicine* 26:3, pp. 364–373, 2020. DOI: [10.1038/s41591-020-0789-4](https://doi.org/10.1038/s41591-020-0789-4)[↗]
- 2019 37. C. Bock[†], M. Togninalli[†], E. Ghisu, T. Gumbsch, **B. Rieck**, and K. Borgwardt: *A Wasserstein Subsequence Kernel for Time Series*. Proceedings of the 19th IEEE International Conference on Data Mining (ICDM), pp. 964–969, 2019. DOI: [10.1109/ICDM.2019.00108](https://doi.org/10.1109/ICDM.2019.00108)[↗]
38. M. Togninalli[†], E. Ghisu[†], F. Llinares-López, **B. Rieck**, and K. Borgwardt: *Wasserstein Weisfeiler–Lehman Graph Kernels*. Advances in Neural Information Processing Systems (NeurIPS), Volume 32, pp. 6436–6446, 2019. Accepted as a *spotlight* presentation at NeurIPS (**top 3%** of all submissions). arXiv: [1906.01277](https://arxiv.org/abs/1906.01277) [cs.LG][↗]
39. M. Moor, M. Horn, **B. Rieck**, D. Roqueiro, and K. Borgwardt: *Early Recognition of Sepsis with Gaussian Process Temporal Convolutional Networks and Dynamic Time Warping*. Proceedings of the 4th Machine Learning for Healthcare Conference. Proceedings of Machine Learning Research 106, pp. 2–26, 2019. arXiv: [1902.01659](https://arxiv.org/abs/1902.01659) [cs.LG][↗]
40. **B. Rieck**[†], C. Bock[†], and K. Borgwardt: *A Persistent Weisfeiler–Lehman Procedure for Graph Classification*. Proceedings of the 36th International Conference on Machine Learning (ICML). Proceedings of Machine Learning Research 97, pp. 5448–5458, 2019.
41. B. Zheng, **B. Rieck**, H. Leitte, and F. Sadlo: *Visualization of Equivalence in 2D Bivariate Fields*. *Computer Graphics Forum* 38:3, pp. 311–323, 2019. DOI: [10.1111/cgf.13691](https://doi.org/10.1111/cgf.13691)[↗]
42. **B. Rieck**[†], M. Togninalli[†], C. Bock[†], M. Moor, M. Horn, T. Gumbsch, and K. Borgwardt: *Neural Persistence: A Complexity Measure for Deep Neural Networks Using Algebraic Topology*. International Conference on Learning Representations (ICLR), 2019. arXiv: [1812.09764](https://arxiv.org/abs/1812.09764) [cs.LG][↗]
- 2018 43. K. Hanser, O. Klein, **B. Rieck**, B. Wiebe, T. Selz, M. Piatkowski, A. Sagristà, B. Zheng, M. Lukáčová-Medvidová, G. Craig, H. Leitte, and F. Sadlo: *Visualization of Parameter Sensitivity of 2D Time-Dependent Flow*. Advances in Visual Computing (Proceedings of the 13th International Symposium on Visual Computing), pp. 359–370, 2018. DOI: [10.1007/978-3-030-03801-4_32](https://doi.org/10.1007/978-3-030-03801-4_32)[↗]
44. C. Bock, T. Gumbsch, M. Moor, **B. Rieck**, D. Roqueiro, and K. Borgwardt: *Association mapping in biomedical time series via statistically significant shapelet mining*. *Bioinformatics* 34:13, pp. i438–i446, 2018. DOI: [10.1093/bioinformatics/bty246](https://doi.org/10.1093/bioinformatics/bty246)[↗]
45. L. Hofmann, **B. Rieck**, and F. Sadlo: *Visualization of 4D Vector Field Topology*. *Computer Graphics Forum* 37:3, pp. 301–313, 2018. DOI: [10.1111/cgf.13421](https://doi.org/10.1111/cgf.13421)[↗]
46. K. Sdeo, **B. Rieck**, and F. Sadlo: *Visualization of Fullerene Fragmentation*. Proceedings of IEEE Pacific Visualization Symposium (PacificVis), pp. 111–115, 2018. DOI: [10.1109/PacificVis.2018.00022](https://doi.org/10.1109/PacificVis.2018.00022)[↗]
47. **B. Rieck**, U. Fugacci, J. Lukasczyk, and H. Leitte: *Clique Community Persistence: A Topological Visual Analysis Approach for Complex Networks*. IEEE Transactions on Visualization and Computer Graphics 24:1, pp. 822–831, 2018. DOI: [10.1109/TVCG.2017.2744321](https://doi.org/10.1109/TVCG.2017.2744321)[↗]
- 2016 48. **B. Rieck** and H. Leitte: *Exploring and Comparing Clusterings of Multivariate Data Sets Using Persistent Homology*. *Computer Graphics Forum* 35:3, pp. 81–90, 2016. DOI: [10.1111/cgf.12884](https://doi.org/10.1111/cgf.12884)[↗]
- 2015 49. **B. Rieck** and H. Leitte: *Persistent Homology for the Evaluation of Dimensionality Reduction Schemes*. *Computer Graphics Forum* 34:3, pp. 431–440, 2015. DOI: [10.1111/cgf.12655](https://doi.org/10.1111/cgf.12655)[↗]
- 2014 50. **B. Rieck** and H. Leitte: *Structural Analysis of Multivariate Point Clouds Using Simplicial Chains*. *Computer Graphics Forum* 33:8, pp. 28–37, 2014. DOI: [10.1111/cgf.12398](https://doi.org/10.1111/cgf.12398)[↗]
- 2013 51. M. Forbriger, H. Mara, **B. Rieck**, C. Siart, and O. Wagener: *Der “Gesprengte Turm” am Heidelberger Schloss – Untersuchung eines Kulturdenkmals mithilfe hoch auflösender terrestrischer Laserscans*. *Denkmalpflege in Baden-Württemberg, Nachrichtenblatt der Landesdenkmalpflege* 3, pp. 165–168, 2013.
52. **B. Rieck**, H. Mara, and S. Krömker: *Unwrapping Highly-Detailed 3D Meshes of Rotationally Symmetric Man-Made Objects*. ISPRS Annals of Photogrammetry, Remote Sensing and Spatial Information Sciences II-5/W1, pp. 259–264, 2013. DOI: [10.5194/isprannals-II-5-W1-259-2013](https://doi.org/10.5194/isprannals-II-5-W1-259-2013)[↗]
- 2012 53. **B. Rieck**, H. Mara, and H. Leitte: *Multivariate Data Analysis Using Persistence-Based Filtering and Topological Signatures*. IEEE Transactions on Visualization and Computer Graphics 18:12, pp. 2382–2391, 2012. DOI: [10.1109/TVCG.2012.248](https://doi.org/10.1109/TVCG.2012.248)[↗]

WORKSHOP PUBLICATIONS

- 2023
54. R. Andreeva, K. Limbeck, **B. Rieck**[‡], and R. Sarkar[‡]: *Metric Space Magnitude and Generalisation in Neural Networks*. Proceedings of the 2nd Annual Workshop on Topology, Algebra, and Geometry in Machine Learning (TAG-ML). Proceedings of Machine Learning Research 221, pp. 242–253, 2023. arXiv: [2305.05611 \[cs.LG\]](#)[☞]
55. K. V. Nadimpalli, A. Chattopadhyay[‡], and **B. Rieck**[‡]: *Euler Characteristic Transform Based Topological Loss for Reconstructing 3D Images from Single 2D Slices*. Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition (CVPR) Workshops, pp. 571–579, 2023. arXiv: [2303.05286 \[cs.LG\]](#)[☞]
- 2022
56. D. Thomas, S. Demers, S. Krishnaswamy[‡], and **B. Rieck**[‡]: *Topological Jet Tagging*. ‘Machine Learning and the Physical Sciences’ Workshop at NeurIPS, 2022.
57. J. Dyer, J. Fitzgerald, **B. Rieck**, and S. M. Schmon: *Approximate Bayesian Computation for Panel Data with Signature Maximum Mean Discrepancies*. ‘Temporal Graph Learning’ Workshop at NeurIPS, 2022.
58. C. Hacker and **B. Rieck**: *On the Surprising Behaviour of node2vec*. Proceedings of Topological, Algebraic, and Geometric Learning Workshops 2022. Proceedings of Machine Learning Research 196, pp. 142–151, 2022. arXiv: [2206.08252 \[cs.LG\]](#)[☞]
59. K. MacDonald, J. Paige, D. Thomas, S. Zhao, K. You, I. M. Adelstein, Y. Aizenbud, **B. Rieck**, D. Bhaskar, and S. Krishnaswamy: *Diffusion-Based Methods for Estimating Curvature in Data*. ‘Geometrical and Topological Representation Learning’ Workshop at ICLR, 2022.
- 2021
60. M. Kuijs, C. R. Jutzeler, **B. Rieck**, and S. C. Brüninkg: *Interpretability Aware Model Training to Improve Robustness against Out-of-Distribution Magnetic Resonance Images in Alzheimer’s Disease Classification*. ‘Machine Learning for Health (ML4H)’ Symposium, 2021. arXiv: [2111.08701 \[eess.IV\]](#)[☞]
61. R. Liu[†], S. Cantürk[†], F. Wenkel, D. Sandfelder, D. Kreuzer, A. Little, S. McGuire, M. Perlmutter, L. O’Bray, **B. Rieck**, M. Hirn, G. Wolf, and L. Rampásek: *Towards a Taxonomy of Graph Learning Datasets*. ‘Data-Centric AI’ Workshop at NeurIPS, 2021. arXiv: [2110.14809 \[cs.LG\]](#)[☞]
62. M. D. Lücken[†], D. B. Burkhardt[†], R. Cannoodt[†], C. Lance[†], A. Agrawal, H. Aliee, A. T. Chen, L. Deconinck, A. M. Detweiler, A. A. Granados, S. Huynh, L. Isacco, Y. J. Kim, B. De Kumar, S. Kuppasani, H. Lickert, A. McGeever, J. C. Melgarejo, H. Mekonen, M. Morri, M. Müller, N. Neff, S. Paul, **B. Rieck**, K. Schneider, S. Steelman, M. Sterr, D. J. Treacy, A. Tong, A.-C. Villani, G. Wang, J. Yan, C. Zhang, A. O. Pisco[‡], S. Krishnaswamy[‡], F. J. Theis[‡], and J. M. Bloom[‡]: *A Sandbox for Prediction and Integration of DNA, RNA, and Proteins in Single Cells*. Advances in Neural Information Processing Systems (Datasets and Benchmarks Track), 2021.
63. S. Horoi[†], J. Huang[†], **B. Rieck**, G. Lajoie, G. Wolf[‡], and S. Krishnaswamy[‡]: *Exploring the Loss Landscape of Neural Networks with Manifold Learning and Topological Data Analysis*. Montreal AI Symposium, 2021.
64. M. Horn[†], E. De Brouwer[†], M. Moor, Y. Moreau, **B. Rieck**[‡], and K. Borgwardt[‡]: *Topological Graph Neural Networks*. 29th Fall Workshop on Computational Geometry, 2021.
65. F. Gao, J. Moore, **B. Rieck**, V. Greco, and S. Krishnaswamy: *Exploring epithelial-cell calcium signaling with geometric and topological data analysis*. ‘Geometrical and Topological Representation Learning’ Workshop at ICLR, 2021.
- 2020
66. M. Moor, M. Horn, K. Borgwardt, and **B. Rieck**: *Challenging Euclidean Topological Autoencoders*. ‘Topological Data Analysis and Beyond’ Workshop at NeurIPS, 2020.
67. S. Groha[†], C. Weis[†], A. Gusev, and **B. Rieck**: *Topological Data Analysis of Copy Number Alterations in Cancer*. ‘Learning Meaningful Representations of Life’ Workshop at NeurIPS, 2020. arXiv: [2011.11070 \[q-bio.GN\]](#)[☞],
68. S. C. Brüninkg[†], F. Hensel[†], C. R. Jutzeler[‡], and **B. Rieck**[‡]: *Scalable Solutions for MR Image Classification of Alzheimer’s Disease*. ‘Medical Imaging meets NeurIPS’ Workshop at NeurIPS, 2020.
69. S. C. Brüninkg[†], F. Hensel[†], C. R. Jutzeler[‡], and **B. Rieck**[‡]: *Image Analysis for Alzheimer’s Disease Prediction: Embracing Pathological Hallmarks for Model Architecture Design*. ‘Machine Learning for Health (ML4H)’ Workshop at NeurIPS, 2020. arXiv: [2011.06531 \[cs.LG\]](#)[☞]
70. M. Moor, M. Horn, C. Bock, K. Borgwardt, and **B. Rieck**: *Path Imputation Strategies for Signature Models*. ICML Workshop on the Art of Learning with Missing Values (ARTEMISS), 2020.

71. **B. Rieck**[†], T. Yates[†], C. Bock, K. Borgwardt, G. Wolf, N. Turk-Browne[‡], and S. Krishnaswamy[‡]: *Topological Methods for fMRI Data*. ICML Workshop on Computational Biology, 2020.
72. C. Weis[†], M. Horn[†], **B. Rieck**[†], A. Cuénod, A. Egli, and K. Borgwardt: *Kernel-Based Antimicrobial Resistance Prediction from MALDI-TOF Mass Spectra*. ICML Workshop on Machine Learning for Global Health, 2020.
- 2019 73. C. Bock[†], M. Togninalli[†], E. Ghisu, T. Gumbsch, **B. Rieck**, and K. Borgwardt: *A Wasserstein Subsequence Kernel for Time Series*. ‘Optimal Transport & Machine Learning’ Workshop at NeurIPS, 2019.
- 2017 74. **B. Rieck**, H. Leitte, and F. Sadlo: *Persistence Concepts for 2D Skeleton Evolution Analysis*. Workshop on Topology-Based Methods in Visualization (TopoInVis), 2017.
75. **B. Rieck**, H. Leitte, and F. Sadlo: *Hierarchies and Ranks for Persistence Pairs*. Workshop on Topology-Based Methods in Visualization (TopoInVis), 2017. **Award** for the best extended abstract.
- 2016 76. **B. Rieck** and H. Leitte: ‘Shall I compare thee to a network?’ — *Visualizing the Topological Structure of Shakespeare’s Plays*. Workshop on Visualization for the Digital Humanities at IEEE Vis, 2016.
- 2015 77. **B. Rieck** and H. Leitte: *Comparing Dimensionality Reduction Methods Using Data Descriptor Landscapes*. Symposium on Visualization in Data Science (VDS) at IEEE VIS, 2015.
78. **B. Rieck** and H. Leitte: *Agreement Analysis of Quality Measures for Dimensionality Reduction*. Workshop on Topology-Based Methods in Visualization (TopoInVis), 2015.
- 2014 79. **B. Rieck** and H. Leitte: *Enhancing Comparative Model Analysis Using Persistent Homology*. IEEE Vis Workshop on Visualization for Predictive Analytics, 2014.

POSTERS

- 2023 80. J. Southern[†], J. Wayland[†], M. Bronstein, and **B. Rieck**: *On the Expressive Power of Ollivier-Ricci Curvature on Graphs*. Peer-reviewed abstract and poster, presented at the 2nd Annual ICML Workshop on ‘Topology, Algebra, and Geometry in Machine Learning’ (TAG-ML), 2023.
- 2020 81. J. Born, G. Markert, M. Manica, **B. Rieck**, K. Borgwardt, G. Schneider, and M. Rodríguez Martínez: *Chemical Representation Learning for Toxicity Prediction*. Peer-reviewed abstract and poster, presented at the 24th International Conference on Research in Computational Molecular Biology (RECOMB), 2020.
- 2019 82. C. Weis[†], M. Horn[†], **B. Rieck**[†], and K. Borgwardt: *Sparse Representations for MALDI-TOF Based Microbial Classification*. Peer-reviewed abstract and poster, presented at the 14th Machine Learning in Computational Biology (MLCB) Meeting, 2019.

BOOK CHAPTERS

- 2020 83. **B. Rieck**, F. Sadlo, and H. Leitte: *Persistence Concepts for 2D Skeleton Evolution Analysis*. Topological Methods in Data Analysis and Visualization V, pp. 139–154, Springer, 2020. DOI: [10.1007/978-3-030-43036-8_9](https://doi.org/10.1007/978-3-030-43036-8_9)[↗]. arXiv: [1907.13486](https://arxiv.org/abs/1907.13486) [math.AT][↗]
84. **B. Rieck**, F. Sadlo, and H. Leitte: *Topological Machine Learning with Persistence Indicator Functions*. Topological Methods in Data Analysis and Visualization V, pp. 87–101, Springer, 2020. DOI: [10.1007/978-3-030-43036-8_6](https://doi.org/10.1007/978-3-030-43036-8_6)[↗]. arXiv: [1907.13496](https://arxiv.org/abs/1907.13496) [math.AT][↗]
85. **B. Rieck**, M. Banagl, F. Sadlo, and H. Leitte: *Persistent Intersection Homology for the Analysis of Discrete Data*. Topological Methods in Data Analysis and Visualization V, pp. 37–51, Springer, 2020. DOI: [10.1007/978-3-030-43036-8_3](https://doi.org/10.1007/978-3-030-43036-8_3)[↗]. arXiv: [1907.13485](https://arxiv.org/abs/1907.13485) [math.AT][↗]
86. **B. Rieck**, F. Sadlo, and H. Leitte: *Hierarchies and Ranks for Persistence Pairs*. Topological Methods in Data Analysis and Visualization V, pp. 3–17, Springer, 2020. DOI: [10.1007/978-3-030-43036-8_1](https://doi.org/10.1007/978-3-030-43036-8_1)[↗]. arXiv: [1907.13495](https://arxiv.org/abs/1907.13495) [math.AT][↗]
- 2017 87. **B. Rieck** and H. Leitte: *Agreement Analysis of Quality Measures for Dimensionality Reduction. Theory, Algorithms, and Applications*. Topological Methods in Data Analysis and Visualization IV, pp. 103–117, Springer, 2017. DOI: [10.1007/978-3-319-44684-4_6](https://doi.org/10.1007/978-3-319-44684-4_6)[↗]
- 2016 88. J. Fangerau, B. Höckendorf, **B. Rieck**, C. Heine, J. Wittbrodt, and H. Leitte: *Interactive Similarity Analysis and Error Detection in Large Tree Collections. Towards Making an Impact*. Visualization in Medicine and Life Sciences III, pp. 287–307, Springer, 2016. DOI: [10.1007/978-3-319-24523-2_13](https://doi.org/10.1007/978-3-319-24523-2_13)[↗]

OTHER PUBLICATIONS

- 2023 89. H. Alhoori, E. A. Fox, I. Frommholz, H. Liu, C. Coupette, **B. Rieck**, T. Ghosal, and J. Wu: *Who can Submit an Excellent Review for this Manuscript in the Next 30 Days? — Peer Reviewing in the Age of Overload*. ACM/IEEE Joint Conference on Digital Libraries (JCDL), pp. 319–320, 2023. DOI: [10.1109/JCDL57899.2023.00077](https://doi.org/10.1109/JCDL57899.2023.00077)



PREPRINTS

- 2023 90. E. Roell and **B. Rieck**: *Differentiable Euler Characteristic Transforms for Shape Classification*. Preprint, 2023. arXiv: [2310.07630](https://arxiv.org/abs/2310.07630) [[cs.LG](#)]
91. S. Kazemina, A. Sadafi, A. Makhro, A. Bogdanova, C. Marr[†], and **B. Rieck**[‡]: *Topologically-Regularized Multiple Instance Learning for Red Blood Cell Disease Classification*. Preprint, 2023. arXiv: [2307.14025](https://arxiv.org/abs/2307.14025) [[cs.LG](#)]
92. D. Bhaskar[†], J. Moore[†], F. Gao, **B. Rieck**, F. Khasawneh, E. Munch, V. Greco[‡], and S. Krishnaswamy[‡]: *Capturing Spatiotemporal Signaling Patterns in Cellular Data with Geometric Scattering Trajectory Homology*. Preprint, 2023. biorXiv: [10.1101/2023.03.22.533807](https://doi.org/10.1101/2023.03.22.533807)
93. **B. Rieck** and C. Coupette: *Evaluating the “Learning on Graphs” Conference Experience*. Preprint, 2023. arXiv: [2306.00586](https://arxiv.org/abs/2306.00586) [[cs.LG](#)]
94. L. Hetzel[†], J. Sommer[†], **B. Rieck**, F. Theis, and S. Günnemann: *MAGNet: Motif-Agnostic Generation of Molecules from Shapes*. Preprint, 2023. arXiv: [2305.19303](https://arxiv.org/abs/2305.19303) [[physics.chem-ph](#)]
95. B. Giunti, J. Lazovskis, and **B. Rieck**: *DONUT – Creation, Development, and Opportunities of a Database*. Preprint, 2023. arXiv: [2304.12417](https://arxiv.org/abs/2304.12417) [[cs.DL](#)]
96. **B. Rieck**: *On the Expressivity of Persistent Homology in Graph Learning*. Preprint, 2023. arXiv: [2302.09826](https://arxiv.org/abs/2302.09826) [[cs.LG](#)]
- 2022 97. C. Weis[†], **B. Rieck**[†], S. Balzer[†], A. Cuénod, A. Egli, and K. Borgwardt: *Improved MALDI-TOF MS based antimicrobial resistance prediction through hierarchical stratification*. Preprint, 2022. biorXiv: [10.1101/2022.04.13.488198v1](https://doi.org/10.1101/2022.04.13.488198v1)
- 2021 98. C. Morris, Y. Lipman, H. Maron, **B. Rieck**, N. M. Kriege, M. Grohe, M. Fey, and K. Borgwardt: *Weisfeiler and Leman go Machine Learning: The Story so far*. Preprint, 2021. arXiv: [2112.09992](https://arxiv.org/abs/2112.09992) [[cs.LG](#)]
99. M. F. Adamer, L. O’Bray, E. De Brouwer, **B. Rieck**[‡], and K. Borgwardt[‡]: *The magnitude vector of images*. Preprint, 2021. arXiv: [2110.15188](https://arxiv.org/abs/2110.15188) [[cs.LG](#)]
100. **B. Rieck**: *Basic Analysis of Bin-Packing Heuristics*. Preprint, 2021. arXiv: [2104.12235](https://arxiv.org/abs/2104.12235) [[math.OC](#)]
- 2020 101. M. Moor, M. Horn, C. Bock, K. Borgwardt, and **B. Rieck**: *Path Imputation Strategies for Signature Models of Irregular Time Series*. Preprint. A preliminary version of this work was accepted for presentation at the ICML Workshop on the Art of Learning with Missing Values (ARTEMISS), 2020. arXiv: [2005.12359](https://arxiv.org/abs/2005.12359) [[cs.LG](#)]

THESES

- 2017 102. **B. Rieck**: *Persistent Homology in Multivariate Data Visualization*. Ph.D. thesis, Heidelberg University, 2017. DOI: [10.11588/heidok.00022914](https://doi.org/10.11588/heidok.00022914)
- 2011 103. **B. Rieck**: *Smoothness Analysis of Subdivision Algorithms*. M.Sc. thesis, Heidelberg University, 2011. DOI: [10.11588/heidok.00013011](https://doi.org/10.11588/heidok.00013011)

INVITED TALKS & GUEST LECTURES

Keynotes at conferences and workshops are highlighted using ; guest lectures (longer than the typical 30 min talk at a seminar) are indicated by . Many lectures are available on [my YouTube channel](#)².

2023

1. *What's in a Graph?* 
Keynote, ECML PKDD Workshop on Mining and Learning with Graphs, Torino
2. *Beyond Message Passing with Geometry and Topology* 
Keynote, ECML PKDD Workshop on Machine Learning for Pharma and Healthcare Applications, Torino
3. *Geometry & Topology in Machine Learning*
Departmental Workshop 'Computer Science Meets Mathematics', University of Barcelona
4. *Curvature for Graph Learning*
Mila - Quebec AI Institute, Montreal, Canada
5. *A Primer on Multi-Scale Topological Kernels*
'Lifting Inference with Kernel Embeddings' Conference, University of Bern
6. *Curvature for Graph Learning*
'Learning on Graphs and Geometry' Seminar, Oxford University
7. *What's in a Graph?*
'I Can't Believe It's Not Better' Seminar Series
8. *Introduction to Graph Learning* 
Seminar on Extended Intelligence, Data Science Lab, University of Bern
9. *Introduction to Topological Machine Learning*
ORIGINS Data Science Laboratory Seminar Series, Excellence Cluster ORIGINS
10. *Curvature for Graph Learning*
Online Machine Learning Seminar, University of Nottingham
11. *Curvature for Graph Learning* 
Seminar on Applications of Geometry and Topology (GEOTOP-A)
12. *Curvature for Graph Learning*
Data Analytics and Machine Learning Group Seminar, Technical University of Munich
13. *Topological Machine Learning: Some Applications of Topological Data Analysis* 
Guest lecture, *Introduction to Topological Data Analysis*, ETH Zurich
14. *Geometry and Topology for Single-Cell Data Analysis*
Workshop on Novel Technologies for Programming Human Cell Fate, Kent, UK
15. *Topology-Based Graph Learning* Workshop on Computational Topology & Quantum Computing, Quantum Leap Africa, Kigali, Rwanda
16. *Topology-Based Graph Learning*
Topological Data Analysis Seminar, Northeastern University
17. *Towards Topological Machine Learning: An Emerging Research Field*
Centre for Artificial Intelligence and Data Science (CAIDAS), Würzburg University
18. *Introduction to Topological Data Analysis* 
Guest lecture, *Theoretical Foundations of Data Science* (STT 3795), Université de Montréal
19. *Zoom and Enhance: Towards Multi-Scale Representations in the Life Sciences*
'Frontiers of Artificial Intelligence in Health Care' Workshop, University of Seville, Baeza
20. *Introduction to Topological Data Analysis* 
Guest lecture, *Geometric and Topological Methods in Machine Learning* (MATH 322a), Yale University
21. *A Good Shape is Hard to Find: Shape Analysis Using Topology* 
Machine Learning Frontiers in Precision Medicine (MLFPM) Symposium 2022, Max Planck Institute of Psychiatry, Munich
22. *Geometrical-Topological Loss Terms for Shape Reconstruction*
'Topology of Data' Workshop, Tor Vergata University of Rome

2022

23. *Topology-Based Graph Learning*
'Learning on Graphs Seminar', organized by Min Zhou (Noah's Ark Lab)
24. *Topology-Based Graph Learning* 
'Workshop on Theoretical and Mathematical Aspects of Deep Learning', UC Chile
25. *The Memory of Persistence* 
Keynote, 'ICML 2022 Workshop on Topology, Algebra, and Geometry in Machine Learning', Baltimore
26. *A Gentle Introduction to Topological Machine Learning* 
Keynote, 'BrainNet Workshop', Digital Futures, KTH Royal Institute of Technology
27. *A Good Scale is Hard to Find: Shape Analysis Using Topology*
'BrainNet Workshop', Digital Futures, KTH Royal Institute of Technology
28. *Topology-Based Graph Learning*
Complex Networks Analysis Discussion Group, National Centre for Scientific Research 'Demokritos'
29. *Zoom and Enhance: Towards Multi-Scale Representations in the Life Sciences*
GOTBIN seminar (Gothenburg Bioinformatics Network), Gothenburg University
30. *Topology-Based Graph Learning*
'BMI Grand Rounds' seminar, Department of Biomedical Informatics, Stony Brook University
31. *A Good Scale is Hard to Find: Shape Analysis Using Topology*
AstraZeneca, AI & Applications Seminar Series, Cambridge, UK
32. *Topological Representation Learning: A Differentiable Perspective*
TDA Week, a week-long workshop on recent advances in topological data analysis, Kyoto University
33. *Topology-Based Graph Learning*
Applied Topology Seminar, Oxford University
34. *Zoom and Enhance: Towards Multi-Scale Representations in the Life Sciences*
'AI4Science' seminar, Chalmers University
- 2021 35. *Topology-Driven Diffusion in Structured and Unstructured Data Sets*
Applied Topology Seminar, Prof. Dr. Kathryn Hess Bellwald, EPFL
36. *Good Gradients & How To Find Them: Towards Multi-Scale Representation Learning*
TransSYS Data Analysis Winter School on Data Analysis for Precision Medicine, Paris
37. *Topological Graph Neural Networks*
Applied Algebraic Topology Research Network
38. *Learning Topology-Based Graph Representations*
Thematic Mini-Conference on Computational Topology and Machine Learning (part of the Thematic Einstein Semester on Geometric and Topological Structure of Materials), TU Berlin
39. *Multi-Scale Topological Representations*
HGS MathComp Annual Retreat, Heidelberg University
40. *Learning Topology-Based Graph Representations*
Michigan State University TDA Seminar
41. *A Short Introduction to Multifiltrations*
Yale SUMRY 2021, Yale University
42. *An Introduction to Computational Topology*
Yale SUMRY 2021, Yale University
43. *Topological Representation Learning for Structured and Unstructured Data*
DATASHAPE seminar of Inria Sophia Antipolis
- 2020 44. *Recent Advances in Topology-Based Graph Classification*
Applied Mathematics Seminar, Yale University
45. *A Primer in Topological Data Analysis* 
Guest lecture, *Geometric Data Analysis* (MAT 6493), Université de Montréal
46. *Machine learning for Personalised Medicine*
Young Scientists Lunch Webinar, Swiss Society for Biomaterials and Regenerative Medicine

47. *Advances in Topology-Based Graph Classification*
DATASIG Seminar, Oxford University
48. *Advances in Topology-Based Graph Classification*
Machine Learning Seminar, Twitter, London
49. *Topological Data Analysis for Machine Learning*
Half-day tutorial, ECML PKDD, Ghent
50. *Topology-Based Representation Learning*
Applied Topology Seminar, Prof. Dr. Kathryn Hess Bellwald, EPFL
51. *Topological Data Analysis for fMRI Data*
Krishnaswamy Lab, Yale University
52. *Introduction to Topology-Based Graph Classification*
Applied Machine Learning Days, AI & Topology Track, EPFL
- 2019 53. *Perspectives in Persistent Homology* 
Keynote, Applications in Topological Data Analysis Workshop, ECML PKDD, Würzburg
- 2018 54. *Statistically Significant Shapelet Mining for Biomedical Time Series*
Research group Prof. Dr. Filip Sadlo, Heidelberg University
- 2017 55. *Persistent Homology for Data Analysis*
Research group Prof. Dr. Karsten Borgwardt, ETH Zurich
- 2016 56. *Aspects of Human Perception* 
Guest lecture, Interdisciplinary Centre for Scientific Computing, Heidelberg University
57. *An Introduction to Persistent Homology*
Public lecture, Heidelberg Chapter of SIAM,³ Heidelberg University
58. *Ein Bild sagt mehr als tausend Worte: Graphische Darstellungen komplexer Daten*
Public lecture, Heidelberg University
59. *Persistent Homology for Multivariate Data Visualization*
Research group Dr. Julien Tierny, Sorbonne Universités UPMC, Paris
- 2015 60. *Aspects of Human Perception* 
Guest lecture, Interdisciplinary Centre for Scientific Computing, Heidelberg University
- 2014 61. *The Poincaré Conjecture and the Shape of the Universe*
Public lecture, Löwenrot Gymnasium,⁴ St. Leon-Rot
- 2013 62. *Weniger Klartext reden!*
Public lecture, Science Academy, Heidelberg University
- 2012 63. *The Poincaré Conjecture*
Public lecture, Science Academy, Heidelberg University
- CONFERENCE & WORKSHOP TALKS
- 2023 64. Panelist, ‘Who can submit an excellent review for this manuscript in the next 30 days?’ — *Peer Reviewing in the Age of Overload*
ACM/IEEE Joint Conference on Digital Libraries, Santa Fe, NM, USA
- 2022 65. *Geometrical–Topological Loss Terms for Shape Analysis*
BIRS Workshop on ‘Deep Exploration of Non-Euclidean Data with Geometric and Topological Representation Learning’, Kelowna, Canada
66. *Topology-Based Graph Learning*
Dagstuhl Seminar ‘Graph Embeddings: Theory meets Practice’, Dagstuhl, Germany
- 2021 67. *Topological Graph Neural Networks*
Lightning Talk at the 2nd Workshop on Topological Methods in Data Analysis, Heidelberg University, Germany (virtual talk)

³Society for Industrial and Applied Mathematics⁴A private German high school

68. *Topology-Based Graph Representation Learning*
Oxford Machine Learning Summer School ‘Unconference’ Track (virtual talk)
69. *Recent Advances in Topology-Based Graph Classification*
IMSI Workshop on Topological Data Analysis (virtual talk)
- 2020 70. *Uncovering the Topology of Time-Varying fMRI Data using Cubical Persistence* (spotlight presentation)
Advances in Neural Information Processing Systems (NeurIPS), Vancouver, Canada (virtual talk)
71. *Topological Methods for fMRI Data*
ICML Workshop on Computational Biology, Vienna, Austria (virtual talk)
- 2019 72. *A Persistent Weisfeiler–Lehman Procedure for Graph Classification*
International Conference on Machine Learning (ICML), Long Beach, CA, USA
- 2018 73. *An Enchiridion for Topological Data Analysis*
Basel Postdoc Retreat, Klosters, Switzerland
- 2017 74. *Persistence Concepts for 2D Skeleton Evolution Analysis*
Workshop on Topology-Based Methods in Visualization (TopoInVis), Tokyo, Japan
75. *Hierarchies and Ranks for Persistence Pairs*
Workshop on Topology-Based Methods in Visualization (TopoInVis), Tokyo, Japan
- 2016 76. *‘Shall I compare thee to a network?’—Visualizing the Topological Structure of Shakespeare’s Plays*
Workshop on Visualization for the Digital Humanities at IEEE VIS, Baltimore, MD, USA
77. *Exploring and Comparing Clusterings of Multivariate Data Sets using Persistent Homology*
EuroVis, Groningen, Netherlands
- 2015 78. *Comparing Dimensionality Reduction Methods Using Data Descriptor Landscapes*
Symposium on Visualization in Data Science at IEEE Vis, Chicago, IL, USA
79. *Structural Analysis of Multivariate Point Clouds*
EuroVis, Cagliari, Italy
80. *Persistent Homology for the Evaluation of Dimensionality Reduction Schemes*
EuroVis, Cagliari, Italy
81. *Analysis of Quality Measures for Dimensionality Reduction*
Workshop on Topology-Based Methods in Visualization (TopoInVis), Annweiler, Germany
- 2014 82. *Enhancing Comparative Model Analysis Using Persistent Homology*
IEEE Vis Workshop on Visualization for Predictive Analytics, Paris, France
- 2013 83. *Castle Meets Computer*
Digital Geoarchaeology, Heidelberg, Germany
- 2012 84. *Multivariate Data Analysis Using Persistence-Based Filtering and Topological Signatures*
IEEE VisWeek, Seattle, WA, USA
- INTERNAL TALKS
- 2023 85. *Digital Emancipation: Create Your Own Research Website*
‘STEM-Tisch,’ Helmholtz Munich, Germany
- 2021 86. *Good Gradients & How To Find Them: Towards Multi-Scale Representation Learning*
Computational Health Seminar, Helmholtz Munich, Germany
87. *Topological Machine Learning for Biomedicine*
Helmholtz Pioneer Campus Retreat, Herrsching, Germany
88. *Diffusion in Structured and Unstructured Data*
Research group Prof. Dr. Karsten Borgwardt, ETH Zurich, Switzerland
89. *A Bestiary of Autoencoders*
‘Digital Campus’ of D-BSSE,⁵ ETH Zurich, Switzerland
- 2020 90. *Multi-Scale Topological Representations*
D-BSSE Webinar, ETH Zurich, Switzerland

⁵Department of Biosystems Science and Engineering

91. *Advances in Topology-Based Representation Learning*
Research group Prof. Dr. Karsten Borgwardt, ETH Zurich, Switzerland
92. *The Many Faces of Manifolds: An Introduction to Topological Data Analysis*
Intra-departmental seminar of D-BSSE, ETH Zurich, Switzerland
- 2019 93. *Path Signatures: Theory & Applications*
Research group Prof. Dr. Karsten Borgwardt, ETH Zurich, Switzerland
94. *A Persistent Weisfeiler–Lehman Procedure for Graph Classification*
Research group Prof. Dr. Karsten Borgwardt, ETH Zurich, Switzerland
- 2018 95. *Level Sets for Time Series Analysis*
Research group Prof. Dr. Karsten Borgwardt, ETH Zurich, Switzerland
96. *Neural Persistence: A Complexity Measure for Deep Neural Networks Using Algebraic Topology*
Research group Prof. Dr. Karsten Borgwardt, ETH Zurich, Switzerland
97. *Time Series Analysis*
Research group Prof. Dr. Karsten Borgwardt, ETH Zurich, Switzerland
98. *Persistent Homology and Networks*
Research group Prof. Dr. Karsten Borgwardt, ETH Zurich, Switzerland
- 2017 99. *A Gentle Introduction to Gaussian Processes*
Research group Prof. Dr. Filip Sadlo, Heidelberg University, Germany
100. *A Primer in VTK & Python*
Research group Prof. Dr. Christoph Garth, Kaiserslautern University, Germany
101. *Persistent Homology for Complex Network Analysis*
Research group Prof. Dr. Filip Sadlo, Heidelberg University, Germany
102. *Persistent Homology in Multivariate Data Visualization*
Research group Prof. Dr. Filip Sadlo, Heidelberg University, Germany
- 2016 103. *Shakespearean Social Network Analysis using Topological Methods*
Research group Prof. Dr. Filip Sadlo, Heidelberg University, Germany
- 2015 104. *How to Present Research Results*
HGS MathComp Presentation Workshop, Heidelberg University, Germany
- 2014 105. *Persistent Homology for Similarity Analysis*
Research group Prof. Dr. Heike Leitte, Heidelberg University, Germany
- 2013 106. *C++11 Programming Concepts*
Research group Prof. Dr. Heike Leitte, Heidelberg University, Germany
107. *Oh my god, it's full of data—A Biased & Incomplete Introduction to Visualization*
HGS MathComp Fellows Seminar, Heidelberg University, Germany
- 2012 108. *Applied Algebraic Topology*
Research group Prof. Dr. Heike Leitte, Heidelberg University

TEACHING EXPERIENCE

- 2023 • Substitute lecturer, *Statistical Learning*, Technical University of Munich
- 2022 • Taught a three-day course on *Synergies between Topological Data Analysis and Machine Learning* as part of the ‘STRUCTURES Cluster of Excellence’ of Heidelberg University.
- 2021 • Mentor and lecturer for the *Diffusion Geometry and Topology* project of the [Summer Undergraduate Maths Research at Yale](#)[☞] (SUMRY) programme.
- 2020 • Lecturer and teaching assistant, *Data Mining I*, ETH Zurich
- Substitute lecturer, *Data Mining II*, ETH Zurich
- 2019 • Substitute lecturer, *Data Mining I*, ETH Zurich
- 2018 • Lecturer and teaching assistant, *Data Mining I*, ETH Zurich
- 2017 • Teaching assistant, *Scientific Visualisation*, Kaiserslautern University

- 2014 • Teaching assistant, *Algorithmische Geometrie*,⁶ Heidelberg University
- 2013 • Teaching assistant, *Wissenschaftliche Visualisierung in den Natur- und Technikwissenschaften*,⁷ Heidelberg University
- 2012 • Seminar assistant, *Spezielle Themen der Wissenschaftlichen Visualisierung*,⁸ Heidelberg University

STUDENTS

- 2023–now • Sebastian Birk (Ph.D., Technical University of Munich)
- Corinna Coupette (Ph.D., Saarland University & Max Planck Institute for Informatics)
- 2022–now • Lydia Mezrag (Ph.D., Université de Montréal)
- Katharina Limbeck (Ph.D., Technical University of Munich)
- Salome Kazeminia (Ph.D., Technical University of Munich)
- Ernst Roell (Ph.D., Technical University of Munich)
- Jeremy Wayland (Ph.D., Technical University of Munich)
- Julius von Rohrscheidt (Ph.D., Technical University of Munich)

THESIS COMMITTEES

- 2023 • Alexandros Keros (Ph.D., University of Edinburgh)
- Beichen Gao (Ph.D., ETH Zurich)
- Uzu Lim (Ph.D., Oxford University)
- Corinna Coupette (Ph.D., Saarland University & Max Planck Institute for Informatics)
- Davide Buffelli (Ph.D., University of Padova)
- 2020 • Robin Vandaele (Ph.D., Ghent University)

THESIS AND PROJECT CO-SUPERVISION

- 2023 1. Franz Srambical: *Graph Filtration Surfaces: A Multi-Scale Approach to Dynamic Graph Representation*
B.Sc. thesis, Technical University of Munich
- 2. Niklas Kiermeyer: *Explainable Comparative Analysis of Modern Survival Models and Patient Similarity Networks: A Case Study for Cancer Patients*
M.Sc. thesis, Technical University of Munich
- 3. Yevhenii Sharapov: *Towards Sparse Topological Shape Reconstruction (working title)*
M.Sc. thesis, Technical University of Munich
- 4. Barış Onarıcı: *Neural Approximations to Gromov–Hausdorff Distances*
M.Sc. thesis, Technical University of Munich
- 5. Kalyan Varma Nadimpalli: *Weighted Euler Characteristic Transform based Topological Loss for Reconstructing 3D Images from Single 2D Slices*
M.Sc. thesis, IIIT Bangalore
- 2022 6. Ferdinand Hölzl: *Analysis of Air Quality Data*
Semester project, Helmholtz Munich
- 7. Artur Szałata: *Representation Learning for Multimodal Single-Cell Data*
Semester Project, EPFL
- 8. Marek Černý: *Persistent Homology and Neural Networks*
M.Sc. thesis, Charles University (primary supervisor: Robert Šámal)
- 2021 9. Julius Wenckstern: *Failure Modes of Evaluation Metrics in Molecule Generation*
Lab rotation, ETH Zurich (primary supervisor: Karsten Borgwardt)

⁶Computational Geometry⁷Scientific Visualisation in the Natural and Engineering Sciences⁸Special Topics in Scientific Visualisation

10. Adrish Dey: *Discrete Non-Euclidean Convolutions: Signal Processing and Random Walks on Simplicial Complexes*
B.Sc. thesis, Netaji Subhash Engineering College
11. Louis Lukas: *Validating Data-Driven Approaches to Resolution of Heterogeneity in Alzheimer's Disease*
M.Sc. thesis, ETH Zurich (primary supervisor: Karsten Borgwardt)
12. Falko Noé: *Topological Layers for Neural Networks*
M.Sc. thesis, ETH Zurich (primary supervisor: Karsten Borgwardt)
13. Jeanne Fernandez: *Topological Comparisons of Generative Adversarial Networks*
M.Sc. thesis, ETH Zurich (primary supervisor: Marloes Maathuis)
14. Aurel Pichollet–Mugnier: *Multi-Scale Representation Learning in Persistent Homology*
M.Sc. thesis, ETH Zurich (primary supervisor: Marloes Maathuis)
- 2020 15. Louis Lukas: *Feature Extraction Methods for fMRI and sMRI Data Sets*
Lab rotation, ETH Zurich (primary supervisor: Karsten Borgwardt)
16. Falko Noé: *Persistence Set Functions*
Lab rotation, ETH Zurich (primary supervisor: Karsten Borgwardt)
17. Etienne Sollier: *Topological Methods for Network Classification*
Lab rotation, ETH Zurich (primary supervisor: Karsten Borgwardt)
- 2019 18. Philipp Nikolaus: *Graph Neural Tangent Kernels*
M.Sc. thesis, ETH Zurich (primary supervisor: Marloes Maathuis)
19. Moritz Gück: *An Ant Colony Optimization Algorithm for Combinatorial Shapelet Mining*
Lab rotation, ETH Zurich (primary supervisor: Karsten Borgwardt)
20. Leslie O'Bray: *Learning Vector Representations of Graphs Using Recurrent Neural Network Autoencoders*
M.Sc. thesis, ETH Zurich (primary supervisor: Marloes Maathuis)
- 2018 21. Jens Beyermann: *Analyse persistenter Homologie auf Graphen*
B.Sc. thesis, Heidelberg University (primary supervisor: Filip Sadlo)
- 2017 22. Kai Sdeo: *Visualization of Laser-Induced Fullerene Fragmentation*
M.Sc. thesis, Heidelberg University (primary supervisor: Filip Sadlo)
- 2015 23. Daniel Beyer: *Using Pathline Data Depth to Analyse Time-Dependent Vector Fields*
M.Sc. thesis, Heidelberg University (primary supervisor: Heike Leitte)
24. Karsten Hanser: *Visualisierung hochdimensionaler skalarer Felder mittels Graßmann-Mannigfaltigkeiten*
B.Sc. thesis, Heidelberg University (primary supervisor: Heike Leitte)
25. Jan Greulich: *Rekonstruktion von segmentierten Grenzschichten mittels B-Spline Fitting*
B.Sc. thesis, Heidelberg University (primary supervisor: Heike Leitte)
26. Markus Kurz: *Quality-Based Ranking of Scatter Plots for Dimensionality Reduction*
M.Sc. thesis, Heidelberg University (primary supervisor: Heike Leitte)
- 2013 27. Daniel Beyer: *Implementierung und Parameteruntersuchung zur Transferfunktionsbestimmung für Volumendaten mittels Segmentierung des Intensität-Gradient-Histogramms*
B.Sc. thesis, Heidelberg University (primary supervisor: Heike Leitte)
- 2012 28. Alexander Eck: *Clustering Algorithms for Cell Cycle Phase Detection*
M.Sc. thesis, Heidelberg University (primary supervisor: Heike Leitte)

SERVICE TO THE COMMUNITY

I am actively serving the community as a board member, reviewer, and organiser. Moreover, I am promoting STEM research in general and my research in particular by participating in outreach activities.

CONFERENCE & WORKSHOP ORGANISATION

- 2024 • Scientific Committee Member, London Geometry and Machine Learning Summer School (LOGML)
- 2023 • Organised [SampTA](#)[☞], the 14th International Conference on Sampling Theory and Applications. Also serving as programme chair for the conference.
- Organised a workshop on ‘Topology, Algebra, and Geometry for Machine Learning’ as part of ICML 2023.
- Organised a workshop on ‘Topology, Algebra, and Geometry for Pattern Recognition with Applications’ as part of CVPR 2023.
- 2022 • Serving as a programme chair for the first conference on [Learning on Graphs \(LoG\)](#)[☞]
- Organised a BIRS Workshop on [Deep Exploration of Non-Euclidean Data with Geometric and Topological Representation Learning](#)[☞]
- Organised an ICLR 2022 workshop on [Geometrical and Topological Representation Learning](#)[☞].
- 2021 • Organised a NeurIPS 2021 competition on [Multimodal Single-Cell Data Integration](#)[☞].
- Organised an ICLR 2021 workshop on [Geometrical and Topological Representation Learning](#)[☞].
- Organiser and panel moderator for a track on [Clinical Machine Learning](#)[☞] at the Applied Machine Learning Days 2021, which brings together practitioners and researchers to showcase state-of-the-art machine learning models for the clinical practice.
- Organised a NeurIPS 2020 workshop [Topological Data Analysis and Beyond](#)[☞], which brings together experts, users, and industry practitioners to discuss the future of the field.
- Organised a workshop on [Introduction to Machine Learning for Biology](#)[☞] by creating slides and designing exercises.
- Organised the hackathon [CollaborationFest 2019](#)[☞] by scouting for an appropriate location, providing logistics and setting up networking equipment.

EDITORIAL BOARD MEMBERSHIPS

- Editorial board member for the journal ‘Machine Learning’
- Editorial board reviewer for the ‘Journal of Machine Learning’ (JMLR)

GRANT REVIEWING

- 2023 • Dutch Research Council (NWO, *Nederlandse Organisatie voor Wetenschappelijk Onderzoek*)
- 2021 • National Science Centre of Poland (*Narodowe Centrum Nauki*)

HIRING COMMITTEE MEMBERSHIPS

- 2023 • Reviewing applications for Principal Investigator positions, Institute of AI for Health, Helmholtz Munich
- 2022 • Expert reviewer, AI Health Innovation Cluster, German Cancer Research Center & Heidelberg University
- 2021 • External reviewer, SEAS Postdoctoral Research Fellow in Topological and Geometric Machine Learning for Marine Sustainability, University of Bergen (*Universitetet i Bergen*)

OUTREACH

- 2023
- Giving a talk on *Why Mathematicians confuse coffee cups with doughnuts* on algebraic topology and the Poincaré conjecture as part of the ‘Pint of Science’ science festival.
 - Participating again in ‘I’m a Scientist, Get me out of here!’ to discuss recent advances in machine learning and artificial intelligence.
- 2022
- Participating in ‘I’m a Scientist, Get me out of here!’ to communicate complex questions in machine learning and computational healthcare to school classes.
- 2020
- Participating again in [Skype a Scientist](#)⁸.
 - Participating in the ‘Machine Learning Mentors’ and ‘Black in STEM’ programmes, i.e. informal lists of researchers willing to provide additional guidance to minority groups. I am mentoring young researchers by providing feedback on their texts, pointing out additional resources, and serving as an informal reviewer of their work.
 - Contributed a book chapter entitled *Immer wieder ins kalte Wasser*⁹ detailing my postdoctoral research. The chapter is part of a collection of testimonials of researchers, to be published by ‘e-fellows’, a German invite-only career network for academics.
- 2019
- Created [TDA in ML](#)⁸, a Slack community to discuss topological machine learning. As of today, there are more than 1,300 members discussing papers, preprints, and potential collaborations.
 - Participating in [Skype a Scientist](#)⁸, an organisation that matches school classes and prison inmates with scientists to discuss their research.
- 2017
- Contributed a book chapter entitled *Vom Mathematiker zum Pixelschubser*¹⁰ discussing my Ph.D. research. The chapter is part of a collection of testimonials of researchers, to be published by ‘e-fellows’, a German invite-only career network for academics.
- 2016
- Gave a public lecture on visualising complex data sets as part of the series *Akademische Mittagspause*.¹¹
- 2013–2015
- As part of the annual [Heidelberg Laureate Forum](#)⁸—a gathering of world-renowned computer scientists and mathematicians—I have been working with school classes and adults to discuss mathematical aspects of films shown in the *Heidelberg Laureate Forum Film Festival*.

PROGRAMME COMMITTEE MEMBERSHIPS

Since 2023, I am serving as an *area chair* for NeurIPS. I am also a regular reviewer for conferences, journals, and workshops in my field. Among others, I have been reviewing for the following venues:

- *Conferences*

ACM Symposium on Computational Geometry (SoCG)	2021
Advances in Neural Information Processing Systems (NeurIPS)	2018–2023
European Conference on Machine Learning and Data Mining (ECML PKDD)	2019
International Conference on Learning Representations (ICLR)	2018–2023
International Conference on Machine Learning (ICML)	2018–2023
IJCAI-PRICAI	2020
Intelligent Systems for Molecular Biology (ISMB)	2018–2020
Machine Learning in Computational Biology (MLCB)	2019–2021
Machine Learning for Healthcare (MLHC)	2020–2021
SIAM Symposium on Algorithm Engineering and Experiments (ALENEX)	2022
Uncertainty in Artificial Intelligence (UAI)	2021
- *Journals*

Advances in Data Analysis and Classification	2022
Entropy	2022
IEEE Access	2017
IEEE Transactions on Signal Processing	2017
OUP Bioinformatics	2018–2023
OUP Bioinformatics Advances	2021

⁸The title refers to being in deep water (and thus a little bit uncomfortable) during large parts of my career.

¹⁰The title can be loosely translated as *From mathematician to pixel tamer*.

¹¹The *Academic Lunch Break* consists of a series of 15 min lectures to the general public about current research topics.

OUP Transactions of Mathematics and Its Applications	2023
Journal of Applied and Computational Topology (JACT)	2021
Journal of Machine Learning Research (JMLR)	2018–2023
Machine Learning	2021–2023
Transactions on Machine Learning Research	2022–2023
zbMATH	2021–2023
• <i>Workshops</i>	
ICML Workshop on Topology, Algebra, and Geometry in Machine Learning	2022
Machine Learning for Pharma & Healthcare Applications (PharML)	2020–2021
NeurIPS Competition Track	2022
NeurIPS Datasets and Benchmarks Track	2022
New in ML	2019–2022
Topological Data Analysis and its Applications for Medical Data	2021
Topological Methods in Data Analysis and Visualization (TopoInVis)	2017
Women in Computational Topology	2021

SOCIAL MEDIA

Since 2006, I am running a [personal blog](#). My posts typically deal with mathematical or technical subjects and I aim to explain complicated phenomena or techniques in an accessible manner. The blog enjoys a sizeable number of readers, receiving over 5.5 million page views since 2017, and my articles are featured on platforms such as [Hacker News](#) or the [Blog on Maths Blogs](#) of the American Mathematical Society. Since its official inception in 2020, my channel acquired more than 1,000 subscribers and more than 35,000 views.

REFERENCES

PROF. DR. KARSTEN BORWARDT
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PROF. DR. GUY WOLF
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