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Anne Driemel

Current Position

W2-Professor (tenured) of Theoretical Computer Science at the University of Bonn
Bonn Junior Fellow of the Hausdorff Center for Mathematics

Education

2013 **PhD in Computing Science**, *Utrecht University*, The Netherlands.
Thesis: "Realistic Analysis for Algorithmic Problems on Geographical Data"
Advisors: Prof. Marc van Kreveld, Utrecht University
Prof. Mark de Berg, TU Eindhoven

2009 **Diplom in Computer Science**, *Free University*, Berlin, Germany.
Thesis: "Multiscale Curvature Matching for Smooth Polylines"
Advisor: Prof. Helmut Alt, Free University of Berlin

2002 **Abitur (Secondary School)**, Fürstenwalde, Germany.

Employment

(I worked part-time where indicated because of parental leave for two children)

since Dec 2018 **W2-Professor (tenured)**, *University of Bonn*, Germany.
Head of group on Computational Geometry within Section on Algorithms and Complexity

Jan 2015 – Dec 2018 **Assistant Professor (0.8 fte)**, *TU Eindhoven*, the Netherlands.
Data Mining, Prof. Mykola Pechenizkiy

Apr 2014 – Jan 2015 **Postdoc (0.8 fte)**, *TU Eindhoven*, the Netherlands.
Information Systems/ Web Engineering, Prof. Paul de Bra

Oct 2013 – Mar 2014 **Wissenschaftlicher Mitarbeiter (0.75 fte)**, *TU Dortmund*, Dortmund, Germany.
Algorithms and Complexity, Prof. Christian Sohler

Sep 2009 – Sep 2013 **Assistent in opleiding (AIO)**, *Utrecht University*, Utrecht, the Netherlands.
Multimedia and Geometry, Prof. Remco Veltkamp

Sep 2008 – Mar 2009 **Studentische Hilfskraft**, *Free University*, Berlin, Germany.
Dept. of Computer Science

Sep 2004 – Aug 2007 **Studentische Hilfskraft**, *Free University*, Berlin, Germany.
Dept. of Computer Science and Dept. of Comparative Literature

Funding, Awards, Scholarships

2022 **PhD-Student (218 000 EUR)**, *ibehave: Algorithms of Adaptive Behavior and their Neuronal Implementation in Health and Disease.*
Within *Neuroscience Network NRW* in the program ‚Netzwerke 2021' funded by the state North Rhine-Westphalia.

2022 **PhD-Student (415 820 EUR)**, *Efficient representation of geometric similarity.*
Within *KI-FOR Algorithmic Data Analysis for Geodesy (AlgoForGe) (FOR 5361).*
Funded by the German Research Foundation (DFG).

2021 **PhD-Student (311 300 EUR)**, *Forecasting Trajectories.*
Within *FOR 2535–Anticipating Human Behavior.*
Funded by the German Research Foundation (DFG).

2018 **Bonn Junior Fellow**.
Five-year appointment at the Hausdorff Center for Mathematics in Bonn.
Funded by the Excellence Iniative of the DFG (German Research Foundation).

2014 **Veni Award (240 000 EUR)**.
Project title: "Detection methods for similarity structures in time-dependent data"
Funded by the Netherlands Organization for Scientific Research (NWO) in the program Innovational Research Incentives Scheme Veni.

2007 **FU Berlin Direct Exchange Scholarship (18 300 USD)**.
To study nine months at the *University of Pennsylvania (UPenn)*

Invited Talks (Recent)

Nov 2021 **Data structures for proximity searching under the Fréchet distance**.
Geometry Seminar, Courant Institute of Mathematical Sciences, New York University
(online)

July 2021 **Models for Trajectory and Subtrajectory Clustering**.
Seminar Series of Center for Earth System Observations and Computational Analysis (CESOC)
(online)

June 2021 **Data structures for proximity searching under the Fréchet distance**.
Workshop on Geometry and Mobility (part of CG Week 2021)
(online)

May 2020 **Clustering Curves under the Fréchet distance**.
Fixed Parameter Computational Geometry III, Workshop
Lorentz Center, Leiden, NL
(Workshop was cancelled due to the COVID pandemic)

Sep 2019 **Clustering Curves under the Fréchet distance**.
Anticipating Human Behavior Workshop
Bonn, DE

Jul 2017 **Algorithms for Structures in Spaces of Curves**.
Workshop on Geometry and Machine Learning (part of CG Week 2017)
Brisbane, AUS

Organization of Workshops and Schools (Recent)

June 2022 **Hausdorff School on Algorithmic Data Analysis**.
Hausdorff Center for Mathematics, Bonn, Germany

May 2021 **Computational Geometry (Dagstuhl Seminar 21181)**.
(online)

Apr 2019 **Computational Geometry (Dagstuhl Seminar 17171)**.
Schloss Dagstuhl - Leibniz Center for Informatics, Wadern, Germany

Feb 2018 **Analysing large collections of time series**.
NII Shonan Meeting, Shonan Village Center, JPN

Apr 2017 **Computational Geometry (Seminar 19181)**.
Schloss Dagstuhl - Leibniz Center for Informatics, Wadern, Germany

Professional Service

Steering Committee

2022-2026 **Computational Geometry**, *Co-chair*.

Editorships

2020 **Guest Editor**, *ACM Transactions on Algorithms (TALG) - Special Issue on SODA'20*.

2021- **Associate Editor**, *Journal of Computational Geometry (JoCG)*.

2021- **Editor**, *Discrete & Computational Geometry*.

2021- **Editor**, *Discrete Mathematics and Theoretical Computer Science (DMTCS)*.

Program Committees (Selection)

2022 **ESA Track S**, *European Symposium on Algorithms, 2022*.

2022 **SOSA**, *SIAM Symposium on Simplicity in Algorithms, 2022*.

2022 **YRF (chair)**, *Computational Geometry: Young Researchers Forum, 2022*.

2021, 2015 **SOCG**, *International Symposium on Computational Geometry, 2021, 2015*.

2021 **ACDA**, *SIAM Conference on Applied and Computational Discrete Algorithms, 2021*.

2021 **ALENEX**, *SIAM Symposium on Algorithm Engineering and Experiments, 2021*.

2020 **YRF**, *Computational Geometry: Young Researchers Forum, 2020*.

2020 **IWOCA**, *International Workshop on Combinatorial Algorithms, 2020*.

2020, 2017 **SODA**, *ACM-SIAM Symposium on Discrete Algorithms, 2020, 2017*.

2019 **EuroCG**, *European Workshop on Computational Geometry, 2019*.

2017 **ESA Track A**, *European Symposium on Algorithms, 2017*.

Other Service

2020- **SafeToC Advocate**, *ACM-SIAM Symposium on Discrete Algorithms, International Symposium on Computational Geometry*, SafeToC is a group of volunteers to help prevent and combat harassment in the Theory of Computing community.

2022-2024 **Chair of the Examination Committee**, *Institute of Computer Science, University of Bonn*.

Teaching

Winter 2022/23 — **Algorithmen und Berechnungskomplexität I (9 ECTS)**, *University of Bonn.*
Bachelor Informatik

Summer 2022 — **Grundlagen der Algorithmischen Geometrie (9 ECTS)**, *University of Bonn.*
Bachelor Informatik

Summer 2021 — **Grundlagen der Algorithmischen Geometrie (9 ECTS)**, *University of Bonn.*
Bachelor Informatik
Co-taught with: Herman Haverkort

Winter 2020/21 — **Discrete and Computational Geometry (9 ECTS)**, *University of Bonn.*
Master Computer Science

Summer 2020 — **Grundlagen des Maschinellen Lernens (9 ECTS)**, *University of Bonn.*
Bachelor Informatik
Co-taught with: Thomas Kesselheim
★ **Course was newly developed**

Winter 2019/20 — **Discrete and Computational Geometry (9 ECTS)**, *University of Bonn.*
Master Computer Science
Co-taught with: Herman Haverkort
★ **Course was newly developed**

Winter 2018/19 — **Grundlagen der Algorithmischen Geometrie (9 ECTS)**, *University of Bonn.*
Bachelor Informatik
Co-taught with: Herman Haverkort

2018 — **Algorithmic Aspects of Data Science (5 ECTS)**, *TU Eindhoven.*
Bachelor Computer Science
Co-taught with: Herman Haverkort
★ **Course was newly developed**

2017 — **Foundations of data mining (5 ECTS)**, *TU Eindhoven.*
Master Computer Science
Co-taught with: Joaquin Vanschoren and Vlado Menkovski

2016 — **Foundations of data mining (5 ECTS)**, *TU Eindhoven.*
Master Computer Science
Co-taught with: Joaquin Vanschoren and Mykola Pechenizkiy
★ **Course was newly developed**

Supervision

Current and Past Group Members

2022- **Dennis Rohde**.
Postdoc

2021- **Jacobus Conradi**.
Doctoral student

2021- **Frederik Brüning**.
Doctoral student

2021- **Benedikt Kolbe**.
Postdoc

2019–2021 **Ioannis Psarros**.
Postdoc

Supervised Theses

At the University of Bonn, I have supervised 5 Master's theses and 2 Bachelor's theses as the primary supervisior. At the TU Eindhoven I have co-supervised 2 Master's theses. At the University of Dortmund I have co-supervised 1 PhD thesis.

2022 **Clemens Severing**, *Bachelor's thesis, Computer Science, University of Bonn.*
Thesis: *Clustern von Subtrajektorien*

2022 **Volker Sobek**, *Bachelor's thesis, Computer Science, University of Bonn.*
Thesis: *Doubling Dimension of Fréchet and Hausdorff Balls*

2021 **David Göckede**, *Master's thesis, Computer Science, University of Bonn.*
Thesis: *Computing the Fréchet distance in graphs efficiently using shortest-path distance oracles*

2020 **Jan Maik Hitschke**, *Master's thesis, Mathematics, University of Bonn.*
Thesis: *Center curves under the Fréchet distance and their computability*

2020 **Carolin Kaffine**, *Master's thesis, Mathematics, University of Bonn.*
Thesis: *On the VC Dimension of Bisector Ranges Defined on Curves*

2020 **Koen van Greevenbroek**, *Master's thesis, Mathematics, University of Bonn.*
Thesis: *Averaging curves under the dynamic time warping distance*

2020 **Jacobus Conradi**, *Master's thesis, Mathematics, University of Bonn.*
Thesis: *k-shortcut Fréchet distance: Hardness and Approximation*
★ **Thesis-award by Bonner Informatik Gesellschaft (BIG)**

2019 **Natasja van de l'Isle**, *Master's thesis, Computer Science, TU Eindhoven.*
Thesis: *Algorithms for center-based trajectory clustering*
Co-supervised with Kevin Buchin

2018 **Martijn Struijs**, *Master's thesis, Mathematics, TU Eindhoven.*
Thesis: *Curve clustering: hardness and algorithms*
Co-supervised with Kevin Buchin and Jesper Nederlof

2014–2018 **Amer Krivošija**, *Doctoral thesis, TU Dortmund.*
Thesis: *On clustering and related problems on curves under the Frechet distance*
Co-supervised with Christian Sohler, Thesis completed in 2021

Selected Publications

2022 **On computing the k-shortcut Fréchet distance**.
with Jacobus Conradi. *49th International Colloquium on Automata, Languages, and Programming, ICALP 2022*

The Fréchet distance is a popular measure of dissimilarity for polygonal curves. It is defined as a min-max formulation that considers all direction-preserving continuous bijections of the two curves. Because of its susceptibility to noise, Driemel and Har-Peled introduced the shortcut Fréchet distance in 2012, where one is allowed to take shortcuts along one of the curves, similar to the edit distance for sequences. We analyse the parameterized version of this problem, where the number of shortcuts is bounded by a parameter k.

2022 **Faster Approximate Covering of Subcurves under the Fréchet Distance.**.
with Frederik Brüning, and Jacobus Conradi. *30th Annual European Symposium on Algorithms, ESA 2022*

Subtrajectory clustering is an important variant of the trajectory clustering problem, where the start and endpoints of trajectory patterns within the collected trajectory data are not known in advance. We study this problem in the form of a set cover problem for a given polygonal curve: find the smallest number k of representative curves such that any point on the input curve is contained in a subcurve that has Fréchet distance at most a given Δ to a representative curve.

2022 **Tight Bounds for Approximate Near Neighbor Searching for Time Series under the Fréchet Distance**.
with Karl Bringmann, André Nusser, and Ioannis Psarros. *Proceedings of the 33th ACM-SIAM Symposium on Discrete Algorithms, SODA 2022.*

We study the c-approximate near neighbor problem under the continuous Fréchet distance: Given a set of n polygonal curves with m vertices, a radius $\delta > 0$, and a parameter $k \leq m$, we want to preprocess the curves into a data structure that, given a query curve q with k vertices, either returns an input curve with Fréchet distance at most $c \cdot \delta$ to q, or returns that there exists no input curve with Fréchet distance at most δ to q.

2022 **Approximating (k,l)-median clustering for polygonal curves.**.
with Maike Buchin, and Dennis Rohde. To appear in *ACM Transactions on Algorithms.* Also appeared in *Proceedings of the 2021 ACM-SIAM Symposium on Discrete Algorithms, SODA 2021.*

In 2015, Driemel, Krivošija and Sohler introduced the (k, ℓ)-median clustering problem for polygonal curves under the Fréchet distance. Given a set of input curves, the problem asks to find k median curves of at most ℓ vertices each that minimize the sum of Fréchet distances over all input curves to their closest median curve. A major shortcoming of their algorithm is that the input curves are restricted to lie on the real line. In this paper, we present a randomized bicriteria-approximation algorithm that works for polygonal curves in $\mathbb{R}^d$ and achieves approximation factor $(1 + \epsilon)$ with respect to the clustering costs.

2021 **The VC dimension of metric balls under Fréchet and Hausdorff distances.**.
with André Nusser, Jeff M. Phillips, and Ioannis Psarros. *Discrete & Computational Geometry*, 2021. Also appeared in *Proceedings of the 35th International Symposium on Computational Geometry, SoCG 2019*

The Vapnik-Chervonenkis dimension provides a notion of complexity for systems of sets. If the VC dimension is small, then knowing this can drastically simplify fundamental computational tasks such as classification, range counting, and density estimation through the use of sampling bounds. We analyze set systems where the ground set is a set of polygonal curves in $\mathbb{R}^d$ and the sets are metric balls defined by curve similarity metrics, such as the Fréchet distance and the Hausdorff distance, as well as their discrete counterparts.

Publications

(author ordering is alphabetical)

Refereed Conference Publications

[1] Garance Gourdel, Anne Driemel, Pierre Peterlongo, and Tatiana Starikovskaya. Pattern matching under DTW distance. In *String Processing and Information Retrieval - 29th International Symposium, SPIRE*, 2022. (to appear).

[2] Maike Buchin, Anne Driemel, Koen van Greevenbroek, Ioannis Psarros, and Dennis Rohde. Approximating length-restricted means under dynamic time warping. In *Approximation and Online Algorithms: 20th International Workshop, WAOA*, 2022. (to appear).

[3] Frederik Brüning, Jacobus Conradi, and Anne Driemel. Faster Approximate Covering of Subcurves Under the Fréchet Distance. In *30th Annual European Symposium on Algorithms (ESA 2022)*, volume 244, pages 28:1–28:16, 2022.

[4] Anna Arutyunova, Anne Driemel, Jan-Henrik Haunert, Herman J. Haverkort, Jürgen Kusche, Elmar Langetepe, Philip Mayer, Petra Mutzel, and Heiko Röglin. Minimum-error triangulations for sea surface reconstruction. In *38th International Symposium on Computational Geometry, SoCG 2022, June 7-10*, pages 7:1–7:18, 2022.

[5] Anne Driemel, Ivor van der Hoog, and Eva Rotenberg. On the discrete Fréchet distance in a graph. In *38th International Symposium on Computational Geometry, SoCG 2022, June 7-10, 2022, Berlin, Germany*, pages 36:1–36:18, 2022.

[6] Jacobus Conradi and Anne Driemel. On computing the k-shortcut Fréchet distance. In *49th International Colloquium on Automata, Languages, and Programming, ICALP*, pages 46:1–46:20, 2022.

[7] Karl Bringmann, Anne Driemel, André Nusser, and Ioannis Psarros. Tight bounds for approximate near neighbor searching for time series under the Fréchet distance. In *Proceedings of the 2022 ACM-SIAM Symposium on Discrete Algorithms, SODA*, pages 517–550, 2022.

[8] Peter Rottmann, Anne Driemel, Herman J. Haverkort, Heiko Röglin, and Jan-Henrik Haunert. Bicriteria aggregation of polygons via graph cuts. In *11th International Conference on Geographic Information Science, GIScience 2021*, pages 6:1–6:16, 2021.

[9] Maike Buchin, Anne Driemel, and Dennis Rohde. Approximating (k,l)-median clustering for polygonal curves. In *Proceedings of the 2021 ACM-SIAM Symposium on Discrete Algorithms, SODA 2021*, pages 2697–2717, 2021.

[10] Anne Driemel and Ioannis Psarros. ANN for time series under the fréchet distance. In *Algorithms and Data Structures - 17th International Symposium, WADS 2021, Virtual Event, August 9-11, 2021, Proceedings*, pages 315–328, 2021.

[11] Kevin Buchin, Anne Driemel, and Martijn Struijs. On the hardness of computing an average curve. In *17th Scandinavian Symposium and Workshops on Algorithm Theory, SWAT 2020*, pages 19:1–19:19, 2020.

[12] Anne Driemel, Jeff M. Phillips, and Ioannis Psarros. The VC dimension of metric balls under Fréchet and Hausdorff distances. In *Proceedings of the 35th International Symposium on Computational Geometry, SoCG*, pages 28:1–28:16, 2019.

[13] Kevin Buchin, Anne Driemel, Joachim Gudmundsson, Michael Horton, Irina Kostitsyna, Maarten Löffler, and Martijn Struijs. Approximating (k,l)-center clustering for curves. In *Proceedings of the Thirtieth Annual ACM-SIAM Symposium on Discrete Algorithms, SODA*, pages 2922–2938, 2019.

[14] Matteo Ceccarello, Anne Driemel, and Francesco Silvestri. FRESH: Fréchet similarity with hashing. In *Proceedings of Algorithms and Data Structures - 16th International Symposium, WADS*, pages 254–268, 2019.

[15] Anne Driemel and Amer Krivosija. Probabilistic embeddings of the Fréchet distance. In *Approximation and Online Algorithms - 16th International Workshop, WAOA 2018*, pages 218–237, 2018.

[16] Peyman Afshani and Anne Driemel. On the complexity of range searching among curves. In *Proceedings of the 29th ACM-SIAM Symposium on Discrete Algorithms, SODA*, pages 898–917, 2018.

[17] Anne Driemel and Francesco Silvestri. Locality-sensitive hashing of curves. In *Proceedings of the 33rd International Symposium of Computational Geometry, SoCG*, pages 37:1–37:16, 2017.

[18] Anne Driemel, Amer Krivošija, and Christian Sohler. Clustering time series under the Fréchet distance. In *Proceedings of the 27th ACM-SIAM Symposium on Discrete Algorithms, SODA*, pages 766–785, 2016.

[19] Maike Buchin, Anne Driemel, and Bettina Speckmann. Computing the Fréchet distance with shortcuts is NP-hard. In *Proceedings of the 30th Symposium on Computational Geometry, SoCG*, pages 367–376, 2014.

[20] Boris Aronov, Anne Driemel, Marc van Kreveld, Maarten Löffler, and Frank Staals. Segmentation of trajectories on non-monotone criteria. In *Proceedings of the 24th ACM-SIAM Symposium on Discrete Algorithms, SODA*, 2013.

[21] Anne Driemel, Sariel Har-Peled, and Benjamin Raichel. On the expected complexity of Voronoi diagrams on terrains. In *Proceedings of the 28th ACM Symposium on Computational Geometry, SoCG*, pages 101–110, 2012.

[22] Anne Driemel and Sariel Har-Peled. Jaywalking your dog: computing the Fréchet distance with shortcuts. In *Proceedings of the 23rd Annual ACM-SIAM Symposium on Discrete Algorithms, SODA*, pages 318–337, 2012.

[23] Atlas F. Cook, Anne Driemel, Sariel Har-Peled, Jessica Sherette, and Carola Wenk. Computing the Fréchet distance between folded polygons. In *Algorithms and Data Structures - 12th International Symposium, WADS*, pages 267–278, 2011.

[24] Anne Driemel, Herman Haverkort, Maarten Löffler, and Rodrigo I. Silveira. Flow computations on imprecise terrains. In *Algorithms and Data Structures - 12th International Symposium, WADS*, pages 350–361, 2011.

[25] Daniel Chen, Anne Driemel, Leonidas J. Guibas, Andy Nguyen, and Carola Wenk. Approximate map matching with respect to the Fréchet distance. In *Proceedings of the Workshop on Algorithm Engineering and Experiments, ALENEX*, pages 75–83, 2011.

[26] Maike Buchin, Anne Driemel, Marc van Kreveld, and Vera Sacristán. An algorithmic framework for segmenting trajectories based on spatio-temporal criteria. In *18th*

ACM SIGSPATIAL International Conference on Advances in Geographic Information Systems, pages 202–211, 2010.

[27] Anne Driemel, Sariel Har-Peled, and Carola Wenk. Approximating the Fréchet distance for realistic curves in near linear time. In *Proceedings of the 26th ACM Symposium on Computational Geometry, SoCG*, pages 365–374, 2010.

Refereed Journal Publications

[28] Maike Buchin, Anne Driemel, and Dennis Rohde. Approximating (k,l)-median clustering for polygonal curves. *ACM Transactions on Algorithms*. (to appear).

[29] Anne Driemel, André Nusser, Jeff M. Phillips, and Ioannis Psarros. The VC dimension of metric balls under Fréchet and Hausdorff distances. *Discrete & Computational Geometry*, 2021.

[30] Anne Driemel, Sariel Har-Peled, and Benjamin Raichel. On the expected complexity of Voronoi diagrams on terrains. *ACM Transactions on Algorithms*, 12(3):37:1–37:20, April 2016.

[31] Boris Aronov, Anne Driemel, Marc Van Kreveld, Maarten Löffler, and Frank Staals. Segmentation of trajectories on nonmonotone criteria. *ACM Transactions on Algorithms*, 12(2):26:1–26:28, December 2015.

[32] Atlas F. Cook IV, Anne Driemel, Jessica Sherette, and Carola Wenk. Computing the Fréchet distance between folded polygons. *Computational Geometry*, 50:1 – 16, 2015.

[33] Anne Driemel and Sariel Har-Peled. Jaywalking your dog: computing the Fréchet distance with shortcuts. *SIAM Journal on Computing*, 42(5):1830–1866, 2013.

[34] Anne Driemel, Herman Haverkort, Maarten Löffler, and Rodrigo Silveira. Flow computations on imprecise terrains. *Journal of Computational Geometry*, 4(1):38–78, 2013.

[35] Anne Driemel, Sariel Har-Peled, and Carola Wenk. Approximating the Fréchet distance for realistic curves in near linear time. *Discrete & Computational Geometry*, 48(1):94–127, 2012.

[36] Maike Buchin, Anne Driemel, Marc van Kreveld, and Vera Sacristán. Segmenting trajectories: A framework and algorithms using spatiotemporal criteria. *Journal of Spatial Information Science*, 3(1):33–63, 2011.

Theses and Books

[37] Rolf Klein, Anne Driemel, and Herman Haverkort. *Algorithmische Geometrie — Grundlagen, Methoden, Anwendungen*. Springer, 2022.

[38] Anne Driemel. *Realistic analysis for algorithmic problems on geographical data*. PhD thesis, Utrecht University, 2013.

[39] Anne Driemel. Multiscale curvature matching for smooth polylines. Master's thesis, Free University of Berlin, 2009.