Ulrich Bauer

Prof. Dr.

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Education and academic positions

since 11/2020 **Technical University of Munich**, *Associate Professor (W3)*, Department of Mathematics.
Applied and Computational Topology

11/2014–10/2020 **Technical University of Munich**, *Assistant Professor (W2)*, Department of Mathematics.
Applied and Computational Topology

3/2012–10/2014 **IST Austria**, *postdoctoral research fellow*, Computational Geometry & Topology.
Mentor: Prof. Herbert Edelsbrunner

7/2011 **Dr. rer. nat. (mathematics)**, *summa cum laude (with distinction)*, University of Göttingen.
Thesis: *Persistence in discrete Morse theory*

8/2008–2/2012 **University of Göttingen**, *research assistant*, Discrete Differential Geometry Lab, Institute of Numerical and Applied Mathematics.
Advisor: Prof. Max Wardetzky

5/2006–7/2008 **Freie Universität Berlin**, *research assistant*, Mathematical Geometry Processing, Institute of Mathematics.
Advisors: Prof. Konrad Polthier, Dr. Max Wardetzky

11/2005 **Dipl.-Inf. Univ. (computer science, minor in mathematics)**, *mit Auszeichnung (with distinction)*, Technical University of Munich.

10/2000–9/2005 **Technical University of Munich**, *diploma student*, major in computer science, minor in mathematics.

9/1998–7/2000 **Richard Strauss Conservatory Munich**, *junior student*, piano.
Advisors: Halina Siedzieniewska-Alberth, Yasuko Matsuda

Publications

Preprints

[1] U. Bauer. Ripser: efficient computation of Vietoris–Rips persistence barcodes. Preprint. arXiv: 1908.02518. Accepted to *Journal of Applied and Computational Topology*.

[2] U. Bauer, M. B. Botnan and B. Fluhr. Universality of the bottleneck distance for extended persistence diagrams. Preprint. arXiv: 2007.01834.

[3] U. Bauer, D. Hien, O. Junge, K. Mischaikow and M. Snijders. Combinatorial models of global dynamics: learning cycling motion from data. arXiv: 2001.07066. Accepted to *ENOC2020+1: 10th European Nonlinear Dynamics Conference*.

[4] U. Bauer, C. Landi and F. Mémoli. The Reeb graph edit distance is universal. Preprint. arXiv: 1801.01866. Submitted to *Foundations of Computational Mathematics*.

[5] U. Bauer and F. Pausinger. Persistent Betti numbers of random Čech complexes. Preprint. arXiv: 1801.08376. Submitted to *Discrete & Computational Geometry*.

Peer-reviewed original work

[6] U. Bauer, H. Edelsbrunner, G. Jabłoński and M. Mrozek. Čech–Delaunay gradient flow and homology inference for self-maps. *Journal of Applied and Computational Topology*, 2020. DOI: 10.1007/s41468-020-00058-8.

[7] U. Bauer, M. B. Botnan, S. Oppermann and J. Steen. Cotorsion torsion triples and the representation theory of filtered hierarchical clustering. *Advances in Mathematics*, 369:107171, 2020. DOI: 10.1016/j.aim.2020.107171.

[8] U. Bauer, C. Landi and F. Mémoli. The Reeb Graph Edit Distance Is Universal. In *36th International Symposium on Computational Geometry (SoCG 2020)*, volume 164, 15:1–15:16, 2020. DOI: 10.4230/LIPIcs.SoCG.2020.15.

[9] U. Bauer and M. Lesnick. Persistence diagrams as diagrams: a categorification of the stability theorem. In *The Abel Symposium 2018: Topological Data Analysis*, pages 67–96. Springer International Publishing, 2020. DOI: 10.1007/978-3-030-43408-3_3.

[10] U. Bauer and A. Rathod. Hardness of approximation for Morse matching. In *Proceedings of the Thirtieth Annual ACM-SIAM Symposium on Discrete Algorithms*, pages 2663–2674, 2019. DOI: 10.1137/1.9781611975482.165.

[11] U. Bauer, A. Rathod and J. Spreer. Parametrized Complexity of Expansion Height. In *27th Annual European Symposium on Algorithms (ESA 2019)*, volume 144, 13:1–15, 2019. DOI: 10.4230/LIPIcs.ESA.2019.13.

[12] M. Carrière and U. Bauer. On the Metric Distortion of Embedding Persistence Diagrams into Separable Hilbert Spaces. In *35th International Symposium on Computational Geometry (SoCG 2019)*, volume 129, 21:1–15, 2019. DOI: 10.4230/LIPIcs.SoCG.2019.21.

[13] U. Bauer and H. Edelsbrunner. The Morse theory of Čech and Delaunay complexes. *Transactions of the American Mathematical Society*, 369(5):3741–3762, 2017. DOI: 10.1090/tran/6991.

[14] U. Bauer, M. Kerber, J. Reininghaus and H. Wagner. PHAT – persistent homology algorithms toolbox. *Journal of Symbolic Computation*, 78:76–90, 2017. DOI: 10.1016/j.jsc.2016.03.008.

[15] U. Bauer, A. Munk, H. Sieling and M. Wardetzky. Persistence barcodes versus Kolmogorov signatures: detecting modes of one-dimensional signals. *Foundations of Computational Mathematics*, 17(1):1–33, 2017. DOI: 10.1007/s10208-015-9281-9.

[16] U. Bauer, B. D. Fabio and C. Landi. An Edit Distance for Reeb Graphs. In *Eurographics Workshop on 3D Object Retrieval*. The Eurographics Association, 2016. DOI: 10.2312/3dor.20161084.

[17] D. Attali, U. Bauer, O. Devillers, M. Glisse and A. Lieutier. Homological reconstruction and simplification in $\mathbb{R}^3$. *Computational Geometry*, 48(8):606–621, 2015. DOI: 10.1016/j.comgeo.2014.08.010.

[18] U. Bauer and M. Lesnick. Induced matchings and the algebraic stability of persistence barcodes. *Journal of Computational Geometry*, 6(2):162–191, 2015. DOI: 10.20382/jocg.v6i2a9.

[19] U. Bauer, E. Munch and Y. Wang. Strong equivalence of the interleaving and functional distortion metrics for Reeb graphs. In *31st International Symposium on Computational Geometry (SoCG 2015)*, pages 461–475, 2015. DOI: 10.4230/LIPIcs.SOCG.2015.461.

[20] R. Kwitt, S. Huber, M. Niethammer, W. Lin and U. Bauer. Statistical topological data analysis – a kernel perspective. In *Advances in Neural Information Processing Systems 28*, pages 3052–3060. Curran Associates, Inc., 2015. URL: http://papers.nips.cc/paper/5887-statistical-topological-data-analysis-a-kernel-perspective.pdf.

[21] J. Reininghaus, S. Huber, U. Bauer and R. Kwitt. A stable multi-scale kernel for topological machine learning. In *Conference on Computer Vision and Pattern Recognition (CVPR 2015)*, pages 4741–4748. IEEE, 2015. DOI: 10.1109/CVPR.2015.7299106.

[22] U. Bauer and H. Edelsbrunner. The Morse theory of Čech and Delaunay filtrations. In *Thirtieth annual symposium on Computational geometry (SoCG '14)*, pages 484–490, New York, NY, USA. ACM, 2014. DOI: 10.1145/2582112.2582167.

[23] U. Bauer, X. Ge and Y. Wang. Measuring distance between Reeb graphs. In *Thirtieth annual symposium on Computational geometry (SoCG '14)*, pages 464–473, New York, NY, USA. ACM, 2014. DOI: 10.1145/2582112.2582169.

[24] U. Bauer, M. Kerber and J. Reininghaus. Clear and compress: computing persistent homology in chunks. In *Topological Methods in Data Analysis and Visualization III*, Mathematics and Visualization, pages 103–117. Springer International Publishing, 2014. DOI: 10.1007/978-3-319-04099-8_7.

[25] U. Bauer, M. Kerber and J. Reininghaus. Distributed computation of persistent homology. In *Proceedings of the Sixteenth Workshop on Algorithm Engineering and Experiments (ALENEX'14)*, pages 31–38. SIAM, 2014. DOI: 10.1137/1.9781611973198.

[26] U. Bauer, M. Kerber, J. Reininghaus and H. Wagner. PHAT – persistent homology algorithms toolbox. In *Mathematical Software – ICMS 2014*, volume 8592 of *Lecture Notes in Computer Science*, pages 137–143. Springer Berlin Heidelberg, 2014. DOI: 10.1007/978-3-662-44199-2_24.

[27] U. Bauer and M. Lesnick. Induced matchings of barcodes and the algebraic stability of persistence. In *Thirtieth annual symposium on Computational geometry (SoCG '14)*, pages 355–364, New York, NY, USA. ACM, 2014. DOI: 10.1145/2582112.2582168.

[28] D. Attali, U. Bauer, O. Devillers, M. Glisse and A. Lieutier. Homological reconstruction and simplification in $\mathbb{R}^3$. In *Proceedings of the twenty-ninth annual symposium on Computational geometry (SoCG '13)*, pages 117–126, New York, NY, USA. ACM, 2013. DOI: 10.1145/2462356.2462373.

[29] U. Bauer, C. Lange and M. Wardetzky. Optimal topological simplification of discrete functions on surfaces. *Discrete & Computational Geometry*, 47(2):347–377, 2012. DOI: 10.1007/s00454-011-9350-z.

[30] U. Bauer, K. Polthier and M. Wardetzky. Uniform convergence of discrete curvatures from nets of curvature lines. *Discrete & Computational Geometry*, 43(4):798–823, June 2010. DOI: 10.1007/s00454-009-9237-4.

[31] U. Bauer and K. Polthier. Generating parametric models of tubes from laser scans. *Computer-Aided Design*, 41(10):719–729, Oct. 2009. DOI: 10.1016/j.cad.2009.01.002.

[32] U. Bauer and K. Polthier. Detection of Planar Regions in Volume Data for Topology Optimization. In *Advances in Geometric Modeling and Processing (GMP '08)*, pages 119–126, 2008. DOI: 10.1007/978-3-540-79246-8_9.

[33] U. Bauer and K. Polthier. Parametric Reconstruction of Bent Tube Surfaces. In *2007 International Conference on Cyberworlds (CW'07)*, pages 465–474. IEEE Computer Society, 2007. DOI: 10.1109/CW.2007.59.

Other publications

[34] U. Bauer, C. B. Schönlieb and M. Wardetzky. Total Variation Meets Topological Persistence: A First Encounter. In *ICNAAM 2010: International Conference of Numerical Analysis and Applied Mathematics 2010*, volume 1281 of number 1 in *AIP Conference Proceedings*, pages 1022–1026. AIP, 2010. DOI: 10.1063/1.3497795.

External funds

7/2020–6/2024 **SFB/TR 109 Discretization in Geometry and Dynamics**, *C04: Persistence and Stability of Geometric Complexes*, applied for funding by DFG, Co-PI: Herbert Edelsbrunner (IST Austria).
Funding volume (TUM portion): €345 000.

7/2020–6/2024 **SFB/TR 109 Discretization in Geometry and Dynamics**, *B12: Coarse Cohomological Models of Dynamical Systems*, applied for funding by DFG, Co-PI: Oliver Junge (TUM).
Funding volume: €250 000.

8/2017–4/2019 **PSOC Computational & Mathematical Pilot Award**, *Computational Feasibility & Accuracy Measures for Topological Methods of Cancer Histology Image Analysis*, funded by Columbia University and NIH, Co-PIs: Anthea Monod (Columbia), Chao Chen (CUNY).
Funding volume: $25 000

1/2016–6/2020 **SFB/TR 109 Discretization in Geometry and Dynamics**, *C04: Persistence and Stability of Geometric Complexes*, funded by DFG, Collaborative Research Center SFB Transregio 109 Discretization in Geometry and Dynamics, Co-PI: Herbert Edelsbrunner (IST Austria).
Funding volume (TUM portion): €370 000 (TUM).

Grants supported as mentor

2/2020–3/2022 **EuroTech Postdoc**, *Topological and Geometric Data Analysis of Random Growth Models*, funded by European Commission and TUM, Marie Skłodowska-Curie COFUND Programme, PI: Érika Roldán Roa.
Funding volume: €130 000

9/2019–8/2020 **TUM Foundation Fellowship**, *The Three-Dimensional Eden Growth Model*, offered by TUM, PI: Érika Roldán Roa.
Declined in favor of EuroTech Postdoc Fellowship

Talks

Keynote and plenary talks at international conferences

8.8.2018 **Multiparameter Persistent Homology**, *BIRS-CMO workshop*, Casa Matemática, Oaxaca, México.

7.6.2018 **Abel Symposium 2018 *Topological Data Analysis***, Geiranger, Norway.

19.9.2017 **Mathematical Signal Processing and Data Analysis**, *GAMM Activity Group Mathematical Signal and Image Processing*, Hannover, Germany.

28.7.2016 **Applied Topology: Methods, Computation, and Science (ATMCS 7)**, Politecnico di Torino, Italy.

17./18.2.2016 **Workshop on Random and Statistical Topology**, Tohoku University, Sendai, Japan.

20.6.2015 **Topological Data Analysis: New Developments and Challenges**, Oxford University, UK.

Invited lectures at summer schools

4.–5.9.2019 **Machine Learning Summer School**, *Skoltech*, Moscow, Russia.

5.–7.8.2019 **Summer school on Persistent Homology and Barcodes**, *JLU Gießen – Schloß Rauischholzhausen*, Germany.

24.4.2019 **TopApp workshop in Computational Topology**, *IST Austria*, Klosterneubrg, Austria.

13.–14.8.2018 **Multiparameter Persistence, Computation, and Applications**, *Institute for Mathematics and its Applications*, Minneapolis, MN, USA.

18.5.2018 **Tripods Summer School: Theory and Foundations of TGDA**, *Ohio State University, Columbus, OH*, USA.

16.–18.2.2017 **Winter Workshop on Dynamics, Topology and Computations**, *Mathematical Research and Conference Center*, Będlewo, Poland.

4.–7.2.2015 **XXI Oporto Meeting on Geometry, Topology and Physics**, *IST, Lisboa*, Portugal.

2.–3.7.2013 **Summer School on Computational Topology and Topological Data Analysis**, *University of Ljubljana*, Slowenia.

Invited talks at international conferences

20–26.6.2021 **Dynamics, Topology and Computations**, *Workshop at Banach Center*, Bedlewo, Poland.

11.12.2020 **Topological Data Analysis and Beyond**, *Workshop at NeurIPS 2020*, Online conference.

3.12.2019 **Mathematical Software Day**, *Max Planck Institute for Mathematics in the Sciences*, Leipzig, Germany.

26.10.2019 **Workshop on Numerical and Applied Mathematics**, *50th anniversary of the Institute of Numerical and Applied Mathematics*, University of Göttingen, Germany.

24.10.2019 **Mathematics of Data Science**, *GAMM Activity Group Computational and Mathematical Methods in Data Science*, Zuse Institute Berlin, Germany.

17.9.2019 **Computational Geometry and Topology**, *Annual meeting of the Austrian Mathematical Society*, Dornbirn, Austria.

17.7.2019 **Minisymposium on Geometry and Topology in Data Analysis**, *International Congress on Industrial and Applied Mathematics (ICIAM) 2019*, Valencia, Spain.

10.7.2019 **Minisymposium on Algebraic Geometry in Topological Data Analysis**, *SIAM Conference on Applied Algebraic Geometry*, Bern, Switzerland.

12.6.2019 **Workshop Geometry, Topology, and Computation**, *Mathematikon*, University of Heidelberg, Germany.

20.5.2019 **Topology, Computation and Data Analysis**, *Dagstuhl Seminar*, Leibniz-Zentrum, Dagstuhl, Germany .

19.11.2018 **Workshop on Computational Topology and Topological Data Analysis**, *HITS*, Heidelberg, Germany.

28.6.2018 **Minisymposium on topological data analysis and learning**, *Curves & Surfaces*, Arcachon, France.

21.6.2018 **HerbertFest**, *60th birthday conference in honor of Herbert Edelsbrunner*, IST Austria, Klosterneuburg, Austria.

21.5.2018 **TGDA@OSU Tripods Workshop: Theory and Foundations of TGDA**, *Ohio State University, Columbus, OH, USA*.

19.2.2018 **TAGS – Linking Topology to Algebraic Geometry and Statistics**, *Max Planck Institute for Mathematics in the Sciences*, Leipzig, Germany.

14.9.2017 **Minisymposium Trends in Persistent Homology**, *Annual meeting of the German and Austrian Mathematical Societies*, Salzburg, Austria.

18.7.2017 **Topology, Computation and Data Analysis**, *Dagstuhl Seminar*, Leibniz-Zentrum, Dagstuhl, Germany.

10.7.2017 **Computational Geometry and Topology workshop**, *Foundations of Computational Mathematics (FoCM) 2017*, Barcelona, Spain.

2.5.2017 **Hausdorff Trimester Program: Applied and Computational Algebraic Topology**, *Hausdorff Center for Mathematics, Bonn, Germany*.

27.4.2017 **Dagstuhl Seminar Computational Geometry**, *Leibniz-Zentrum, Dagstuhl, Germany*.

24.4.2017 **Hausdorff Trimester Program: Applied and Computational Algebraic Topology**, *Hausdorff Center for Mathematics, Bonn, Germany*.

23.3.2017 **Computational and Statistical Aspects of Topological Data Analysis**, *Alan Turing Institute, London, UK*.

7.12.2015 **Second Mexican School/Conference on Topological Data Analysis**, *Juriquilla, Querétaro, México*.

12.7.2015 **Geometry workshop**, *Seggau, Austria*.

7.4.2015 **GETCO 2015**, *Aalborg, Denmark*.

23.3.2015 **Workshop Discrete Models in Geometry and Topology**, *Freie Universität Berlin, Germany*.

6.3.2015 **Discrete Differential Geometry**, *Oberwolfach Workshop*, Mathematisches Forschungsinstitut Oberwolfach, Germany.

15./17.12.2014 **Computational Topology and Geometry workshop**, *Foundations of Computational Mathematics (FoCM) 2014*, Montevideo, Uruguay.

7.4.2013 **EMS/DMF Joint Mathematical Weekend**, *Aarhus, Denmark*.

7.11.2011 **Workshop on Computational Topology**, *Fields Institute*, Toronto, Canada.

15.1.2009 **Discrete Differential Geometry**, *Oberwolfach workshop*, Mathematisches Forschungsinstitut Oberwolfach, Germany.

Invited colloquium and seminar talks

14.12.2020 **Mathematical colloquium**, *University of Verona*, Italy.

2.5.2019 **Mathematical colloquium**, *University of Bielefeld*, Germany.

23.1.2019 **Mathematical colloquium**, *University of Osnabrück*, Germany.

27.1.2017 **ARCES**, *University of Bologna*, Italy.

26.1.2017 **Algebra and geometry seminar**, *University of Bologna*, Italy.

8.9.2016 **Geometry seminar**, *TU Graz*, Austria.

24.5.2016 **DataShape seminar**, *INRIA Saclay*, France.

11.11.2015 **TDA seminar**, *Duke University, Durham, NC*, USA.

9.11.2015 **Rabadan Lab seminar**, *Department of Systems Biology*, Columbia University, New York City, USA.

25.2.2015 **Topology research seminar**, *UC Louvain*, Belgium.

24.7.2014 **Algebra and geometry seminar**, *University of Bologna*, Italy.

18.6.2014 **Geometry seminar**, *Technische Universität Wien*, Austria.

13.1.2014 **Seminar**, *Institute for Mathematics and its Applications*, Minneapolis, MN, USA.

9.1.2014 **Topology, Geometry, and Data seminar**, *Ohio State University*, Columbus, OH, USA.

26.7.2013 **Carlsson–Guibas Seminar**, *Stanford University*, Palo Alto, CA, USA.

28.6.2011 **Media Research Lab**, *Courant Institute for Mathematical Sciences*, NYU, USA.

27.5.2011 **Research seminar Geometry & Visualization**, *TU München*, Germany.

14.4.2011 **IST Austria**, *Klosterneuburg*, Austria.

13.1.2011 **Research seminar applied mathematics**, *Universität Münster*, Germany.

7.10.2009 **Geometrica seminar**, *INRIA Sophia-Antipolis*, France.

11.6.2009 **Seminar Laboratoire Jean Kuntzmann**, *Université Joseph Fourier*, Grenoble, France.

21.5.2007 **Colloquium Methods for Discrete Structures**, *FU Berlin*, Germany.

Contributions to conferences

22.6.2020 **Symposium on Computational Geometry 2020**, *ETH Zürich*, Switzerland, Online conference.

25.7.2016 **ATMCS 7 software session**, *Politecnico di Torino*, Italy.

17.9.2015 **Shape Up 2015**, *TU Berlin*, Germany.

7.7.2015 **ACAT meeting**, *IST Austria*, Klosterneuburg, Austria.

9.9.2014 **TopoSys meeting**, *IST Austria*, Klosterneuburg, Austria.

11.6.2014 **ACM Symposium on Computational Geometry 2014**, *Kyoto*, Japan.

5.1.2014 **ALENEX14: SIAM Meeting on Algorithm Engineering and Experiments**, Portland, OR, USA.

1.8.2013 **SIAM Conference on Applied Algebraic Geometry**, *Colorado State University*, Fort Collins, CO, USA.

18.6.2013 **ACM Symposium on Computational Geometry 2013**, *Rio de Janeiro*, Brazil.

2.7.2012 **ATMCS 5**, *IMCS*, Edinburgh, UK.

28.6.2008 **International conference on Mathematical methods for curves and surfaces**, *Tønsberg*, Norway.

23.4.2008 **GMP 2008**, *Hangzhou*, China.

13.3.2008 **Industry Challenges in Geometric Modeling, CAD and Simulation**, *TU Darmstadt*, Germany.

27.10.2007 **NASAGEM Workshop**, *Hannover*, Germany.

Supervision

Postdocs

2/2020– **Érika Roldán Roa, PhD**, *postdoc*, funded by EU/TUM (EuroTech PostDoc Fellowship).

1/2016–6/2018 **Magnus Bakke Botnan, PhD**, *postdoc*, funded by DFG (SFB/TRR 109).
Since 7/2018: assistant professor (tenure track) at Vrije Universiteit Amsterdam

10/2015–8/2017 **Florian Pausinger, PhD**, *postdoc*, funded by department.
Since 9/2017: lecturer (tenured) at Queens University, Belfast

Graduate students

10/2019– **Fabian Roll, BSc**, *MSc/PhD student*, TopMath graduate program.

12/2018– **Abhishek Rathod, MSc**, *PhD student*, funded by DFG (SFB/TRR 109).

4/2018– **Fabian Lenzen, MSc**, *PhD student*, funded by DFG (SFB/TRR 109).

10/2017– **Benedikt Fluhr, MSc**, *PhD student*, funded by department.

Undergraduate students in graduate programs or research projects

10/2018–09/2019 **Fabian Roll, BSc**, *MSc student*, TopMath graduate program.

01/2017–09/2019 **Maximilian Schmahl, BSc**, *BSc/MSc student*, independent research.
Now PhD student at University of Heidelberg

10/2016–12/2018 **Abhishek Rathod, BSc**, *MSc student*, PreDoc graduate program.

Teaching activities

Lectures

Graduate level (english)

winter 2019/20 **Geometry & Topology for Data Analysis**, *lecture*, 2 SWS.

summer 2018 **Computational Topology**, *lecture*, 2 SWS.
Teaching award: *best special topics course* (runner-up)

winter 2017/18 **Geometry & Topology for Data Analysis**, *lecture*, 2 SWS.

summer 2017 **Introduction to Topology**, *lecture*, 2 SWS.

summer 2015 **Computational Topology**, *lecture with tutorial*, 2+2 SWS.

Undergraduate level (german)

summer 2016 **Differentialgeometrie: Grundlagen**, *lecture*, 2 SWS.

winter 2015/16 **Fallstudien der Mathematischen Modellbildung: Graphen als mathematische Modelle**, *lecture*, 1 SWS.

Service for other departments (german)

winter 2018/19 **Mathematik für Physiker 1 (Lineare Algebra)**, *lecture*, 4 SWS.

Seminars

Graduate level (english)

winter 2019/20 **Category Theory by Examples**, *seminar*, 2 SWS.
Joint with Prof. Claudia Scheimbauer

summer 2019 **Introduction to Homological Algebra**, *seminar*, 2 SWS.
Joint with Benedikt Fluhr, MSc

summer 2018 **Category Practice and Theory**, *seminar*, 2 SWS.
Joint with Magnus Botnan, PhD

winter 2017/18 **Winding Around: The Winding Number in Topology, Geometry and Analysis**, *seminar*, 2 SWS.
Joint with Magnus Botnan, PhD

winter 2016/17 **Category Theory by Examples**, *seminar*, 2 SWS.
Joint with Magnus Botnan, PhD

winter 2016/17 **Creation of Mathematical Models**, *seminar*, 2 SWS.
Joint with Prof. Tim Hoffmann

Undergraduate level workshops (german)

summer 2018 **Martin Gardner's Mathematical Games**, *workshop*, 1 SWS.

summer 2017 **Martin Gardner's Mathematical Games**, *workshop*, 1 SWS.

summer 2016 **Martin Gardners Mathematical Games**, *workshop*, 1 SWS.

Research seminar (english)

summer 2016– **Applied and Computational Topology**, *graduate seminar*, 2 SWS.

Teaching assistant

spring 2013 **Algorithms 2**, *recitation*, IST Austria.

winter 2009/10 **Differential Geometry I**, *tutorial*, Georg-August-Universität Göttingen.

Supervised theses

Master theses

11/2019 **Persistent Homology and Morse's Functional Topology**, *M. Schmahl*.

5/2019 **Homotopy Fibre Sequences**, *J. Luff*.
Co-supervised with Prof. Denis Cisinski (Regensburg)

11/2018 **Automatic Probabilistic Modelling of Dynamical Systems Based on Global Geometry & Topology of Data**, *M. Snijders*, TUM/LMU.
Co-supervised with Prof. Oliver Junge and Prof. Konstantin Mischaikow (Rutgers)

11/2018 **Approximation Algorithms for Morse Matching**, *A. Rathod*.

9/2018 **Object Pose Estimation with PointNet**, *M. Haberl*.
Co-supervised with Benjamin Busam, MSc

10/2017 **Applications of Topological and Geometrical Data Analysis to Dynamical Data Sets**, *I. Garnelo*.
Co-supervised with Dr. Daniel Karrasch

Bachelor theses

8/2020 **Algorithms for the Computation of Minimal Free Resolutions**, *T. Reinhardt*.
Co-supervised with Benedikt Fluhr, MSc

11/2019 **Barcode Decomposition of Persistence Modules**, *A. Brockhaus*.
Co-supervised with Benedikt Fluhr, MSc

10/2018 **Mapping Cylinders from Morse Functions**, *M. Hess*.
Co-supervised with Benedikt Fluhr, MSc

10/2018 **Cohomology and the de Rham Isomorphism**, *F. Roll*.

4/2018 **Audio Fingerprinting**, *M. Reich*.

7/2017 **Computing Image Persistent Homology**, *M. Schmahl*.

12/2016 **Combinatorial Curvature on Graphs**, *S. Bach*.

9/2011 **Persistenzpaarauslöschung für 3D-Daten**, *N. Deuschle*, Georg-August-Universität Göttingen.
Co-supervised with Prof. Dr. Max Wardetzky

Teaching award

summer 2018 **Best special topics course**, *runner-up*, Computational Topology.
Awarded by the student representative organization (*TUM Fachschaft Mathematik/Physik/Informatik*)

Academic engagement

Organizing

7/2021 **Metrics in Multiparameter Persistence**, *workshop*, Lorentz Center Leiden, Netherlands.
Co-organized with Magnus Botnan (VU Amsterdam) and Michael Lesnick (U Albany)

6/2021 **10th Annual Minisymposium on Computational Topology**, *minisymposium*, CG Week 2021, U Buffalo.
Co-organized with Arnaud de Mesmay (Université Paris Est) and Uli Wagner (IST Austria)

2/2018 **Persistence, Representations, and Computation**, *workshop*, Akademiezentrum TUM Raitenhaslach, Germany.

8/2017 **Topological Data Analysis: Developing Abstract Foundations**, *workshop*, Banff International Research Station, Banff, Canada.
Co-organized with Anthea Monod (Columbia University)

7/2016 **Mathematical methods for high-dimensional data analysis**, *summer school*, TUM.
Co-organized with Felix Krahmer (TUM)

6/2015 **Computational Topology and Data Analysis**, *workshop*, 4th Annual Minisymposium on Computational Topology, CG Week 2015, Eindhoven, Netherlands.
Co-organized with Donald Sheehy (University of Connecticut) and Michael Kerber (MPI Saarbrücken)

6/2013 **2nd Annual Minisymposium on Computational Topology**, *minisymposium*, CG Week 2013, Rio de Janerio, Brazil.
Co-organized with Tamal Dey (University of Connecticut) and Jan Reininghaus (IST Austria)

Scientific committees and board memberships

2021 **Program committee member**, *Symposium on Computational Geometry (SoCG) 2021*.

2020 **Program committee member**, *Algebraic Topology: Methods, Computation and Science (ATMCS) 2020*.

1/2019– **Editor**, *Journal of Applied and Computational Topology*, Springer.

2018– **Member of Scientific Advisory Board**, *Centre for Topological Data Analysis*, EPSRC, Oxford, Swansea and Liverpool.
Further board members: Jean-Daniel Boissonnat, Gunnar Carlsson, Frederic Chazal, Kathryn Hess, Konstantin Mischaikow, Shmuel Weinberger.

2018 **Program committee chair**, *Algebraic Topology: Methods, Computation and Science (ATMCS) 2018*.

2016 **Program committee member**, *Symposium on Computational Geometry (SoCG) 2016*.

2015– **Member of Executive Board**, *Discretization in Geometry & Dynamics*, SFB-TR 109, TUM.
Further board members: Alexander Bobenko, Folkmar Bornemann, Gitta Kutyniok, Yuri Suris, Günter Ziegler.

Academic administration

2018–2019 **Faculty board (*Fakultätsrat*)**, Department of Mathematics, TUM.

2018– **Candidate selection**, *MSc Data Science*.
Handling between 75 and 170 applications per semester

2016, 2017 **Candidate selection**, *TopMath*.

2016–2017 **Department board of directors (*Direktorium*)**, *representative of Tenure Track Assistant Professors*, Department of Mathematics, TUM.

Grant application referee

- European commission (ERC grant)
- European commission (Marie Curie Individual Fellowships) (evaluating 12 proposals)
- Royal Society (University Research Fellowship)
- Agence Nationale de la Recherche (ANR)
- Deutsche Forschungsgemeinschaft (DFG)

Performance reviews for institutions

- Czech Academy

Journal referee

- Foundations of Computational Mathematics (FoCM)
- Advances in Computational Mathematics
- SIAM Journal on Discrete Mathematics
- Journal of Applied and Computational Topology
- Discrete & Computational Geometry (DCG)
- Computational Geometry: Theory and Applications (CGTA)
- Journal of Computational Geometry
- Revista Matematica Complutense
- Bernoulli

- Topology and its Applications
- Topological Methods in Nonlinear Analysis
- Applicable Algebra in Engineering, Communication and Computing (AAECC)
- Symmetry, Integrability And Geometry: Methods And Applications (SIGMA)
- Journal on Computational Dynamics
- Journal of Symbolic Computing
- Computer Aided Geometric Design (CAGD)
- Computer Aided Design (CAD)
- GAMM-Mitteilungen

Conference referee

- ACM–SIAM Symposium on Discrete Algorithms (SODA)
- Symposium on Computational Geometry (SoCG)
- European Symposium on Algorithms (ESA)
- International Conference on Robotics and Automation (ICRA)
- International Conference on Intelligent Robots and Systems (IROS)
- Topological Methods in Data Analysis and Visualization (TopoInVis)
- Conference of the European Association for Computer Graphics (EG)
- SIBGRAPI Conference on Graphics, Patterns and Images

Awards

2016 **Best New Software Award**, *Ripser: a lean C++ code for computation of Vietoris–Rips persistence barcodes*, ATMCS7.

2013 **Best Paper Award**, *Clear and Compress: Computing Persistent Homology in Chunks*, TopoInVis.

2003 **Apple Design Award**, *Hydra*, student category.

2003 **O'Reilly Mac OS X Innovators Award**, *Hydra*.

Further activities

Invited research fellowships

4/2017, 9/2017 **Hausdorff Institute Bonn (HIM)**, *Applied and computational topology*, Hausdorff special trimester program, Bonn, Germany .

11/2016 **Institute for Computational and Experimental Research in Mathematics (ICERM)**, *Topology and Geometry in a Discrete Setting*, thematic program, Providence, RI.

Software

2016– **Ripser Live** *live.ripser.org*

Web-based software for computation of Vietoris–Rips persistence barcodes

2015– **Ripser** *ripser.org*

Leading software for computation of Vietoris–Rips persistence barcodes

2014– **DIPHA (distributed persistent homology algorithm)** *bitbucket.org/dipha*

Software for distributed computation of persistent homology

2013– **PHAT (persistent homology algorithm toolbox)** *bitbucket.org/phat-code*

Software for computation of persistent homology