

STEFFEN BORGWARDT

Curriculum Vitae

Assistant Professor
University of Colorado Denver
Department of Mathematical and Statistical Sciences
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Denver, CO, 80204, USA

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PROFESSIONAL EXPERIENCE

- from Aug. 2016 **Assistant Professor**
Department of Mathematical and Statistical Sciences,
University of Colorado Denver
- Sep. 2015 – July 2016 **Privatdozent**
Department of Mathematics, Technische Universität München
- Aug. 2014 – Aug. 2015 **Visiting Assistant Professor**
University of California, Davis
- Oct. 2013 – Mar. 2014 **Acting Associate Professor** for Mathematical Optimization
Department of Mathematics, Technische Universität Braunschweig
- Jan. 2013 – Sep. 2013,
April 2014 – July 2014 **Akademischer Rat**
Department of Mathematics, Technische Universität München
- April 2012 – July 2013 **Head of Research and Development Project ‘ArborChange’**
Project of the Bavarian State Ministry for Nutrition, Agriculture and
Forests for the optimization of the cost-effective structure of forests
- Jan. 2011 – Mar. 2012 **Postdoctoral Research Associate**
Chair for Applied Geometry and Discrete Mathematics
Department of Mathematics, Technische Universität München

EDUCATION

- May 2015 **Habilitation**
‘Data Analysis through Polyhedral Theory’
Technische Universität München
- Dec. 2010 **Dr. rer. nat. in Mathematics**
‘A Combinatorial Optimization Approach to Constrained Clustering’
Advisor: Prof. Dr. Peter Gritzmann, Technische Universität München
Grade: summa cum laude
- Mar. 2007 **Diploma (Master) in Mathematics**
Diploma (Master) in Computer Science
‘Nearly Optimal Algorithms on Minimum Spanning Trees’
Advisor: Prof. Dr. Ernst Mayr, Technische Universität München

AWARDS AND GRANTS

RESEARCH

- July 2017 **Simons Collaboration Grant for Mathematicians**
‘Polyhedral Theory in Data Analytics’
Awarded by the Simons Foundation (volume \$42000)
- Jan. 2017 **ORS Large Grant**
‘Constructing the Difference of Clusterings’
Awarded by the Office of Research Services, University of Colorado
Denver (volume \$11200)
- Sep. 2014 – Aug. 2015 **Feodor Lynen Research Scholarship and Humboldt Fellowship**
‘Data Analysis through the Geometry of Transportation Polytopes’
Host: Prof. Dr. Jesús De Loera, University of California Davis
(volume about \$50000)
- July 2013 **European Excellence in Practice Award 2013**
‘Geometric clustering for the consolidation of farm- and woodland’
Joint work with Prof. Dr. Andreas Brieden, Prof. Dr. Peter Gritzmann.
Awarded by EURO, the Association of the European Operational
Research Societies within IFORS
- April 2012 – July 2013 **Research and Development Project *ArborChange***
Project of the Bavarian State Ministry for Nutrition, Agriculture and
Forests for the optimization of the cost-effective structure of forests
(volume about \$110000 + primary costs for the Bavarian State)

TEACHING

- Aug. 2016 **TeachInf Best Teaching Award** for the best undergraduate lecture
‘Linear Algebra for Computer Science’ in Summer 2016, awarded by the
Department of Computer Science, Technische Universität München
- 2013-2016 **Two Good Teaching Awards**
Awarded by the student association of the Department of Mathematics,
Technische Universität München

RESEARCH VISITS AND COLLOQUIUM TALKS

- 2017 University of Wyoming
University of Colorado Boulder
- 2016 Simon Fraser University at Burnaby
Simon Fraser University at Surrey
University of Colorado Denver
Georgia Southern University
Northern Illinois University
TU Chemnitz
- 2014 – 2015 Maastricht University
Cardiff University
University of Edinburgh
University of California Los Angeles
University of North Carolina, Chapel Hill

Deutscher Akademischer Austauschdienst (DAAD)
Technion – Israel Institute of Technology, Haifa

2011 – 2013

University of California Davis
Technische Universität Dortmund
Goethe-Universität Frankfurt
Universität Hamburg
Technische Universität Hamburg- Harburg
Max-Planck Institute Tübingen

FULL BIBLIOGRAPHY

JOURNAL PAPERS

- S. Borgwardt, C. Viss (2017) *Circuit Walks in Integral Polyhedra*. In review (available on arxiv: 1712.01933)
- S. Borgwardt, R. Frongillo (2017) *Power Diagram Detection with Applications to Information Elicitation*. In review (available on arxiv: 1711.06207)
- S. Borgwardt (2017) *Strongly Polynomial 2-Approximations of Discrete Wasserstein Barycenters*. In review (available on arxiv: 1704.05491)
- S. Borgwardt, F. Happach (2017) *Good Clusterings Have Large Volume*. In review (available on arxiv: 1706.08996)
- S. Borgwardt, J. De Loera, and E. Finhold (2017) *The Diameters of Network Flow Polytopes satisfy the Hirsch Conjecture*. **Mathematical Programming**, Series A, in print
- A. Malkis, S. Borgwardt (2017) *Binary Multithreaded Programs have Low Reachability-Complexity and Small Diameters*. In review
- S. Borgwardt, A. Brieden, and P. Gritzmann (2017) *A balanced k-means algorithm for weighted point sets*. **European Journal of Operational Research**, in print
- S. Borgwardt, T. Stephen, and T. Yusun (2016) *On the Circuit Diameter Conjecture*. In review (available on arxiv: 1611.08039)
- E. Anderes, S. Borgwardt, and J. Miller (2016) *Discrete Wasserstein Barycenters: Optimal Transport for Discrete Data*. **Mathematical Methods of Operations Research** 84:2, pp. 389-409
- S. Borgwardt, S. Onn (2016) *Efficient solutions for weight-balanced partitioning problems*. **Discrete Optimization** 21:C, pp. 71-84
- S. Borgwardt, E. Finhold, and R. Hemmecke (2016) *Quadratic diameter bounds for dual network flow polyhedra*. **Mathematical Programming** 159:1, pp. 237-251
- S. Borgwardt, J. De Loera, E. Finhold (2016) *Edges vs Circuits: a Hierarchy of Diameters in Polyhedra*. **Advances in Geometry** 16:4, pp. 511-530

S. Borgwardt, A. Brieden, and P. Gritzmann (2015) *Geometrisches Clustering: Mathematik für die Flurverbesserung (Geometric clustering: Mathematics for land improvement)*. **Mitteilungen der DMV** 23/2015, pp. 82-90

S. Borgwardt, J. De Loera, E. Finhold, and J. Miller (2015) *The Hierarchy of Circuit Diameters for Transportation Polytopes*. **Discrete Applied Mathematics**. doi:10.1016/j.dam.2015.10.017

S. Borgwardt (2015) *On Soft Power Diagrams*. **Mathematical Modelling and Algorithms in Operations Research** 14:2, pp. 173-196

S. Borgwardt, E. Finhold, and R. Hemmecke (2015) *On the circuit diameter of dual transportation polyhedra*. **SIAM Journal on Discrete Mathematics** 29:1, pp. 113-121

S. Borgwardt, S. Schaffner, M. Suda (2014) *Geometrische Kennzahlen für die forstfachliche Bewertung der Zersplitterung von Privatwaldarealen (Geometric measures for the assessment of fragmentation of private forest areas)*. **Forstarchiv** 06/14, pp. 188-196

S. Borgwardt, A. Brieden, and P. Gritzmann (2014) *Geometric clustering for the consolidation of farmland and woodland*. **Mathematical Intelligencer** 36:2, pp. 37-44 (including front cover of journal)

S. Borgwardt, F. Schmiedl (2014) *Threshold-based preprocessing for approximating the weighted dense k -subgraph problem*. **European Journal of Operational Research** 234, pp. 631-640

S. Borgwardt (2013) *On the Diameter of Partition Polytopes and Vertex-Disjoint Cycle Cover*. **Mathematical Programming**, Series A 141:1, pp. 1-20

S. Borgwardt, A. Brieden, and P. Gritzmann (2011) *Constrained Minimum- k -Star Clustering and its application to the consolidation of farmland*. **Operational Research** 11:1, pp. 1-17

OTHER PUBLICATIONS

A. Malkis, S. Borgwardt (2016) *Reachability in Binary Multithreaded Programs Is Polynomial*. **ICDCS 17**, pp. 2083-2088

S. Borgwardt, J. De Loera, and E. Finhold (2016) *The Diameters of Transportation Polytopes satisfy the Hirsch Conjecture*. Available on arxiv: 1603.00325v1

S. Borgwardt, J. De Loera, and E. Finhold (2016) *The Diameters of Transportation Polytopes satisfy the Hirsch Conjecture*. **2016 SIAM Workshop on Network Science**. Extended abstract.

S. Borgwardt, A. Malkis, and Y. Nagashima (2014) *On the Diameter of Multithreaded Programs: The Basic Case*. Technical report

S. Borgwardt, A. Brieden, and P. Gritzmann (2013) *Mathematics in Agriculture and Forestry: Geometric Clustering for Land Consolidation*. **IFORS news**, Dec. 2013

S. Borgwardt (2013) *Das Programm ArborTec – ArborChange mit ArborEval und ArborOpt*. Public report for the software engineered in project *ArborChange* of the Bavarian State Ministry for Nutrition, Agriculture and Forests. www-m9.ma.tum.de/foswiki/pub/Projekte/VLE/ArborTec.pdf

K. Borgwardt, S. Borgwardt, A. Feragen, N. Shervashidze (2011) *Balanced kernel k-means for comparing large graphs with landmarks*. Technical report

S. Borgwardt, P. Gritzmann (2009) *Automatisches Routing der Erntemaschinen in der Holzertesimulation des Virtuellen Walds*. Expert report for the Lehrstuhl für Forstliche Arbeitswissenschaft und Angewandte Informatik, Technische Universität München

THESES

Steffen Borgwardt (2015) *Data Analysis through Polyhedral Theory*, Habilitation thesis

Steffen Borgwardt (2010) *A Combinatorial Optimization Approach to Constrained Clustering*, Ph.D. thesis

Steffen Borgwardt (2007) *Nearly Optimal Algorithms on Minimum Spanning Trees*, diploma thesis in computer science and diploma thesis in mathematics

IN PREPARATION

S. Borgwardt, J. De Loera, J. Lee, S. Weibel *The Hirsch Conjecture is true for Totally Unimodular Polytopes*

S. Borgwardt, S. Patterson *A Divide-and-Conquer Algorithm for Discrete Barycenters*

TEACHING

2018 CU Denver	<i>Network Flows</i> , CU Denver, Lecture <i>Applied Linear Algebra</i> , CU Denver, Lecture
2017 CU Denver	<i>Linear Programming</i> , CU Denver, Lecture <i>Integer Programming</i> , CU Denver, Lecture <i>Applied Linear Algebra</i> , CU Denver, Lecture
2014 – 2016 CU Denver TU München UC Davis	<i>Introduction to Operations Research</i> , CU Denver, Lecture <i>Linear Algebra for Computer Science</i> , TU München, Lecture* *TeachInf Best Teaching Award <i>Introduction to Discrete Mathematics</i> , TU München, Lecture <i>Linear Algebra</i> , UC Davis, Lecture <i>Mathematics and Computers</i> , UC Davis, Lecture
2013 – 2014 TU Braunschweig TU München ISM München	<i>Linear Optimization</i> , TU Braunschweig, Lecture <i>Discrete Optimization</i> , TU Braunschweig, Lecture <i>Computational Complexity in Optimization</i> , TU München, Lead TA* *Good Teaching Award <i>Game Theory 1</i> , TU München, Seminar <i>Game Theory 2</i> , TU München, Seminar <i>Mathematics 1</i> , Int. School of Management München, Lecture
2007 – 2013 TU München	<i>Algebraic and Geometric Techniques for Optimization</i> , Lead TA* *Good Teaching Award <i>Discrete Mathematics in Data Analysis</i> , Seminar <i>Combinatorial Optimization</i> , Lead TA <i>Mathematical Methods for the Business Sciences 2</i> , TA <i>Applied Discrete Mathematics</i> , Lead TA

Selected Topics from Combinatorial Optimization, Seminar
Mathematics 2 for Electrical Engineering, TA
Mathematics 1 for Electrical Engineering, TA
Optimization 3, Lead TA
Optimization 2, Lead TA and Programming Course
Optimization 1, Lead TA and Programming Course

SUPERVISED HONOR'S, BACHELOR AND MASTER THESES

- 2017 *Diameters of Cellular Automata*, Jordan Perr-Sauer
A review of Lagrangian Duality, Christina Ebben
- 2016 *Stable Clusterings and the Cones of Outer Normals*, Felix Happach*
***received best master's thesis award
from Society of Operations Research**
Variants of the facility location problem, Larissa Böse
On the monotone Hirsch conjecture, Daniel Haller
- 2013 – 2015 *On the computation of optimal soft power diagrams*, Alexander
Kampmeier
 l_p -norm Voronoi diagrams, Michael Heptner
Support vector machines and the kernel trick, Philipp Fröhlich
On the best number of clusters, Gabriel Anzer
- 2011 – 2012 *Norm maximization over gravity polytopes*, Andrej Winokurow
Hierarchical clustering, Philipp Krenz
Clustering with instance-level constraints, Christoph Bolkart
*Zellzerlegungen und Least-Squares Assignments für die aquatische
Ökologie*, Martin Zach
- 2008 – 2010 *Hierarchische Clustering-Verfahren*, Gabriel Guckenbiehl
Cluster categorization of sediments in aquatic ecology, Jakob Engel
Packing and covering of scaled polytopal unit balls, Felix Schmiedl
Shaped partitioning, Andreas Lechner
Clusterings, Voronoi diagrams and separability, Martin Meinel

SELECTED SERVICE

- 2017 Search Committee, CU Denver
Conference organizing committee
Informs Optimization Society Meeting 2018
Co-Organization of Operations Research Seminar, CU Denver
Linear Algebra Preliminary Committee, CU Denver
Minisymposium Organization for the SIAM Conference on
Optimization 2017
- 2016 Linear Algebra Preliminary Committee, CU Denver
Preliminary examiner for the foundations of mathematics, TU Munich

- 2015 Moderator for the 26th undergraduate student conference, UC Davis
- 2014 **Conference organizing committee**
Colloquium in Honor of the 60th Birthday of Peter Gritzmann
- Conference organizing committee**
ECCO-CO 2014 – European Chapter on Combinatorial Optimization
- IFORS 2014, Barcelona, organizer of stream ‘Geometric Clustering’
- 2013 EURO 2013, Rome, organizer of stream ‘Geometric Clustering’
- Since 2011 **Reviewer** for journals and organizations such as
American Mathematical Society, NSA Mathematical Sciences Program
National Science Foundation
Mathematical Programming
ACM Transactions on Algorithms
Discrete Optimization
SIAM Journal on Discrete Mathematics
Discrete Applied Mathematics
European Journal of Operational Research
(and about 20 more)

INVITED TALKS AND RESEARCH VISITS

- 2017 Operations Research Seminar, TU Munich, Dec. 2017
- Research visit to University of Wyoming, Oct. 2017
invited by Prof. Dr. Tyrrell Bard McAllister
Lecture: ‘The Hirsch Conjecture is True for Network-Flow Polytopes’
- Optimization Seminar, CU Boulder, April 2017
- SIAM OP 2017, Vancouver
- INFORMS Rocky Mountain Chapter Meeting, Jan. 2017
- Applied Mathematics Colloquium, CU Boulder, Jan. 2017
- 2016 Research visit to two Simon Fraser Universities, Nov. 2016
invited by Prof. Dr. Tamon Stephen
Lecture: ‘The Hirsch Conjecture is True for Network-Flow Polytopes’ at
Simon Fraser University at Burnaby
Lecture: ‘Operations Research in Land Exchange’ at Simon Fraser
University at Surrey
- 2015 DMV-Jahrestagung 2015, Hamburg
- ISMP 2015, Pittsburgh
- Workshop ‘Paths, Pivots, and Practice: The Power of Optimization’,
Montreal
- Research visit to the University of California Los Angeles, May 2015
invited by Prof. Dr. Igor Pak

- Lecture ‘Edges vs. Circuits’
- 2014 Research visit to the Universität Hamburg, May 2014,
invited by Prof. Dr. Ulrike von Luxburg
Lecture ‘Geometrisches Clustering für die Flurbereinigung’
- IFORS 2014, Barcelona, organization of stream ‘Geometric Clustering’
- Research visit to the Technion, Haifa, April 2014,
invited by Prof. Dr. Shmuel Onn
Lecture ‘Geometric Clustering for Land Consolidation’
- 2013 Research visit to the University of California, Davis, Aug. 2013,
invited by Prof. Dr. Jesús De Loera
Lecture series ‘On the Geometry of Constrained Clustering’
- EURO 2013, Rome, organization of stream ‘Geometric Clustering’
- 2012 ISMP 2012, Berlin
- EURO 2012, Vilnius, co-organization of stream and talk
- ECCO 2012, Antalya
- 2011 Research visit to the Max-Planck Institute for Intelligent Systems,
Tübingen, Oct. 2011,
invited by Prof. Dr. Bernhard Schölkopf
Lecture ‘Gravity Polytopes and Power Diagrams’
- 2010 EURO 2010, Lissabon
- DMV-Jahrestagung 2010, München
- 2009 Euro 2009, Bonn

WORKSHOP AND CONFERENCE PARTICIPATION

- 2017 Workshop on ‘Fast Iterative Methods in Optimization’
Simons Institute for the Theory of Computing, UC Berkeley
- 2 INFORMS Rocky Mountain Chapter Meetings
- 4 *Immigration Research Initiative Meetings*, CU Denver
- 2016 INFORMS Rocky Mountain Chapter Meeting
- Applied Mathematics and Statistics Colloquium, Colorado School of Mines
- Immigration Research Initiative Meeting*, CU Denver
- Faculty Seminar *Writing Successful Grants*, CU Denver
- 2015 Humboldt Netzwerktagung, Universität Augsburg

- Bay Area Optimization Meeting, UC Berkeley
- 2014 AMS 2014 Fall Western Sectional Meeting, San Francisco
- Workshop on ‚Algorithmic Spectral Graph Theory‘
Simons Institute for the Theory of Computing, UC Berkeley
- 2012 - 2013 Nine interdisciplinary workshops for project ‚Arborchange‘
- 2012 Workshop on ‚Möglichkeiten und Grenzen von Softwareunterstützung in der forstlichen Beratung bei besitzzersplitterten Ausgangssituationen‘, Amt für ländliche Entwicklung und Forsten Schweinfurt, invited talk
- 2010 Workshop on ‚Grundlagen und aktuelle Ansätze der Touren- und Fahrtenplanung mit extern verursachten Unterbrechungen‘, Universität für Bodenkultur Wien, co-organization and invited talk
- 2009 Kickoff-Meeting Synbreed – Synergistic Plant and Animal Breeding, Network of excellence for interdisciplinary, genome based research in plant and animal breeding, Freising
13. Forstlicher Unternehmertag des Clusters Holz und Forst Bayern, Freising
11. Münchner Tage der Bodenordnung und Landentwicklung, on ‚Gebot der Stunde: (Neue) Wertschöpfung im ländlichen Raum, Zweckoptimismus oder reale Chance?‘, München
- 2008 Block course on ‚Complexity of Geometric Problems‘, part of the graduate school ‚Methods for Discrete Structures‘, FU Berlin