SIAM

Conference
on Applied
Algebraic Geometry

Tuesday 9-Saturday 13
July 2019
Bern, Switzerland

mathsites.unibe.ch/siamag19

Programme and Practical Information

Contents

General Information

Venues

University of Bern, Switzerland:

- vonRoll area, Fabriksstrasse 6 and 8 (for registration, invited presentations, poster session, and business meeting; shaded grey in the programme); and
- Unitobler building, Lerchenweg 36 (for minisymposiums, contributed talks, and coffee).

Unitobler and vonRoll are about 900m apart. See page 83 for maps.

Invited speakers

In chronological order:

IP01: Switched linear systems and infinite products of matrices
Pablo Parrilo, Massachusetts Institute of Technology, Cambridge, USA (page 14)

IP02: Efficient computation of low-rank approximations to higher-order moments
Tamara G. Kolda, Sandia National Laboratories, Livermore, USA (page 20)

IP03: Cluster algebras and applications to geometry
Lauren Williams, Harvard University, Cambridge, USA (page 28)

IP04: Applications of sphere geometries in computational design
Helmut Pottmann, Technische Unversität Wien, Vienna, Austria (page 35)

IP05: Algebra and geometry in the study of enzymatic cascades
Alicia Dickenstein, Universidad de Buenos Aires, Buenos Aires, Argentina (page 43)

IP06: Data science and causality
Jonas Peters, University of Copenhagen, Copenhagen, Denmark (page 50)

IP07: Supersingular isogeny graphs in cryptography
Kristin Lauter, Microsoft Research, Redmond, USA (page 57)

IP08: Some mathematical aspects of gene regulation
Jeremy Gunawardena, Harvard Medical School, Boston, USA (page 64)

IP09: Extremal properties of 2-regular varieties
Mauricio Velasco, Universidad de los Andes, Bogotá, Colombia (page 70)

IP10: Topological adventures in neuroscience
Kathryn Hess Bellwald, École Polytechnique Fédérale de Lausanne, Lausanne, Switzerland (page 77)

Organising committee

Conference co-chairs

Sandra Di Rocco, KTH Royal Institute of Technology, Stockholm, Sweden
Caroline Uhler, MIT Massachusetts Institute of Technology, Boston, USA

Programme committee

Wolfram Decker, Technische Universität Kaiserslauten, Germany
Jon Hauenstein, University of Notre Dame, USA
Bernd Sturmfels, MPI-MIS Leipzig, Germany; and UC Berkeley, USA

Kai Hormann, Università della Svizzera Italiana, Switzerland
Venkat Chandrasekaran, California Institute of Technology, USA
Rekha Thomas, University of Washington, UK
Heather Harrington, University of Oxford, UK
Henry Cohn, Microsoft Research New England, USA

Local organisers

Emanuele Delucchi, University of Fribourg, Switzerland
Jan Draisma (chair), University of Bern, Switzerland; and Eindhoven University of Technology, The Netherlands
Elisa Gorla, University of Neuchâtel, Switzerland
Joachim Rosenthal, University of Zurich, Switzerland

Audio-visual set-up in meeting rooms

The organisers do not provide computers for any speaker. When giving an electronic presentation, speakers must provide their own computers. The organisers are not responsible for the safety and security of speakers' computers.

The plenary session room has three large screens, of which the outer two show the same image. These screens can be connected to two pieces of equipment from the multiset laptop,laptop,visualiser,visualiser. The room also has a sound system with three microphones. All other rooms have one screen and one data projector. The data projectors support both VGA and HDMI connections. Presenters requiring an alternate connection must provide their own adaptor.

Wireless internet access

The University of Bern provides eduroam on its campus. If your institution participates in Eduroam, please connect to this network. If not, please ask for the wifi voucher code from the registration desk. Then connect to public-unibe, select the menu item Guest Login and register with your cell phone number and voucher code. You will receive your access code by text message (SMS).

Poster session

The poster session will take place on Tuesday evening, July 9, from 17:15 to 19:30; see page 26. *All poster presenters are requested to be in the Foyer of Fabriksstrasse 8, the other large building at vonRoll (not the one where the plenary talks are), at 16:45*. So they will, unfortunately, have to miss the last talk in the minisymposium session that afternoon.

Description of the SIAM Activity Group in Algebraic Geometry SI(AG)[2]

The purpose of the SIAM Activity Group in Algebraic Geometry is to bring together researchers who use algebraic geometry in industrial and applied mathematics. "Algebraic geometry" is interpreted broadly to include at least: algebraic geometry, commutative algebra, noncommutative algebra, symbolic and numeric computation, algebraic and geometric combinatorics, representation theory, and algebraic topology. These methods have already seen applications in: biology, coding theory, cryptography, combustion, computational geometry, computer graphics, quantum computing, control theory, geometric design, complexity theory, machine learning, nonlinear partial differential equations, optimization, robotics, and statistics. We welcome participation from both theoretical mathematical areas and application areas not on this list which fall under this broadly interpreted notion of algebraic geometry and its applications.

Membership

If you enjoy this conference and are not yet a SIAM member, please consider joining SIAM and the SIAM Activity Group on Algebraic Geometry. SIAM members receive subscriptions to SIAM Review, SIAM Unwrapped and SIAM News and enjoy substantial discounts on SIAM books, journal subscriptions, and conference registrations.

If you are a SIAM member, it only costs $15 to join the SIAM Activity Group on Algebraic Geometry. As a SI(AG)^2 member, you are eligible for an additional discount for future SIAM AG conferences.

Free student memberships are available to all students who attend an institution that is an academic member of SIAM, are members of student chapters of SIAM, or are nominated by a regular member of SIAM.

Statement on inclusiveness

As a professional society, SIAM is committed to providing an inclusive climate that encourages the open expression and exchange of ideas, that is free from all forms of discrimination, harassment, and retaliation, and that is welcoming and comfortable to all members and to those who participate in its activities. In pursuit of that commitment, SIAM is dedicated to the philosophy of equality of opportunity and treatment for all participants regardless of gender, gender identity or expression, sexual orientation, race, color, national or ethnic origin, religion or religious belief, age, marital status, disabilities, veteran status, field of expertise, or any other reason not related to scientific merit. This philosophy extends from SIAM conferences, to its publications, and to its governing structures and bodies. We expect all members of SIAM and participants in SIAM activities to work towards this commitment.

Emergency phone numbers

- 112: International emergency call
- 117: Police
- 118: Fire station
- 144: Ambulance
- 145: Toxin information
- (+41/0) 31 326 20 00: City emergency walk-in clinic, Schanzenstrasse 4A (open until 10pm)
- (+41/0) 31 632 92 77: Inselspital emergency center (open 24h)
- (+41/0) 31 321 50 50: Lost and found (City of Bern)
- (+41/0) 31 321 88 44: Lost and found (Bernmobil, local public transport)

Sponsors

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- the Netherlands Organisation for Scientific Research NWO, via Jan Draisma's Vici grant 639.033.514;
- The Swiss National Science Foundation SNF, via Scientific Exchanges grant IZSEZ0_183750;
- The Swiss National Science Foundation SNF, via Emanuele Delucchi's grant PP00P2_179110;
- The University of Bern, Faculty of Natural Sciences, via Jan Draisma's start-up funding; and of course
- The Society for Industrial and Applied Mathematics SIAM, in part via their NSF block grant.

NWO Netherlands Organisation for Scientific Research

siam Society for Industrial and Applied Mathematics

FNSNF Swiss National Science Foundation

ub Universität Bern

Programme Overview

The following pages show print-outs of the online programme. Different parts of the same minisymposium typically, but not always, take place in the same room and appear in the same column. Abstracts of the minisymposiums and titles of the talks start on page 13.

Date: Tuesday, 09/Jul/2019

7:30am - 8:15am	**Registration (if too busy, come back any time later during the conference!)** Location: vonRoll, Fabrikstr. 6, Foyer					
8:15am - 8:30am	**Opening by the Chairs and word of welcome by Daniel Candinas, Vice-Rector for Research, University of Bern** Location: vonRoll, Fabrikstr. 6, 001					
8:30am - 9:30am	**IP01: Pablo A. Parrilo: Switched linear systems and infinite products of matrices** Location: vonRoll, Fabrikstr. 6, 001			**IP01-streamed from 001: Pablo A. Parrilo: Switched linear systems and infinite products of matrices** Location: vonRoll, Fabrikstr. 6, 004		
9:30am - 10:00am	**Coffee Break** Location: Unitobler, F wing, floors 0 and -1					
10:00am - 12:00pm	**Room free** Location: Unitobler, F005	**MS143, part 1: Algebraic geometry in topological data analysis** Location: Unitobler, F006	**MS123, part 1: Asymptotic phenomena in algebra and statistics** Location: Unitobler, F007	**MS177, part 1: Algebraic and combinatorial phylogenetics** Location: Unitobler, F011	**Room free** Location: Unitobler, F012	**MS122: Tropical and combinatorial methods in economics** Location: Unitobler, F013
	MS182, part 1: Matrix and tensor optimization Location: Unitobler, F021	**Room free** Location: Unitobler, F022	**MS142: Algebraic geometry of low-rank matrix completion** Location: Unitobler, F023	**MS148, part 1: Algebraic neural coding** Location: Unitobler, F-105	**MS151, part 1: Cluster algebras and positivity** Location: Unitobler, F-106	**MS140, part 1: Multivariate spline approximation and algebraic geometry** Location: Unitobler, F-107
	MS149, part 1: Stability of moment problems and super-resolution imaging Location: Unitobler, F-111	**MS197, part 1: Numerical differential geometry** Location: Unitobler, F-112	**Room free** Location: Unitobler, F-113	**MS172, part 1: Algebraic statistics** Location: Unitobler, F-121	**MS134, part 1: Coding theory and cryptography** Location: Unitobler, F-122	**MS132, part 1: Polynomial equations in coding theory and cryptography** Location: Unitobler, F-123
1:30pm - 2:30pm	**IP02: Tamara G. Kolda: Efficient Computation of Low-Rank Approximations to Higher-Order Moments** Location: vonRoll, Fabrikstr. 6, 001			**IP02-streamed from 001: Tamara G. Kolda: Efficient Computation of Low-Rank Approximations to Higher-Order Moments** Location: vonRoll, Fabrikstr. 6, 004		
2:30pm - 3:00pm	**Coffee break** Location: Unitobler, F wing, floors 0 and -1					
3:00pm - 5:00pm	**Room free** Location: Unitobler, F005	**MS165, part 1: Multiparameter persistence: algebra, algorithms, and applications** Location: Unitobler, F006	**MS123, part 2: Asymptotic phenomena in algebra and statistics** Location: Unitobler, F007	**Room free** Location: Unitobler, F011	**MS160, part 1: Numerical methods for structured polynomial system solving** Location: Unitobler, F012	**MS138: Computational aspects of tropical geometry** Location: Unitobler, F013
	MS191, part 1: Algebraic and geometric methods in optimization. Location: Unitobler, F021	**MS195, part 1: Algebraic methods for convex sets** Location: Unitobler, F022	**MS187, part 1: Signature tensors of paths** Location: Unitobler, F023	**MS152: Stochastic chemical reaction networks** Location: Unitobler, F-105	**MS154, part 1: New developments in matroid theory** Location: Unitobler, F-106	**MS168, part 1: Riemann Surfaces** Location: Unitobler, F-107
	Room free Location: Unitobler, F-111	**MS197, part 2: Numerical differential geometry** Location: Unitobler, F-112	**MS184, part 1: Algebraic geometry for kinematics, mechanism science, and rigidity** Location: Unitobler, F-113	**MS157, part 1: Graphical models** Location: Unitobler, F-121	**MS134, part 2: Coding theory and cryptography** Location: Unitobler, F-122	**MS132, part 2: Polynomial equations in coding theory and cryptography** Location: Unitobler, F-123
5:15pm - 7:30pm	**PP: Welcome reception and poster session** Location: vonRoll, Fabrikstr. 8, Foyer					

Date: Wednesday, 10/Jul/2019

8:25am - 8:30am	**Announcements** Location: vonRoll, Fabrikstr. 6, 001					
8:30am - 9:30am	IP03: Lauren K. Williams: Cluster algebras and applications to geometry Location: vonRoll, Fabrikstr. 6, 001			IP03-streamed from 001: Lauren K. Williams: Cluster algebras and applications to geometry Location: vonRoll, Fabrikstr. 6, 004		
9:30am - 10:00am	**Coffee break** Location: Unitobler, F wing, floors 0 and -1					
10:00am - 12:00pm	MS147, part 1: SC-square 2019 workshop on satisfiability checking and symbolic computation Location: Unitobler, F005	MS143, part 2: Algebraic geometry in topological data analysis Location: Unitobler, F006	MS200, part 1: From algebraic geometry to geometric topology: Crossroads on applications Location: Unitobler, F007	MS177, part 2: Algebraic and combinatorial phylogenetics Location: Unitobler, F011	Room free Location: Unitobler, F012	MS156: Tropical geometry in statistics Location: Unitobler, F013
	MS182, part 2: Matrix and tensor optimization Location: Unitobler, F021	MS130, part 1: Polynomial optimization and its applications Location: Unitobler, F022	MS163: Theory and methods for tensor decomposition Location: Unitobler, F023	MS148, part 2: Algebraic neural coding Location: Unitobler, F-105	MS151, part 2: Cluster algebras and positivity Location: Unitobler, F-106	MS140, part 2: Multivariate spline approximation and algebraic geometry Location: Unitobler, F-107
	MS149, part 2: Stability of moment problems and super-resolution imaging Location: Unitobler, F-111	Room free Location: Unitobler, F-112	MS166, part 1: Computational aspects of finite groups and their representations Location: Unitobler, F-113	MS172, part 2: Algebraic statistics Location: Unitobler, F-121	MS134, part 3: Coding theory and cryptography Location: Unitobler, F-122	MS145, part 1: Isogenies in Cryptography Location: Unitobler, F-123
1:30pm - 2:30pm	IP04: Helmut Pottman: Applications of sphere geometries in computational design Location: vonRoll, Fabrikstr. 6, 001			IP04-streamed from 001: Helmut Pottman: Applications of sphere geometries in computational design Location: vonRoll, Fabrikstr. 6, 004		
2:30pm - 3:00pm	**Coffee break** Location: Unitobler, F wing, floors 0 and -1					
3:00pm - 5:00pm	MS165, part 2: Multiparameter persistence: algebra, algorithms, and applications Location: Unitobler, F006	MS200, part 2: From algebraic geometry to geometric topology: Crossroads on applications Location: Unitobler, F007	MS199, part 1: Applications of topology in neuroscience Location: Unitobler, F011	MS160, part 2: Numerical methods for structured polynomial system solving Location: Unitobler, F012	MS167, part 1: Computational tropical geometry Location: Unitobler, F013	MS191, part 2: Algebraic and geometric methods in optimization. Location: Unitobler, F021
	MS195, part 2: Algebraic methods for convex sets Location: Unitobler, F022	MS187, part 2: Signature tensors of paths Location: Unitobler, F023	MS183, part 1: Polyhedral geometry methods for biochemical reaction networks Location: Unitobler, F-105	MS154, part 2: New developments in matroid theory Location: Unitobler, F-106	MS168, part 2: Riemann Surfaces Location: Unitobler, F-107	MS175, part 1: Algebraic geometry and combinatorics of jammed structures Location: Unitobler, F-111
	MS178: Geometric design for fabrication Location: Unitobler, F-112	MS184, part 2: Algebraic geometry for kinematics, mechanism science, and rigidity Location: Unitobler, F-113	MS157, part 2: Graphical models Location: Unitobler, F-121	MS134, part 4: Coding theory and cryptography Location: Unitobler, F-122	MS132, part 3: Polynomial equations in coding theory and cryptography Location: Unitobler, F-123	
3:00pm - 5:30pm	MS147, part 2: SC-square 2019 workshop on satisfiability checking and symbolic computation Location: Unitobler, F005					
5:15pm - 6:00pm	SI(AG)^2 Early Career Prize Lecture: Elina Robeva: Orthogonal Tensor Decomposition Location: vonRoll, Fabrikstr. 6, 001			SI(AG)^2 Early Career Prize Lecture streamed from 001: Elina Robeva: Orthogonal Tensor Decomposition Location: vonRoll, Fabrikstr. 6, 004		

Date: Thursday, 11/Jul/2019

8:25am - 8:30am	**Announcements** Location: vonRoll, Fabrikstr. 6, 001					
8:30am - 9:30am	**IP05: Alicia Dickenstein: Algebra and geometry in the study of enzymatic cascades** Location: vonRoll, Fabrikstr. 6, 001			**IP05-streamed from 001: Alicia Dickenstein: Algebra and geometry in the study of enzymatic cascades** Location: vonRoll, Fabrikstr. 6, 004		
9:30am - 10:00am	**Coffee break** Location: Unitobler, F wing, floors 0 and -1					
10:00am - 12:00pm	**MS137, part 1: Symbolic Combinatorics** Location: Unitobler, F005	**MS146, part 1: Random geometry and topology** Location: Unitobler, F006	**MS181, part 1: Integral and algebraic geometric methods in the study of Gaussian random fields** Location: Unitobler, F007	**MS126, part 1: Euclidean distance geometry and its applications** Location: Unitobler, F011	**MS173, part 1: Numerical methods in algebraic geometry** Location: Unitobler, F012	**MS144: Tropical geometry in machine learning** Location: Unitobler, F013
	MS153, part 1: Symmetry in algorithmic questions of real algebraic geometry Location: Unitobler, F021	**MS130, part 2: Polynomial optimization and its applications** Location: Unitobler, F022	**MS124, part 1: The algebra and geometry of tensors 1: general tensors** Location: Unitobler, F023	**MS174, part 1: Algebraic aspects of biochemical reaction networks** Location: Unitobler, F-105	**MS164, part 1: Algebra, geometry, and combinatorics of subspace packings** Location: Unitobler, F-106	**MS140, part 3: Multivariate spline approximation and algebraic geometry** Location: Unitobler, F-107
	MS149, part 3: Stability of moment problems and super-resolution imaging Location: Unitobler, F-111	**MS150, part 1: Fitness landscapes and epistasis** Location: Unitobler, F-112	**MS180, part 1: Network coding and subspace designs** Location: Unitobler, F-113	**MS194: Latent graphical models** Location: Unitobler, F-121	**MS185, part 1: Algebraic Geometry Codes** Location: Unitobler, F-122	**MS145, part 2: Isogenies in Cryptography** Location: Unitobler, F-123
1:30pm - 2:30pm	**IP06: Jonas Peters: Data Science and Causality** Location: vonRoll, Fabrikstr. 6, 001			**IP06-streamed from 001: Jonas Peters: Data Science and Causality** Location: vonRoll, Fabrikstr. 6, 004		
2:30pm - 3:00pm	**Coffee break** Location: Unitobler, F wing, floors 0 and -1					
3:00pm - 5:00pm	**MS188: Probability and randomness in commutative algebra and algebraic geometry** Location: Unitobler, F005	**MS189, part 1: Geometry and topology in applications.** Location: Unitobler, F006	**MS200, part 3: From algebraic geometry to geometric topology: Crossroads on applications** Location: Unitobler, F007	**MS166, part 2: Computational aspects of finite groups and their representations** Location: Unitobler, F011	**MS160, part 3: Numerical methods for structured polynomial system solving** Location: Unitobler, F012	**MS167, part 2: Computational tropical geometry** Location: Unitobler, F013
	MS158, part 1: Structured sums of squares Location: Unitobler, F021	**MS195, part 3: Algebraic methods for convex sets** Location: Unitobler, F022	**MS124, part 2: The algebra and geometry of tensors 1: general tensors** Location: Unitobler, F023	**MS183, part 2: Polyhedral geometry methods for biochemical reaction networks** Location: Unitobler, F-105	**MS154, part 3: New developments in matroid theory** Location: Unitobler, F-106	**MS136, part 1: Syzygies and applications to geometry** Location: Unitobler, F-107
	MS175, part 2: Algebraic geometry and combinatorics of jammed structures Location: Unitobler, F-111	**MS150, part 2: Fitness landscapes and epistasis** Location: Unitobler, F-112	**MS155, part 1: Massively parallel computations in algebraic geometry** Location: Unitobler, F-113	**MS139, part 1: Combinatorics and algorithms in decision and reason** Location: Unitobler, F-121	**MS134, part 5: Coding theory and cryptography** Location: Unitobler, F-122	**MS132, part 4: Polynomial equations in coding theory and cryptography** Location: Unitobler, F-123
5:15pm - 6:30pm	**SIAGA meeting for corresponding and associate editors** Location: Unitobler, F011					

Date: Friday, 12/Jul/2019

8:25am - 8:30am	**Announcements** Location: vonRoll, Fabrikstr. 6, 001					
8:30am - 9:30am	**IP07: Kristin Lauter: Supersingular Isogeny Graphs in Cryptography** Location: vonRoll, Fabrikstr. 6, 001			**IP07-streamed from 001: Kristin Lauter: Supersingular Isogeny Graphs in Cryptography** Location: vonRoll, Fabrikstr. 6, 004		
9:30am - 10:00am	**Coffee break** Location: Unitobler, F wing, floors 0 and -1					
10:00am - 12:00pm	**MS137, part 2: Symbolic Combinatorics** Location: Unitobler, F005	**MS146, part 2: Random geometry and topology** Location: Unitobler, F006	**MS181, part 2: Integral and algebraic geometric methods in the study of Gaussian random fields** Location: Unitobler, F007	**MS126, part 2: Euclidean distance geometry and its applications** Location: Unitobler, F011	**MS173, part 2: Numerical methods in algebraic geometry** Location: Unitobler, F012	**MS141, part 1: Chip-firing and tropical curves** Location: Unitobler, F013
	MS179, part 1: Algebraic methods for polynomial system solving Location: Unitobler, F021	**MS130, part 3: Polynomial optimization and its applications** Location: Unitobler, F022	**MS124, part 3: The algebra and geometry of tensors 1: general tensors** Location: Unitobler, F023	**MS174, part 2: Algebraic aspects of biochemical reaction networks** Location: Unitobler, F-105	**MS164, part 2: Algebra, geometry, and combinatorics of subspace packings** Location: Unitobler, F-106	**MS125: Efficient algorithms for geometric invariant theory** Location: Unitobler, F-107
	MS169, part 1: Applications of Algebraic geometry to quantum information Location: Unitobler, F-111	**MS128, part 1: Symbolic-numeric methods for non-linear equations: Algorithms and applications** Location: Unitobler, F-112	**MS180, part 2: Network coding and subspace designs** Location: Unitobler, F-113	**MS198: Positive and negative association** Location: Unitobler, F-121	**MS185, part 2: Algebraic Geometry Codes** Location: Unitobler, F-122	**MS145, part 3: Isogenies in Cryptography** Location: Unitobler, F-123
1:30pm - 2:30pm	**IP08: Jeremy Gunawardena: Some mathematical aspects of gene regulation** Location: vonRoll, Fabrikstr. 6, 001			**IP08-streamed from 001: Jeremy Gunawardena: Some mathematical aspects of gene regulation** Location: vonRoll, Fabrikstr. 6, 004		
2:30pm - 3:00pm	**Coffee break** Location: Unitobler, F wing, floors 0 and -1					
3:00pm - 5:00pm	**MS131, part 1: Computations in algebraic geometry** Location: Unitobler, F005	**MS189, part 2: Geometry and topology in applications.** Location: Unitobler, F006	**MS200, part 4: From algebraic geometry to geometric topology: Crossroads on applications** Location: Unitobler, F007	**MS186, part 1: Algebraic vision** Location: Unitobler, F011	**MS160, part 4: Numerical methods for structured polynomial system solving** Location: Unitobler, F012	**MS167, part 3: Computational tropical geometry** Location: Unitobler, F013
	MS158, part 2: Structured sums of squares Location: Unitobler, F021	**MS129, part 1: Sparsity in polynomial systems and applications** Location: Unitobler, F022	**MS127, part 1: The algebra and geometry of tensors 2: structured tensors** Location: Unitobler, F023	**Room free** Location: Unitobler, F-105	**MS154, part 4: New developments in matroid theory** Location: Unitobler, F-106	**MS136, part 2: Syzygies and applications to geometry** Location: Unitobler, F-107
	MS193: Algebraic geometry, data science and fundamental physics Location: Unitobler, F-111	**MS137, part 3: Symbolic Combinatorics** Location: Unitobler, F-112	**MS155, part 2: Massively parallel computations in algebraic geometry** Location: Unitobler, F-113	**MS139, part 2: Combinatorics and algorithms in decision and reason** Location: Unitobler, F-121	**MS134, part 6: Coding theory and cryptography** Location: Unitobler, F-122	**MS162, part 1: Applications of finite fields theory** Location: Unitobler, F-123
5:15pm - 7:00pm	**SI(AG)^2 business meeting** Location: vonRoll, Fabrikstr. 6, 001					

Date: Saturday, 13/Jul/2019

8:25am - 8:30am	**Announcements** Location: vonRoll, Fabrikstr. 6, 001					
8:30am - 9:30am	**IP09: Mauricio Velasco: Extremal properties of 2-regular varieties** Location: vonRoll, Fabrikstr. 6, 001			**IP09-streamed from 001: Mauricio Velasco: Extremal properties of 2-regular varieties** Location: vonRoll, Fabrikstr. 6, 004		
9:30am - 10:00am	**Coffee break** Location: Unitobler, F wing, floors 0 and -1					
10:00am - 12:00pm	**Room reserved (unless you reserved it, please don't enter)** Location: Unitobler, F005	**MS146, part 3: Random geometry and topology** Location: Unitobler, F006	**MS171, part 1: Grassmann and flag manifolds in data analysis** Location: Unitobler, F007	**MS186, part 2: Algebraic vision** Location: Unitobler, F011	**MS173, part 3: Numerical methods in algebraic geometry** Location: Unitobler, F012	**MS141, part 2: Chip-firing and tropical curves** Location: Unitobler, F013
	MS179, part 2: Algebraic methods for polynomial system solving Location: Unitobler, F021	**MS130, part 4: Polynomial optimization and its applications** Location: Unitobler, F022	**MS127, part 2: The algebra and geometry of tensors 2: structured tensors** Location: Unitobler, F023	**MS174, part 3: Algebraic aspects of biochemical reaction networks** Location: Unitobler, F-105	**MS164, part 3: Algebra, geometry, and combinatorics of subspace packings** Location: Unitobler, F-106	**MS159: Intersections in practice** Location: Unitobler, F-107
	MS169, part 2: Applications of Algebraic geometry to quantum information Location: Unitobler, F-111	**MS128, part 2: Symbolic-numeric methods for non-linear equations: Algorithms and applications** Location: Unitobler, F-112	**MS176: Algebraic geometry for kinematics and dynamics in robotics** Location: Unitobler, F-113	**MS196: Algebro-geometric methods for social network modelling** Location: Unitobler, F-121	**MS185, part 3: Algebraic Geometry Codes** Location: Unitobler, F-122	**MS145, part 4: Isogenies in Cryptography** Location: Unitobler, F-123
1:30pm - 2:30pm	**IP10: Kathryn Hess Bellwald: Topological adventures in neuroscience** Location: vonRoll, Fabrikstr. 6, 001			**IP10-streamed from 001: Kathryn Hess Bellwald: Topological adventures in neuroscience** Location: vonRoll, Fabrikstr. 6, 004		
2:30pm - 3:00pm	**Coffee break** Location: Unitobler, F wing, floors 0 and -1					
3:00pm - 5:00pm	**MS131, part 2: Computations in algebraic geometry** Location: Unitobler, F005	**Room free** Location: Unitobler, F006	**MS171, part 2: Grassmann and flag manifolds in data analysis** Location: Unitobler, F007	**Room free** Location: Unitobler, F011	**Room free** Location: Unitobler, F012	**MS167, part 4: Computational tropical geometry** Location: Unitobler, F013
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	Room free Location: Unitobler, F-111	**Room free** Location: Unitobler, F-112	**Room free** Location: Unitobler, F-113	**MS139, part 3: Combinatorics and algorithms in decision and reason** Location: Unitobler, F-121	**MS134, part 7: Coding theory and cryptography** Location: Unitobler, F-122	**MS162, part 2: Applications of finite fields theory** Location: Unitobler, F-123

Programme

Here, within the timeslots, the minisymposiums are ordered by number. This ordering differs from the schedule in the overview, where the minisymposiums are ordered according to room.

Tuesday, July 9

Registration (if too busy, come back any time later during the conference!)

Tuesday, July 9, 07:30–08:15
Room: vonRoll, Fabrikstr. 6, Foyer

Opening by the Chairs and word of welcome by Daniel Candinas, Vice-Rector for Research, University of Bern

Tuesday, July 9, 08:15–08:30
Room: vonRoll, Fabrikstr. 6, 001

IP01: Pablo Parrilo: Switched linear systems and infinite products of matrices

Tuesday, July 9, 08:30–09:30
Room: vonRoll, Fabrikstr. 6, 001
Streamed to: vonRoll, Fabrikstr. 6, 004

Many situations of interest can be modeled as "switched linear systems", which are collections of linear difference equations, with some logical rule for switching between subsystems. Mathematically, this boils down to understanding infinite products of matrices, all of which are elements of a given finite set. Analyzing these systems is a difficult question that appears in a number of applications, including the analysis of optimization algorithms, information theory, and wavelets. Depending on whether the switching is deterministic or stochastic, different notions can be used to quantify the resulting convergence rate, like the *joint spectral radius*, or the *Lyapunov exponent*. In this talk, we provide a gentle introduction to this class of problems, their applications, and several results regarding their exact and approximate computation.

Speaker: Pablo Parrilo (MIT, USA)

Coffee Break

Tuesday, July 9, 09:30–10:00
Room: Unitobler, F wing, floors 0 and -1

MS122: Tropical and combinatorial methods in economics

Tuesday, July 9, 10:00–12:00
Room: Unitobler, F013

Over the past ten years, combinatorial auctions and mechanism designs have posed interesting challenges at the intersection of tropical geometry, matroid theory, discrete convex analysis and integer programming. This minisymposium features experts who work at this intersection discussing the latest developments and potential approaches to major conjectures concerning valuated matroids (also known as gross substitutes or $M^\natural$-concave functions).

Organizers: Ngoc Mai Tran (The University of Texas at Austin, United States of America)

On the Construction of Substitutes
Eric Balkanski (Harvard)

Connection Between Discrete Convex Analysis and Auction Theory
Akiyoshi Shioura (Tokyo Institute of Technology)

Unimodular schemes
Gleb Koshevoy (Russian Academy of Sciences)

Transversal valuated matroids
Alex Fink (Queen Mary University of London)

MS123, part 1: Asymptotic phenomena in algebra and statistics

Tuesday, July 9, 10:00–12:00
Room: Unitobler, F007

Across several branches of mathematics, the following fundamental question arises: given a sequence of algebraic structures with maps between them, can the entire sequence be characterized by a finite segment? Here the maps are comprising symmetries of the objects as well as morphisms between them. An affirmative answer leads to a description of all structures by using finite data only. There is a growing body of work that establishes the desired finiteness result in varied contexts. Nevertheless, instances where stability is not well understood include:

• In algebraic statistics, a typical object is a toric ideal arising from a statistical model, and the maps correspond to shrinking the state space of the variables. The question is whether these ideals stabilize as n approaches infinity.

• In commutative algebra, a typical object is a free resolution of an ideal over a polynomial ring in n variables, and the maps are induced by injections of the rings. The question is whether the resolutions stabilize as n varies.

• In representation stability, a typical object is a cohomology group of the configuration space of n labeled points in a manifold M, and the maps between the groups correspond to relabeling or forgetting points. The question is whether these groups stabilize.

• tensor decomposition, a typical object is the variety of n-way tensors of bounded border rank, and the maps correspond to actions of products of general linear groups acting on the tensor factors and contractions relating the varieties for different n. The question is whether equations or higher-order syzygies of them stabilize.

The aim of the minisymposium is to build bridges between the varied mathematicians and the different areas investigating stability phenomena.

Organizers: Rob H. Eggermont (Technical University Einhoven, Netherlands), Uwe Nagel (University of Kentucky, USA), and Tim Römer (Universität Osnabrück, Germany)

Strength and polynomial functors
Arthur Bik (University of Bern, Switzerland)

Asymptotics Proved by the Method of Cumulants
Hanna Döring (Universität Osnabrück, Germany)

FI-algebras: examples and counterexamples
Robert Krone (University of California at Davis, USA)

Asymptotic behavior of chains of ideals with symmetry
Dinh Le Van (Universität Osnabrück, Germany)

MS132, part 1: Polynomial equations in coding theory and cryptography

Tuesday, July 9, 10:00–12:00
Room: Unitobler, F-123

Polynomial equations are central in algebraic geometry, being algebraic varieties geometric manifestations of solutions of systems of polynomial equations. Actually, modern algebraic geometry is based on the use of techniques for studying and solving geometrical problems about these sets of zeros. At the same time, polynomial equations have found interesting applications in coding theory and cryptography. The interplay between algebraic geometry and coding theory is old and goes back to the first examples of algebraic codes defined with polynomials and codes coming from algebraic curves. More recently, polynomial equations have found important applications in cryptography as well. For example, in multivariate cryptography, one of the prominent candidates for post-quantum cryptosystems, the trapdoor one-way function takes the form of a multivariate quadratic polynomial map over a finite field. Furthermore, the efficiency of the index calculus attack to break an elliptic curve cryptosystem relies on the effectiveness of solving a system of multivariate polynomial equations. This session will feature recent progress in these and other applications of polynomial equations to coding theory and cryptography.

Organizers: Alessio Caminata (University of Neuchâtel, Switzerland) and Alberto Ravagnani (University College Dublin, Ireland)

Free resolutions of test sets and their applications to coding theory
Edgar Martinez Moro (University of Valladolid)

Algebraic geometry codes from del Pezzo surfaces
Alain Couvreur (INRIA)

An Approach to Density Problems in Coding Theory
Eimear Byrne (University College Dublin)

Multivariate Signatures
Jintai Ding (University of Cincinnati)

MS134, part 1: Coding theory and cryptography

Tuesday, July 9, 10:00–12:00
Room: Unitobler, F-122

The focus of this minisymposium is on coding theory and cryptography, with emphasis on the algebraic aspects of these two research fields. Error-correcting codes are mathematical objects that allow reliable communications over noisy/lossy/adversarial channels. Constructing good codes and designing efficient decoding algorithms for them often reduces to solving algebra problems, such as counting rational points on curves, solving equations, and classifying finite rings and modules. Cryptosystems can be roughly defined as functions that are easy to evaluate, but whose inverse is difficult to compute in practice. These functions are in general constructed using algebraic objects and tools, such as polynomials, algebraic varieties, and groups. The security of the resulting cryptosystem heavily relies on the mathematical properties of these. The sessions we propose feature experts of algebraic methods in coding theory and cryptography. All levels of experience are represented, from junior to very experienced researchers.

Organizers: Alessio Caminata (University of Neuchâtel, Switzerland) and Alberto Ravagnani (University College Dublin, Ireland)

Ferrers Diagram Codes: Constructions and Proportion
Heide Gluesing-Luerssen (University of Kentucky)

Subspace designs and majority logic decoding
Alfred Wassermann (University of Bayreuth)

Bounds on the complexity of computing Groebner bases for HFE systems
Elisa Gorla (University of Neuchâtel)

Post-quantum key agreement from commutative group actions
Wouter Castryck (KU Leuven)

MS140, part 1: Multivariate spline approximation and algebraic geometry

Tuesday, July 9, 10:00–12:00
Room: Unitobler, F-107

The focus of the proposed minisymposium is on problems in approximation theory that may be studied using techniques from commutative algebra and algebraic geometry. Research interests of the participants relevant to the minisymposium fall broadly under multivariate spline theory, interpolation, and geometric modeling. For instance, a main problem of interest is to study the dimension of the vector space of splines of a bounded degree on a simplicial complex; recently there have been several advances on this front using notions from algebraic geometry. Nevertheless this problem remains elusive in low degree; the dimension of the space of piecewise cubics on a planar triangulation (especially relevant for applications) is still unknown in general.

Organizers: Michael DiPasquale (Colorado State University, United States of America) and Nelly Villamizar (Swansea University)

Algebraic Approaches to Spline Theory
Michael DiPasquale (Colorado State University)

Polynomial splines of non-uniform degree: Combinatorial bounds on the dimension
Deepesh Toshniwal (The University of Texas at Austin), Bernard Mourrain (Inria), and Thomas Hughes (The University of Texas at Austin)

Approximation power of C1-smooth isogeometric functions on trivariate two-patch domains
Katharina Birner (Johannes Kepler University Linz), Bert Jüttler (Johannes Kepler University Linz), and Angelos Mantzaflaris (Inria)

Splines, representations, and the Stanley-Stembridge conjecture
Julianna Tymoczko (Smith College)

MS142: Algebraic geometry of low-rank matrix completion

Tuesday, July 9, 10:00–12:00
Room: Unitobler, F023

In a matrix completion problem, one is presented with a subset of entries of a matrix and wishes to find values for the remaining entries so that the completed matrix has a particular property. For example, one may want the completed matrix to have low rank or to be positive semidefinite. Such problems abound in application areas ranging from recommender systems (e.g. the "Netflix problem"), to rigidity theory, to compressed sensing, to maximum likelihood estimation for graphical models. Matrix completion problems also motivate many questions that can be considered fundamental within algebraic geometry. For example, studying low-rank matrix completion motivates the question: which coordinate projections of a given determinantal variety are dominant? What changes when one restricts to the real part of this determinantal variety? This minisymposium aims to bring together researchers who study algebraic aspects of matrix completion, both from theoretical and applied perspectives.

Organizers: Carlos Améndola (TU Munich) and Daniel Irving Bernstein (MIT)

Real geometry of matrix completion
Rainer Sinn (FU Berlin)

Low algebraic dimension matrix completion
Greg Ongie (U Chicago)

The tropical Cayley-Menger variety
Daniel Irving Bernstein (MIT)

Unlabelled global rigidity and low-rank matrix completion
Louis Theran (University of St. Andrews)

MS143, part 1: Algebraic geometry in topological data analysis

Tuesday, July 9, 10:00–12:00
Room: Unitobler, F006

In the last 20 years methods from topology, the mathematical area that studies "shapes", have proven successful in studying data that is complex, and whose underlying shape is not known a priori. This practice has become known as topological data analysis (TDA). As additional methods from topology still find their application in the study of complex structure in data, the practice is evolving and expanding, and now moreover draws increasingly upon data science, computer science, computational algebra, computational topology, computational geometry, and statistics.

While ideas from category theory, sheaf theory and representation theory of quivers have driven the theoretical development in the past decade, in the last years ideas from commutative algebra and algebraic geometry have started have started to be used to tackle some theoretical problems in TDA. The aim of the minisymposium is to seize this momentum and to bring together experts in algebraic geometry and researchers in topological data analysis to explore new avenues of research and foster research collaborations.

Organizers: Nina Otter (UCLA, United States of America)

Algebraic geometry in topological data analysis: an overview
Nina Otter (UCLA, United States of America)

Applications of Groebner bases
Natalia Iyudu (University of Edinburgh, United Kingdom)

Decomposition of 2-parameter persistence modules
Steve Oudot (Inria Saclay, France)

Classification of filtered chain complexes
Barbara Giunti (Università di Pavia, Italy), Wojciech Chacholski (KTH, Stockholm), and Claudia Landi (Università di Modena e Reggio Emilia)

MS148, part 1: Algebraic neural coding

Tuesday, July 9, 10:00–12:00
Room: Unitobler, F-105

Neuroscience aims to decipher how the brain represents information via the firing of neurons. Place cells of the hippocampus have been demonstrated to fire in response to specific regions of Euclidean space. Since this discovery, a wealth of mathematical exploration has described connections between the algebraic and combinatorial features of the firing patterns and the shape of the space of stimuli triggering the response. These methods generalize to other types of neurons with similar response behavior. We bring together a group of mathematicians doing innovative work in this exciting field. This will allow experts in commutative algebra, combinatorics, geometry and topology to connect and collaborate on problems related to neural codes, neural rings, and neural networks.

Organizers: Nora Youngs (Colby College) and Zvi Rosen (Florida Atlantic University, United States of America)

Flexible Motifs in Threshold-Linear Networks
Carina Curto (The Pennsylvania State University)

Robust Motifs in Threshold-Linear Networks
Katherine Morrison (University of Northern Colorado)

An Algebraic Perceptron and the Neural Ideals
Vladimir Itskov (The Pennsylvania State University)

Properties of Hyperplane Neural Codes
Alexander Kunin (The Pennsylvania State University)

MS149, part 1: Stability of moment problems and super-resolution imaging

Tuesday, July 9, 10:00–12:00
Room: Unitobler, F-111

Algebraic techniques have proven useful in different imaging tasks such as spike reconstruction (single molecule microscopy), phase retrieval (X-ray crystallography), and contour reconstruction (natural images). The available data typically consists of (trigonometric) moments of low to moderate order and one asks for the reconstruction of fine details modeled by zero- or positive-dimensional algebraic varieties. Often, such reconstruction problems have a generically unique solution when the number of data is larger than the degrees of freedom in the model.

Beyond that, the minisymposium concentrates on simple a-priori conditions to guarantee that the reconstruction problem is well or only mildly ill conditioned. For the reconstruction of points on the complex torus, popular results ask the order of the moments to be larger than the inverse minimal distance of the points. Moreover, simple and efficient eigenvalue based methods achieve this stability numerically in specific settings. Recently, the situation of clustered points, points with multiplicities, and positive-dimensional algebraic varieties have been studied by similar methods and shall be discussed within the minisymposium.

Organizers: Stefan Kunis (University Osnabrueck, Germany) and Dmitry Batenkov (MIT Boston)

Introductory talk: stability of moment problems and super-resolution imaging
Dmitry Batenkov (MIT Boston)

Non-ideal Super-resolution and Variations on a Theme
Ayush Bhandari (Imperial College London)

Clustered Super-Resolution
Gil Goldman (Weizmann Institute)

Geometry of Error Amplification in Spike-train Fourier Reconstruction
Yosef Yomdin (Weizmann Institute)

MS151, part 1: Cluster algebras and positivity

Tuesday, July 9, 10:00–12:00
Room: Unitobler, F-106

Cluster algebras are commutative rings whose generators and relations can be defined in a remarkably succinct recursive fashion. Algebras of this kind, introduced by Fomin and Zelevinsky in 2000, are equipped with a powerful combinatorial structure frequently appearing in many mathematical contexts such as Lie theory, triangulations of surfaces, Teichmueller theory and beyond. Coordinate rings of Grassmannians and related invariant rings are well-studied examples of algebras of this type. One important aspect arising from the intrinsic combinatorial structure of cluster algebras is that it uncovers systematic, intriguing and complex positivity properties in these families of rings. For instance, it is expected that for each cluster algebra there is a distinguished basis, such that all elements can be expressed as a "positive" linear combination of basis vectors. Seemingly elementary claims of this type, so far proved only in certain cases, have triggered important developments in research areas at the intersection of geometry, algebra and combinatorics.

In this session, we glimpse at recent developments in this field and discuss open questions.

Organizers: Lisa Lamberti (ETHZ, Switzerland), Khrystyna Serhiyenko (University of California, Berkeley, USA / University of Kentucky, Lexington), and Lauren Williams (Harvard, USA)

Toric degenerations of cluster varieties and cluster duality
Konstanze Rietsch (King's College London)

On mirror symmetry for homogeneous spaces
Lara Bossinger (Max Planck Institute for Mathematics in the Sciences), Juan Bosco Frías Medina (Instituto de Matematicas UNAM, Mexico), *Tim Magee* (Instituto de Matematicas UNAM, Mexico), and Alfredo Nájera Chávez (Instituto de Matematicas UNAM, Mexico)

Generalised friezes and the weak Ptolemy map
Ilke Canakci (Newcastle University, UK) and Peter Jørgensen (Newcastle University, UK)

Perfect matching modules for dimer algebras
Ilke Canakci (Newcastle University, UK), Alastair King (University of Bath,UK), and *Matthew Pressland* (Universität Stuttgart, D)

MS172, part 1: Algebraic statistics

Tuesday, July 9, 10:00–12:00
Room: Unitobler, F-121
Algebraic statistics studies statistical models through the lens of algebra, geometry, and combinatorics. From model selection to inference, this interdisciplinary field has seen applications in a wide range of statistical procedures. This session will focus broadly on new developments in algebraic statistics, both on the theoretical side and the applied side.

Organizers: Jose Israel Rodriguez (UW Madison) and Elizabeth Gross (University of Hawai'i at Mānoa)

Testing model fit for networks: algebraic statistics of mixture models and beyond
Sonja Petrovic (IIT)

Oriented Gaussoids
Thomas Kahle (OvGU Magdeburg)

Ideals of Gaussian Graphical Models
Seth Sullivant (NCSU)

Combinatorial matrix theory in structural equation models
Marc Harkonen (Georgia Tech)

MS177, part 1: Algebraic and combinatorial phylogenetics

Tuesday, July 9, 10:00–12:00
Room: Unitobler, F011
Since late eighties, algebraic tools have been present in phylogenetic theory and have been crucial in understanding the limitations of models and methods and in proposing improvements to the existing tools. In this session we intend to present some of the most recent work in this area.

Organizers: Marta Casanellas (Universitat Politècnica de Catalunya), Jane Coons (North Carolina State University), and Seth Sullivant (North Carolina State University)

An Introduction to Algebraic and Combinatorial Phylogenetics
Jane Coons (North Carolina State University)

Inferring species networks from gene trees
Elizabeth S. Allman (University of Alaska Fairbanks), Hector Baños (University of Alaska Fairbanks), and John Rhodes (University of Alaska Fairbanks)

Algebraic versus semi-algebraic conditions for phylogenetic varieties
Marina Garrote-López (BGSMath and Universitat Politècnica de Catalunya)

Trait evolution on two gene trees
James Degnan (The University of New Mexico)

MS182, part 1: Matrix and tensor optimization

Tuesday, July 9, 10:00–12:00
Room: Unitobler, F021

Matrix and tensor optimization has important applications in the context of modern data analysis and high dimensional problems. Specifically, low rank approximations and spectral properties are of interest. Due to their multilinear parametrization, sets of low rank matrices and tensors form sets with interesting, and sometimes challenging, geometric and algebraic structures. Studying such sets of tensors and matrices in the context of algebraic geometry is therefore not only helpful but also necessary for the development of efficient optimization algorithms and a rigorous analysis thereof. In this respect, the area of matrix and tensor optimization relates to the field applied algebraic geometry by the addressed problems and some of the employed concepts. In this minisymposium, we wish to bring the latest developments in both of these aspects to attention.

Organizers: Max Pfeffer (Max Planck Institute MiS, Leipzig, Germany) and André Uschmajew (Max Planck Institute MiS, Leipzig, Germany)

Tensorized Krylov subspace methods
Daniel Kressner (EPF Lausanne, Switzerland)

Critical points of quadratic low-rank optimization problems
Bart Vandereycken (University of Geneva, Switzerland)

Matrix product states from an algebraic geometer's point of view
Tim Seynnaeve (Max Planck Institute MiS, Leizpig, Germany)

Computation of the norm of a nonnegative tensor
Antoine Gautier (Saarland University, Saarbruecken, Germany)

MS197, part 1: Numerical differential geometry

Tuesday, July 9, 10:00–12:00
Room: Unitobler, F-112

The profound theory of differential geometry has interacted with the computational and statistical communities in the past decades, yielding fruitful outcomes in a wide range of fields including manifold learning, Riemannian optimization, and geometry processing. This minisymposium encourages researchers from applied differential geometry, optimization, manifold learning, and geometry processing to share their perspectives and technical tools on problems lying in the intersection of geometry and computations.

Organizers: Tingran Gao (The University of Chicago, United States of America) and Ke Ye (Chinese Academy of Sciences)

Introduction to Numerical Differential Geometry
Ke Ye (Chinese Academy of Sciences)

A Riemannian Proximal Gradient Descent Method with Optimal Convergence Rate
Wen Huang (Xiamen University)

Semi-Riemannian Manifold Optimization
Tingran Gao (The University of Chicago)

IP02: Tamara G. Kolda: Efficient Computation of Low-Rank Approximations to Higher-Order Moments

Tuesday, July 9, 13:30–14:30
Room: vonRoll, Fabrikstr. 6, 001
Streamed to: vonRoll, Fabrikstr. 6, 004

We consider the problem of decomposing a data tensor that is naturally expressed as the sum of p symmetric outer products of vectors of length n. For instance, a dth-order empirical moment tensor has such an expression, and there have been examples of this structure arising in machine learning problems. Our goal is to find the best approximate decomposition that is the sum of r symmetric outer products with $r \ll p$. We reduce the work and storage from exponential to linear in n, breaking the curse of dimensionality. When p is massive or the data is streaming, we show that stochastic sampling methods can be used to further reduce the complexity. We also show some intriguing finding on the rank of random tensors. This is joint work with PhD candidate Samantha Sherman at the University of Notre Dame.

Speaker: Tamara Kolda (Sandia National Laboratories, United States of America)

Coffee break

Tuesday, July 9, 14:30–15:00
Room: Unitobler, F wing, floors 0 and -1

MS123, part 2: Asymptotic phenomena in algebra and statistics

Tuesday, July 9, 15:00–17:00
Room: Unitobler, F007

Across several branches of mathematics, the following fundamental question arises: given a sequence of algebraic structures with maps between them, can the entire sequence be characterized by a finite segment? Here the maps are comprising symmetries of the objects as well as morphisms between them. An affirmative answer leads to a description of all structures by using finite data only. There is a growing body of work that establishes the desired finiteness result in varied contexts. Nevertheless, instances where stability is not well understood include:

• In algebraic statistics, a typical object is a toric ideal arising from a statistical model, and the maps correspond to shrinking the state space of the variables. The question is whether these ideals stabilize as n approaches infinity.

• In commutative algebra, a typical object is a free resolution of an ideal over a polynomial ring in n variables, and the maps are induced by injections of the rings. The question is whether the resolutions stabilize as n varies.

• In representation stability, a typical object is a cohomology group of the configuration space of n labeled points in a manifold M, and the maps between the groups correspond to relabeling or forgetting points. The question is whether these groups stabilize.

• In tensor decomposition, a typical object is the variety of n-way tensors of bounded border rank, and the maps correspond to actions of products of general linear groups acting on the tensor factors and contractions relating the varieties for different n. The question is whether equations or higher-order syzygies of them stabilize.

The aim of the minisymposium is to build bridges between the varied mathematicians and the different areas investigating stability phenomena.

Organizers: Rob H. Eggermont (Technical University Einhoven, Netherlands), Uwe Nagel (University of Kentucky, USA), and Tim Römer (Universität Osnabrück, Germany)

Quantitative Properties of Ideals arising from Hierarchical Models
Aida Maraj (University of Kentucky, USA)

Bounding degrees of generators for sequences of ideals
Mateusz Michalek (Max-Planck-Institute MiS, Germany)

Asymptotic Phenomena in the homology groups of graph configuration spaces
Eric Ramos (University of Oregon, USA)

Mirror spaces and stability in the homology of Vandermonde varieties
Cordian Riener (The University of Tromsø)

MS132, part 2: Polynomial equations in coding theory and cryptography

Tuesday, July 9, 15:00–17:00
Room: Unitobler, F-123

Polynomial equations are central in algebraic geometry, being algebraic varieties geometric manifestations of solutions of systems of polynomial equations. Actually, modern algebraic geometry is based on the use of techniques for studying and solving geometrical problems about these sets of zeros. At the same time, polynomial equations have found interesting applications in coding theory and cryptography. The interplay between algebraic geometry and coding theory is old and goes back to the first examples of algebraic codes defined with polynomials and codes coming from algebraic curves. More recently, polynomial equations have found important applications in cryptography as well. For example, in multivariate cryptography, one of the prominent candidates for post-quantum cryptosystems, the trapdoor one-way function takes the form of a multivariate quadratic polynomial map over a finite field. Furthermore, the efficiency of the index calculus attack to break an elliptic curve cryptosystem relies on the effectiveness of solving a system of multivariate polynomial equations. This session will feature recent progress in these and other applications of polynomial equations to coding theory and cryptography.

Organizers: Alessio Caminata (University of Neuchâtel, Switzerland) and Alberto Ravagnani (University College Dublin, Ireland)

Efficient Key Generation for Rainbow
Albrecht Petzoldt (University of Versailles)

Algebraic techniques for cryptanalysis of rank-based cryptosystems
Simona Samardjiska (Radboud University)

MinRank Problems in Post-Quantum Cryptography
Daniel Smith-Tone (NIST and University of Louisville)

Rank Analysis of Cubic Multivariate Cryptosystems
Karan Khathuria (University of Zurich)

MS134, part 2: Coding theory and cryptography

Tuesday, July 9, 15:00–17:00
Room: Unitobler, F-122

The focus of this minisymposium is on coding theory and cryptography, with emphasis on the algebraic aspects of these two research fields. Error-correcting codes are mathematical objects that allow reliable communications over noisy/lossy/adversarial channels. Constructing good codes and designing efficient decoding algorithms for them often reduces to solving algebra problems, such as counting rational points on curves, solving equations, and classifying finite rings and modules. Cryptosystems can be roughly defined as functions that are easy to evaluate, but whose inverse is difficult to compute in practice. These functions are in general constructed using algebraic objects and tools, such as polynomials, algebraic varieties, and groups. The security of the resulting cryptosystem heavily relies on the mathematical properties of these. The sessions we propose feature experts of algebraic methods in coding theory and cryptography. All levels of experience are represented, from junior to very experienced researchers.

Organizers: Alessio Caminata (University of Neuchâtel, Switzerland) and Alberto Ravagnani (University College Dublin, Ireland)

Privacy and lifted codes
Ragnar Freij-Hollanti (Aalto University)

Decoding of 2D convolutional codes
Raquel Pinto (University of Aveiro)

On the computation of the duals of certain Algebraic Geometric codes with an application to quantum codes
Fernando Hernando (Universidad Jaume I)

Generalization of the ball-collision algorithm
Violetta Weger (University of Zurich)

MS138: Computational aspects of tropical geometry

Tuesday, July 9, 15:00–17:00
Room: Unitobler, F013

The aim of this session is to demonstrate the effictive use of tropical geometry to tackle problems from optimization and various applications.

Organizers: Georg Peter Loho (London School of Economics), Ngoc Mai Tran (University of Texas), Yue Ren (Max Planck Institute for Mathematics in the Sciences, Germany), and Kalina Mincheva (Yale University, USA)

Condition numbers of stochastic mean payoff games and what they say about nonarchimedean semidefinite programming
Xavier Allamigeon (INRIA & CMAP), Stéphane Gaubert (INRIA & CMAP), Ricardo Katz (CONICET-CIFASIS), and Mateusz Skomra (École normale supérieure de Lyon)

Computing tropical hypersurface intersections
Anders Jensen (Aarhus University)

Algebraic systems and exterior semi-algebras
Letterio Gatto (Politecnico di Torino) and *Lois Rowen* (Bar-Ilan University)

Tropical volume by tropical Ehrhart polynomials
Matthias Schymura (EPFL)

MS152: Stochastic chemical reaction networks

Tuesday, July 9, 15:00–17:00
Room: Unitobler, F-105

The focus of this minisymposium is on new algebraic and analytic methods for stochastic chemical reaction networks. In contrast to deterministic models, stochastic systems cannot be described by systems of ordinary differential equations and, hence, direct application of algebraic methods is often not possible. We are interested in when the deterministic and the stochastic behaviour of chemical reaction networks diverge and how to analyse this behaviour with a combination of algebra, stochastic analysis and chemical reaction network theory.

Organizers: Michael Felix Adamer (University of Oxford, United Kingdom)

Piecewise linear Lyapunov functions for stochastic reaction networks
Daniele Cappelletti (ETHZ)

Robust stochastic control of reaction networks
Tomislav Plesa (Imperial College)

One-dimensional stochastic reaction networks: Classification and dynamics
Chuang Xu (U Copenhagen)

The geometry and dynamics of spatial networks subject external noise
Michael Adamer (University of Oxford)

MS154, part 1: New developments in matroid theory

Tuesday, July 9, 15:00–17:00
Room: Unitobler, F-106

The interactions between Matroid Theory, Algebra, Geometry, and Topology have long been deep and fruitful. Pertinent examples of such interactions include breakthrough results such as the g-Theorem of Billera, Lee and Stanley (1979); the proof that complements of finite complex reflection arrangements are aspherical by Bessis (2014); and, very recently, the proof of Rota's log-concavity conjecture by Adiprasito, Huh, and Katz (2015).

The proposed mini-symposia will focus on the new exciting development in Matroid Theory such as the role played by Bergman fans in tropical geometry, several results on matroids over a commutative ring and over an hyperfield, and the new improvement in valuated matroids and about toric arrangements. We plan to bring together researchers with diverse expertise, mostly from Europe but also from US and Japan. We are going to include a number of postdocs and junior mathematicians.

Organizers: Alex FInk (Queen Mary), Ivan Martino (KTH), and Luca Moci (Bologna)

Positivity of the coefficients of G-Tutte polynomials
Tan Nhat Tran (Hokkaido)

Enumerative aspects of G-Tutte polynomials
Masahiko Yoshinaga (Hokkaido)

Abelian arrangements, matroids and group actions
Emanuele Delucchi (Fribourg (CH))

Group actions on generalized Stanley-Reisner rings
Alessio D'Ali (Genova)

MS157, part 1: Graphical models

Tuesday, July 9, 15:00–17:00
Room: Unitobler, F-121

Graphical models are used to express relationships between random variables. They have numerous applications in the natural sciences as well as in machine learning and big data. This minisymposium will feature talks on several different types of graphical models, including latent tree models, max linear models, network models, boltzman machines, and non-Gaussian graphical models, each of which exploits their intrinsic algebraic, geometric, and combinatorial structure.

Organizers: Elina Robeva (Massachusetts Institute of Technology, United States of America)

Brownian motion tree models are toric
Piotr Zwiernik (Universitat Pompeu Fabra)

Algebra and statistical learning for inferring phylogenetic networks
Elizabeth Gross (University of Hawaii at Manoa)

Geometry of max-linear graphical models
Carlos Améndola (Technical University Munich)

Maximum Likelihood Estimation of Toric Fano Varieties motivated by phylogenetics
Dimitra Kosta (University of Glasgow)

MS160, part 1: Numerical methods for structured polynomial system solving

Tuesday, July 9, 15:00–17:00
Room: Unitobler, F012

Improvements in the understanding of numerical methods for dense polynomial system solving led to the complete solution of Smale's 17th problem. At this point, it remains an open challenge to achieve the same success in the solution of structured polynomial systems: explain the typical behavior of current algorithms and devise polynomial-time algorithms for computing roots of polynomial systems. In this minisymposium, researchers will present the current progress on applying numerical methods to structured polynomial systems.

Organizers: Alperen Ergur (TU Berlin), Pierre Lairez (INRIA), Gregorio Malajovich (Universidade Federal do Rio de Janeiro, Brazil), and Josue Tonelli-Cueto (TU Berlin)

Introductory Talk
Alperen Ergur (TU Berlin)

On the condition number of some algebraic problems.
Diego Armentano (Universidad de la Republica) and Carlos Beltrán (Universidad de Cantábria)

Numerical irreducible decomposition with one homotopy
Dan Bates (US Naval Academy), David Eklund (KTH), Jonathan Hauenstein (University of Notre Dame), and Chris Peterson (Colorado State University)

Computing the Homology of arbitrary Semialgebraic Sets
Felipe Cucker (City University of Hong Kong), Peter Bürgisser (TU Berlin), and Josue Tonelli-Cueto (TU Berlin)

MS165, part 1: Multiparameter persistence: algebra, algorithms, and applications

Tuesday, July 9, 15:00–17:00
Room: Unitobler, F006

Multiparameter persistent homology is an area of applied algebraic topology that studies topological spaces, often arising from complex data, simultaneously indexed by multiple parameters. In the usual setting, persistent homology studies a single-parameter filtration associated with a topological space. The homology of such a filtration is a persistence module, which can be conveniently described by its barcode decomposition. In many applications, however, a single-parameter filtration is not adequate to encode the structures of interest in complex data; two or more filtrations may be required. Multiparameter persistence studies the homology of spaces equipped with multiple filtrations. The homological invariants of these spaces are far more complicated than in the single-parameter setting, requiring new algebraic, computational, and statistical techniques. This work has deep connections to representation theory and commutative algebra, with compelling applications to data analysis.

Recent years have seen considerable advances in multiparameter persistent homology, including algorithms for working with large multiparameter persistence modules, software for computing and visualizing invariants, statistical techniques, and applications. This minisymposium will highlight recent work in multiparameter persistence. Talks will include including theoretical results, algorithmic advances, and applications to data analysis. As many important questions remain to be answered in order to advance the theory and to increase the applicability of multiparameter persistence, this minisymposium seeks to cultivate discussion and collaboration that will lead to new results in the practical use of multiparameter persistent homology.

Organizers: Matthew Wright (St. Olaf College, United States of America)

Multiparameter persistence: brief background and current challenges
Matthew Wright (St. Olaf College)

Computing minimal presentations and bigraded Betti numbers of 2-parameter persistent homology
Michael Lesnick (University of Albany)

A kernel for multi-parameter persistent homology and its computation
René Corbet (TU Graz)

Morse inequalities for multiparameter persistence
Andrea Guidolin (Basque Center for Applied Mathematics) and Claudia Landi (Università di Modena e Reggio Emilia)

MS168, part 1: Riemann Surfaces

Tuesday, July 9, 15:00–17:00
Room: Unitobler, F-107

In the past decades, the central role played by Riemann surfaces in pure mathematics has been strengthened with their surprising appearance in string theory, cryptography and material science. This minisymposium is intended for the curve theorists and the avant-garde applied mathematician. Our emphasis will be on the computational aspects of Riemann surfaces that are prominent in pure mathematics but are not yet part of the canon of applied mathematics. Some of the subjects that will be touched upon by our speakers are integrable systems, Teichmüller curves, Arakelov geometry, tropical geometry, arithmetic geometry and cryptography of curves.

Organizers: Daniele Agostini (Humboldt-Universität), Türkü Özlüm Çelik (Max Planck Institute for Mathematics in the Sciences), Christian Klein (Institut de Mathématiques de Bourgogne), and Emre Can Sertöz (Max Planck Institute for Mathematics in the Sciences)

Real soliton lattices of KP-II equation and desingularization of spectral curves
Simonetta Abenda (Università di Bologna)

Conformal patterns on closed surfaces via discrete conformal maps and holomorphic differentials
Alexander I. Bobenko (Technische Universität Berlin)

Arakelov invariants in the tropical limit
Robin de Jong (University of Leiden)

Siegel modular forms and classical invariants
Christophe Ritzenthaler (University Rennes 1)

MS184, part 1: Algebraic geometry for kinematics, mechanism science, and rigidity

Tuesday, July 9, 15:00–17:00
Room: Unitobler, F-113

Mathematicians became interested in problems concerning mobility and rigidity of mechanisms as soon as study of the subject began. Algebraists and geometers among them, notably Clifford and Study, developed tools still used today to investigate pertinent questions in the field. Recent renewed interest in techniques of algebraic geometry applied to kinematics and rigidity led to a modern classification of mechanisms, discovery of new families, development of algorithms for path planning and overall better understanding of rigid structures and configurations. A wide variety of techniques has been used in this regard and it is reasonable to expect that further influence of algebraic geometry upon kinematics and rigidity will produce deeper understanding leading to useful advancement of technology. We will focus on topics in algebraic geometry motivated by kinematics and rigidity or algebraic geometry methodology with potential application in kinematics and rigidity.

Organizers: Matteo Gallet (SISSA, Trieste, Italy), Josef Schicho (JKU University Linz, Austria), and Hans-Peter Schröcker (University of Innsbruck, Austria)

On four-bar linkages, elliptic functions, and flexible polyhedra
Ivan Izmestiev (Université de Fribourg, Switzerland)

Singularity distance computation for parallel manipulators of Stewart Gough Type
Georg Nawratil (Technische Universität Wien, Austria)

Analysis of kinematic singularities through roadmap computations
Mohab Safey El Din (Sorbonne Universités, Universite Pierre et Marie Curie, France) and Eric Schost (University of Waterloo, Canada)

Computing cognates of mechanisms
Samantha Sherman (University of Notre Dame, USA), Jonathan Hauenstein (University of Notre Dame), and Charles Wampler (General Motors)

MS187, part 1: Signature tensors of paths

Tuesday, July 9, 15:00–17:00
Room: Unitobler, F023

Given a path X in $\mathbb{R}^n$, it is possible to naturally associate an infinite list of tensors, called the iterated-integral signature of X. These tensors were introduced in the 1950s by Kuo-Tsai Chen, who proved that every (smooth enough) path is uniquely determined by its signature. Over the years this topic became central in control theory, stochastic analysis and, lately, in time series analysis.

In applications the following inverse problem appears: given a finite collection of tensors, can we find a path that yields them as its signature? One usually introduces additional requirements, like minimal length, or a parameterized class of functions (say, piecewise linear). It then becomes crucial to know when there are only finitely many paths having a given signature that satisfy the constraints. This problem, called identifiability, can be tackled with an algebraic-geometric approach.

On the other hand, by fixing a class of paths (polynomial, piecewise linear, lattice paths, ...) one can look at the variety carved out by the signatures of those paths inside the tensor algebra. Besides identifiability, the geometry of these signature varieties can give a lot of information on paths of that class. One important class is that of rough paths. Apart from applications to stochastic analysis, its signature variety has a strong geometric significance and it exhibits surprising similarities with the classical Veronese variety.

In time series analysis, it is often necessary to extract features that are invariant under some group action of the ambient space. The signature of iterated signals is a general way of feature extraction; one can think of it as a kind of nonlinear Fourier transform. Understanding its invariant elements relates to classical invariant theory but poses new algebraic questions owing to the particularities of iterated integrals.

Recent developments in these aspects will be explored in this minisymposium.

Organizers: Carlos Améndola (TU Munich), Joscha Diehl (MPI Leipzig), Francesco Galuppi (MPI Leipzig), and Anna Seigal (UC Berkeley)

Varieties of signature tensors
Carlos Améndola (TU Munich)

Learning paths from signature tensors
Max Pfeffer (MPI Leipzig)

Signatures of paths: an algebraic perspective
Laura Colmenarejo (MPI Leipzig)

Signatures of paths transformed by polynomial maps
Rosa Preiss (TU Berlin)

MS191, part 1: Algebraic and geometric methods in optimization.

Tuesday, July 9, 15:00–17:00
Room: Unitobler, F021
Recently advanced techniques from algebra and geometry have been used to prove remarkable results in Optimization. Some examples of the techniques used are polynomial algebra for non-convex polynomial optimization problems, combinatorial tools like Helly's theorem from combinatorial geometry to analyze and solve stochastic programs through sampling, and using ideal bases to find optimality certificates. Test-set augmentation algorithms for integer programming involving Graver sets for block-structured integer programs, come from concepts in commutative algebra. In this sessions experts will present a wide range of results that illustrate the power of the above mentioned methods and their connections to applied algebra and geometry.

Organizers: Jesus A. De Loera (University of California, Davis, United States of America) and Rekha Thomas (University of Washington)

Integer optimization from the perspective of subdeterminants
Robert Weismantel (ETH Zurich, Switzerland)

The Minimum Euclidean-Norm Point in a Convex Polytope: Wolfe's Combinatorial Algorithm is Exponential
Jamie Haddock (Dept. Math. UCLA, USA)

Matrices of bounded factor width and sums of k-nomial squares
Joao Gouveia (University of Coimbra, Portugal)

A friendly smooth analysis of the Simplex method
Sophie Huiberts (CWI, Amsterdam)

MS195, part 1: Algebraic methods for convex sets

Tuesday, July 9, 15:00–17:00
Room: Unitobler, F022
Convex relaxations are extensively used to solve intractable optimization instances in a wide range of applications. For example, convex relaxations are prominently utilized to find solutions of combinatorial problems that are computationally hard. In addition, convexity-based regularization functions are employed in (potentially ill-posed) inverse problems, e.g., regression, to impose certain desirable structure on the solution.

In this mini-symposium, we discuss the use of convex relaxations and the study of convex sets from an algebraic perspective. In particular, the goal of this minisymposium is to bring together experts from algebraic geometry (real and classical), commutative algebra, optimization, statistics, functional analysis and control theory, as well as discrete geometry to discuss recent connections and discoveries at the interfaces of these fields.

Organizers: Rainer Sinn (Freie Universität Berlin, Germany), Greg Blekherman (Georgia Institute of Technology), Daniel Plaumann (Technische Universität Dortmund), Yong Sheng Soh (Institute of High Performance Computing, Singapore), and Dogyoon Song (Massachusetts Institute of Technology)

The slack variety of a polytope
Antonio Macchia (Freie Universität Berlin)

Spectrahedral representations of polar orbitopes
Claus Scheiderer (Universität Konstanz)

Sums of squares and quadratic persistence
Gregory G. Smith (Queen's University)

Semialgebraic Vision
Rekha Thomas (University of Washington, Seattle)

MS197, part 2: Numerical differential geometry

Tuesday, July 9, 15:00–17:00
Room: Unitobler, F-112

The profound theory of differential geometry has interacted with the computational and statistical communities in the past decades, yielding fruitful outcomes in a wide range of fields including manifold learning, Riemannian optimization, and geometry processing. This minisymposium encourages researchers from applied differential geometry, optimization, manifold learning, and geometry processing to share their perspectives and technical tools on problems lying in the intersection of geometry and computations.

Organizers: Tingran Gao (The University of Chicago, United States of America) and Ke Ye (Chinese Academy of Sciences)

Anisotropic Diffusion Kernels to Compare Distributions
Xiuyuan Cheng (Duke University)

Coupled Geometric and Topological Basis for Data-Driven Shape Reconstruction
Qixing Huang (The University of Texas at Austin)

Intrinsic Gaussian processes on complex constrained domains
Mu Niu (Plymouth University)

Locally Linear Embedding on Manifold
Nan Wu (Duke University)

PP: Welcome reception and poster session

Tuesday, July 9, 17:15–19:30
Room: vonRoll, Fabrikstr. **8**(*!*)*, Foyer*

A generalization of Strassen's Positivstellensatz and its application to large deviation theory
Tobias Fritz (Perimeter Institute for Theoretical Physics, Canada)

A linear method for positive solutions to polynomial systems
Polly Yu (Univeresity of Wisconsin-Madison, United States of America)

A module theoretic perspective on matroids
Colin William Crowley (University of Wisconsin Madison, United States of America)

Catalan-many tropical morphisms to metric trees
Alejandro José Vargas De León (University of Bern, Switzerland)

Classification of triples of lattice polytopes with a given mixed volume
Christopher Borger (Otto-von-Guericke Universität Magdeburg, Germany)

Complexity of variety learning
Oliver Gäfvert (KTH Royal Institute of Technology, Sweden)

Embeddability of Markov matrices does not depend only on its principal logarithm
Jordi Roca-Lacostena (Universitat Politècnica de Catalunya, Spain)

Gröbner Bases for Toric Staged Tree Models
Lamprini Ananiadi (Otto-von-Guericke Universität Magdeburg, Germany)

Hermitian Determinantal Surfaces and Three-Dimensional Spectrahedra
Roland Daniel Piontek (TU Dortmund University, Germany)

Hyperplane Sections on Real Algebraic Curves
Dimitri Manevich (TU Dortmund, Germany)

Initial degenerations of Grassmannians
Daniel Joseph Corey (University of Wisconsin - Madison, United States of America)

Maximum Likelihood Estimation for Linear Gaussian Covariance Models with One Sample Point
Jane Ivy Coons (North Carolina State University, United States of America)

Multistationarity in Deficiency-one Power-law Kinetic Systems with Reactant-determined Interactions
Noel Fortun (De La Salle University Manila, Philippines)

On new families of stable subgroups of affine Cremona groups, their tame homomorphisms and Non-commutative Cryptography.
Vasyl Alex Ustymenko (University of Maria Curie Sklodowska, Poland)

Parameter identifiability for ODE models via an input-output representation
Gleb Pogudin (New York University, United States of America)

Probabilistic analysis on Macaulay matrices over finite fields and complexity of constructing Gröbner bases
Andrea Tenti (University of Bergen, Norway)

The colorful interior of families of convex bodies and its tropical analogue
Marin Boyet (INRIA École Polytechnique, France)

The Configuration Space and Kinematics of the Canfield Joint
Christian Bueno (University of California, Santa Barbara and NASA Glenn Research Center)

Limits of Voronoi Decompositions
Madeline Brandt (University of California, Berkeley, United States of America)

Multistationarity in the space of total concentrations for systems that admit a monomial parametrization
Alexandru Iosif (OvGU Magdeburg, Germany)

Rhomboid Designs for Linear Regression with Correlated Random Coefficients
Frank Röttger (OVGU Magdeburg, Germany)

Selecting Minimum Explaining Variables by Pruned Primary Ideal Decomposition with Recursive Calls
Keiji Miura (Kwansei Gakuin University, Japan)

Species Subsets and Embedded Networks of S-systems
Angelyn Relucio Lao (De La Salle University, Philippines)

TensorFox
Felipe Bottega Diniz (Universidade Federal do Rio de Janeiro, Brazil)

Topological analysis of neural spike data
Andrea Guidolin (BCAM, Spain)

Torus quotient of Richardson varieties in Orthogonal and Symplectic Grassmannians
Arpita Nayek (Indian Institute of Technology, Kanpur, India)

Unboundedness of Markov complexity of monomial curves in $\mathbb{A}^n$ for $n \geq 4$
Dimitra Kosta (University of Glasgow)

Wednesday, July 10

Announcements

Wednesday, July 10, 08:25–08:30
Room: vonRoll, Fabrikstr. 6, 001

IP03: Lauren K. Williams: Cluster algebras and applications to geometry

Wednesday, July 10, 08:30–09:30
Room: vonRoll, Fabrikstr. 6, 001
Streamed to: vonRoll, Fabrikstr. 6, 004

Cluster algebras are a class of commutative rings with a remarkable combinatorial structure, which were introduced by Fomin and Zelevinsky around 2000. I will give a gentle introduction to cluster algebras, and then explain how Grassmannians and more generally their Schubert varieties have a cluster algebra structure (joint work with Khrystyna Serhiyenko and Melissa Sherman-Bennett). If time permits, I will also discuss applications to toric degenerations and mirror symmetry (joint work with Konstanze Rietsch).

Speaker: Lauren K. Williams (Harvard University, United States of America)

Coffee break

Wednesday, July 10, 09:30–10:00
Room: Unitobler, F wing, floors 0 and -1

MS130, part 1: Polynomial optimization and its applications

Wednesday, July 10, 10:00–12:00
Room: Unitobler, F022

The importance of polynomial (aka semi-algebraic) optimization is highlighted by the large number of its interactions with different research domains of mathematical sciences. These include, but are not limited to, automatic control, combinatorics, and quantum information. The mini-symposium will focus on the development of methods and algorithms dedicated to the general polynomial optimization problem. Both the theoretical and more applicative viewpoints will be covered.

Organizers: Timo de Wolff (Technische Universität Berlin, Germany), Simone Naldi (Université de Limoges, France), and João Gouveia (Universidade de Coimbra, Portugal)

The Geometry of SDP-Exactness in Quadratic Optimization
Diego Cifuentes (MIT, Cambridge, MA, USA), Corey Harris (University of Oslo, Norway), and Bernd Sturmfels (MPI Leipzig, Germany)

Semidefinite representations of the set of separable states
Hamza Fawzi (Cambridge University, United Kingdom)

Noncommutative polynomial optimization and quantum graph parameters
Sander Gribling (CWI, Amsterdam, The Netherlands), David de Laat (Emory University, Atlanta, GA, USA), and Monique Laurent (CWI, Amsterdam, The Netherlands)

On Convexity of Polynomials over a Box
Georgina Hall (INSEAD, Paris, France), Amir Ali Ahmadi (Princeton University, NJ, USA), and Mihaela Curmei (Microsoft)

MS134, part 3: Coding theory and cryptography

Wednesday, July 10, 10:00–12:00
Room: Unitobler, F-122

The focus of this minisymposium is on coding theory and cryptography, with emphasis on the algebraic aspects of these two research fields. Error-correcting codes are mathematical objects that allow reliable communications over noisy/lossy/adversarial channels. Constructing good codes and designing efficient decoding algorithms for them often reduces to solving algebra problems, such as counting rational points on curves, solving equations, and classifying finite rings and modules. Cryptosystems can be roughly defined as functions that are easy to evaluate, but whose inverse is difficult to compute in practice. These functions are in general constructed using algebraic objects and tools, such as polynomials, algebraic varieties, and groups. The security of the resulting cryptosystem heavily relies on the mathematical properties of these. The sessions we propose feature experts of algebraic methods in coding theory and cryptography. All levels of experience are represented, from junior to very experienced researchers.

Organizers: Alessio Caminata (University of Neuchâtel, Switzerland) and Alberto Ravagnani (University College Dublin, Ireland)

Linear Complementary Pair of Codes and Some Results on Boolean Functions
Ferruh Özbudak (Middle East Technical University, Ankara)

Optimal Locally Recoverable Codes via Chebotarev Density Theorem
Giacomo Micheli (EPFL)

Explicit optimal-length locally repairable codes of small distances
Hiram H. Lopez Valdez (Cleveland State University)

Fast Computation of the Roots of Polynomials Over the Ring of Power Series
Eric Schost (University of Waterloo)

MS140, part 2: Multivariate spline approximation and algebraic geometry

Wednesday, July 10, 10:00–12:00
Room: Unitobler, F-107

The focus of the proposed minisymposium is on problems in approximation theory that may be studied using techniques from commutative algebra and algebraic geometry. Research interests of the participants relevant to the minisymposium fall broadly under multivariate spline theory, interpolation, and geometric modeling. For instance, a main problem of interest is to study the dimension of the vector space of splines of a bounded degree on a simplicial complex; recently there have been several advances on this front using notions from algebraic geometry. Nevertheless this problem remains elusive in low degree; the dimension of the space of piecewise cubics on a planar triangulation (especially relevant for applications) is still unknown in general.

Organizers: Michael DiPasquale (Colorado State University, United States of America) and Nelly Villamizar (Swansea University)

Bounds on the dimension of spline spaces on polyhedral cells
Nelly Villamizar (Swansea University) and Michael DiPasquale (Colorado State University)

On the gradient conjecture for homogeneous polynomials
Boris Shekhtman (University of South Florida)

Ambient Spline Approximation of Functions on Submanifolds
Lars Maier (TU Darmstadt)

Watertight Trimmed NURBS Surfaces
Ulrich Reif (TU Darmstadt)

MS143, part 2: Algebraic geometry in topological data analysis

Wednesday, July 10, 10:00–12:00
Room: Unitobler, F006

In the last 20 years methods from topology, the mathematical area that studies "shapes", have proven successful in studying data that is complex, and whose underlying shape is not known a priori. This practice has become known as topological data analysis (TDA). As additional methods from topology still find their application in the study of complex structure in data, the practice is evolving and expanding, and now moreover draws increasingly upon data science, computer science, computational algebra, computational topology, computational geometry, and statistics.

While ideas from category theory, sheaf theory and representation theory of quivers have driven the theoretical development in the past decade, in the last years ideas from commutative algebra and algebraic geometry have started to be used to tackle some theoretical problems in TDA. The aim of the minisymposium is to seize this momentum and to bring together experts in algebraic geometry and researchers in topological data analysis to explore new avenues of research and foster research collaborations.

Organizers: Nina Otter (UCLA, United States of America)

High-throughput topological screening of nanoporous materials
Kathryn Hess (EPFL, Switzerland)

Sampling real algebraic varieties for topological data analysis
Parker Edwards (University of Florida, United States of America), Emilie Dufresne (University of York), Heather Harrington (University of Oxford), and Jonathan D. Hauenstein (University of Notre Dame)

How wild is the homological clustering problem?
Ulrich Bauer (TU Munich, Germany)

Learning elliptic curves
Daniele Agostini (Humboldt-Universitaet zu Berlin)

MS145, part 1: Isogenies in Cryptography

Wednesday, July 10, 10:00–12:00
Room: Unitobler, F-123

The isogeny graph of elliptic curves over finite fields has long been a subject of study in algebraic geometry and number theory. During the past 10 years several authors have shown multiple applications in cryptology. One interesting feature is that systems built on isogenies seem to resist attacks by quantum computers, making them the most recent family of cryptosystems studied in post-quantum cryptography.

This mini-symposium brings together presentations on cryptosystems built on top of isogenies, their use in applications, and different approaches to the cryptanalysis, including quantum cryptanalysis.

Organizers: Tanja Lange (Eindhoven University of Technology, Netherlands, The), Chloe Martindale (Eindhoven University of Technology, Netherlands, The), and Lorenz Panny (Eindhoven University of Technology, Netherlands, The)

Overview of isogenies in cryptography (Part I)
Chloe Martindale (Eindhoven University of Techonology) and *Lorenz Panny* (Eindhoven University of Technology)

Overview of isogenies in cryptography (Part II)
Lorenz Panny (Eindhoven University of Technology) and *Chloe Martindale* (Eindhoven University of Technology)

Quantum attacks against isogenies
Daniel J. Bernstein (University of Illinois at Chicago)

Pre- and post-quantum Diffie-Hellman
Benjamin Smith (INRIA & LIX - Ecole Polytechnique)

MS147, part 1: SC-square 2019 workshop on satisfiability checking and symbolic computation

Wednesday, July 10, 10:00–12:00
Room: Unitobler, F005

Symbolic Computation is concerned with the algorithmic determination of exact solutions to complex mathematical problems; some recent developments in the area of Satisfiability Checking are starting to tackle similar problems, however with different algorithmic and technological solutions. The two communities share many central interests, but so far researchers from these two communities rarely interact. Furthermore, the lack of compatible interfaces for tools from the two areas is an obstacle to their fruitful combination. Bridges between the communities in the form of common platforms and road-maps are necessary to initiate a mutually beneficial exchange, and to support and direct their interaction. The aim of this workshop is to provide fertile ground to discuss, share knowledge and experience across both communities.

The topics of interest include but are not limited to:

• Decision procedures and their embedding into SMT solvers and computer algebra systems

• Satisfiability Checking for Symbolic Computation

• Symbolic Computation for Satisfiability Checking

• Applications relying on both Symbolic Computation and Satisfiability Checking

• Combination of Symbolic Computation and Satisfiability Checking tools.

The 2016 and 2017 editions of the workshop were affiliated to conferences in Symbolic Computation. The 2018 edition was affiliated to FLoC, the international federated logic conference.

Organizers: John Abbott (Universitaet Passau, Germany) and Alberto Griggio (Fondazione Bruno Kessler, Italy)

Invited Talk of SC-Square: SC-square-methods for the Detection of Hopf Bifurcations in Chemical Reaction Networks—Part I: Background and and basic methods
Andreas Weber (Universität Bonn)

Invited Talk of SC-Square: SC-square-methods for the Detection of Hopf Bifurcations in Chemical Reaction Networks—Part II: Advanced methods for chemical reaction networks
Andreas Weber (Universität Bonn)

Regular Paper 1 of SC-Square: Solving Constraint Systems from Traffic Scenarios for the Validation of Autonomous Driving
Karsten Scheibler (BTC Embedded Systems), Andreas Eggers (BTC Embedded Systems), Tino Teige (BTC Embedded Systems), Marius Walz (BTC Embedded Systems), Tom Bienmüller (BTC Embedded Systems), and Udo Brockmeyer (BTC Embedded Systems)

Regular Paper 2 of SC-Square: On the proof complexity of MCSAT
Gereon Kremer (RWTH Aachen), Erika Abraham (RWTH Aachen), and Vijay Ganesh (University of Waterloo)

MS148, part 2: Algebraic neural coding

Wednesday, July 10, 10:00–12:00
Room: Unitobler, F-105

Neuroscience aims to decipher how the brain represents information via the firing of neurons. Place cells of the hippocampus have been demonstrated to fire in response to specific regions of Euclidean space. Since this discovery, a wealth of mathematical exploration has described connections between the algebraic and combinatorial features of the firing patterns and the shape of the space of stimuli triggering the response. These methods generalize to other types of neurons with similar response behavior. We bring together a group of mathematicians doing innovative work in this exciting field. This will allow experts in commutative algebra, combinatorics, geometry and topology to connect and collaborate on problems related to neural codes, neural rings, and neural networks.

Organizers: Nora Youngs (Colby College) and Zvi Rosen (Florida Atlantic University, United States of America)

Sunflowers of Convex Sets and New Obstructions to Convexity
R. Amzi Jeffs (University of Washington)

Convex Codes and Oriented Matroids
Caitlin Lienkaemper (The Pennsylvania State University)

Sufficient Conditions for 1- and 2- Inductively Pierced Codes
Nida Obatake (Texas A&M University)

Progress Toward a Classification of Inductively Pierced Codes via Polyhedra
Robert Davis (Harvey Mudd College)

MS149, part 2: Stability of moment problems and super-resolution imaging

Wednesday, July 10, 10:00–12:00
Room: Unitobler, F-111

Algebraic techniques have proven useful in different imaging tasks such as spike reconstruction (single molecule microscopy), phase retrieval (X-ray crystallography), and contour reconstruction (natural images). The available data typically consists of (trigonometric) moments of low to moderate order and one asks for the reconstruction of fine details modeled by zero- or positive-dimensional algebraic varieties. Often, such reconstruction problems have a generically unique solution when the number of data is larger than the degrees of freedom in the model.

Beyond that, the minisymposium concentrates on simple a-priori conditions to guarantee that the reconstruction problem is well or only mildly ill conditioned. For the reconstruction of points on the complex torus, popular results ask the order of the moments to be larger than the inverse minimal distance of the points. Moreover, simple and efficient eigenvalue based methods achieve this stability numerically in specific settings. Recently, the situation of clustered points, points with multiplicities, and positive-dimensional algebraic varieties have been studied by similar methods and shall be discussed within the minisymposium.

Organizers: Stefan Kunis (University Osnabrueck, Germany) and Dmitry Batenkov (MIT Boston)

The condition number of Vandermonde matrices with clustered nodes
Dominik Nagel (University Osnabrueck)

Prony's problem and the hyperbolic cross
Benedikt Diederichs (University Passau)

Reconstruction of generalized exponential sums
Markus Wageringel (University Osnabrueck)

Phase retrieval of sparse continuous-time signals by Prony's method
Robert Beinert (University Graz)

MS151, part 2: Cluster algebras and positivity

Wednesday, July 10, 10:00–12:00
Room: Unitobler, F-106

Cluster algebras are commutative rings whose generators and relations can be defined in a remarkably succinct recursive fashion. Algebras of this kind, introduced by Fomin and Zelevinsky in 2000, are equipped with a powerful combinatorial structure frequently appearing in many mathematical contexts such as Lie theory, triangulations of surfaces, Teichmueller theory and beyond. Coordinate rings of Grassmannians and related invariant rings are well-studied examples of algebras of this type. One important aspect arising from the intrinsic combinatorial structure of cluster algebras is that it uncovers systematic, intriguing and complex positivity properties in these families of rings. For instance, it is expected that for each cluster algebra there is a distinguished basis, such that all elements can be expressed as a "positive" linear combination of basis vectors. Seemingly elementary claims of this type, so far proved only in certain cases, have triggered important developments in research areas at the intersection of geometry, algebra and combinatorics.

In this session, we glimpse at recent developments in this field and discuss open questions.

Organizers: Lisa Lamberti (ETHZ, Switzerland), Khrystyna Serhiyenko (University of California, Berkeley, USA / University of Kentucky, Lexington), and Lauren Williams (Harvard, USA)

Combinatorics of cluster structures in Schubert varieties
Khrystyna Serhiyenko (University of California, Berkeley, USA / University of Kentucky, Lexington), *Melissa Sherman-Bennett* (University of California, Berkeley, USA), and Lauren Williams (Harvard, USA)

Cluster tilting modules for mesh algebras
Karin Erdmann (University of Oxford, UK), Sira Gratz (University of Glasgow, UK), and *Lisa Lamberti* (ETHZ, Switzerland)

Strings, snake graphs and the cluster expansion formulas
Ilke Canakci (Newcastle University), Vincent Pilaud (École polytechnique), Nathan Reading (NCSU Campus), and *Sibylle Schroll* (University of Leicester, UK)

Friezes and Grassmannian cluster structures
Karin Baur (Universität Graz / University of Leeds, Austria / UK), Eleonore Faber (University of Leeds, UK), Sira Gratz (University of Glasgow, UK), Khrystyna Serhiyenko (University of California, Berkeley, USA / University of Kentucky, Lexington), and Gordana Todorov (Northeastern University, Boston, USA)

MS156: Tropical geometry in statistics

Wednesday, July 10, 10:00–12:00
Room: Unitobler, F013

Classically, statistics is the branch of mathematics that deals with data. The challenges of modern data demand the development of new statistical methods to handle them. Modern data collection technology brings not only "big data" that are extremely high dimensional, but additionally, they are made up of complex structures, which can be prohibitive to the Euclidean setting of classical statistics. Tropical geometry defines and studies piecewise linear structures in an algebraic framework that, if interpreted appro- priately, is amenable to modern data structures and challenges. This session focuses on leveraging the potential of tropical geometry to reinterpret classical statistics and enhance the utility of statistical methodology in the face of modern data challenges. Specifically, we seek to adapt the linearizing properties of the tropical semiring to statistical settings that rely on principles of linear algebra and optimization. These encompass fundamental descriptive and inferential statistics, such as the computation of Fréchet means, principal component analysis, linear regression, and hypothesis testing. This is a very new direction of research with potential for wide-reaching applications from biology to economics, and it is our hope to bring together researchers to develop and advance the interaction between tropical geometry and statistics.

Organizers: Carlos Améndola (TU Munich), Anthea Monod (Columbia University), and Ruriko Yoshida (Naval Postgraduate School)

Tropical principal component analysis
Leon Zhang (UC Berkeley)

Tropical Foundations for Probability and Statistics on Phylogenetic Tree Spaces
Bo Lin (Georgia Tech)

Tropical Gaussians
Ngoc Tran (University of Texas, Austin)

Tropical hardware for data intensive applications: DNA sequence alignment to machine learning
Advait Madhavan (University of Maryland College Park, NIST)

MS163: Theory and methods for tensor decomposition

Wednesday, July 10, 10:00–12:00
Room: Unitobler, F023

Tensors are a ubiquitous data structure with applications in numerous fields, including machine learning and big data. Decomposing a tensor is important for understanding the structure of the data it represents. Furthermore, there are different ways to decompose tensors, each of which poses its own theoretical and computational challenges and has its own applications. In our minisymposium, we will bring together researchers from different communities to share their recent research discoveries in the theory, methods, and applications of tensor decomposition.

Organizers: Tamara Kolda (Sandia National Laboratories) and Elina Robeva (MIT)

A nearly optimal algorithm to decompose binary forms
Elias Tsigaridas (Inria Paris)

On convergence of matrix and tensor approximate diagonalization algorithms by unitary transformations
Konstantin Usevich (CNRS and University of Lorraine), Jianze Li (No affiliation), and Pierre Comon (CNRS, Université Grenoble Alpes)

Non-linear singular value decomposition
Mariya Ishteva (Free University Brussels) and Philippe Dreesen (Vrije Universiteit Brussel (VUB))

A symmetrization approach to hypermatrix SVD
Edinah Gnang (Johns Hopkins University)

MS166, part 1: Computational aspects of finite groups and their representations

Wednesday, July 10, 10:00–12:00
Room: Unitobler, F-113

The theory of finite groups and their representations is not only an interesting topic for mathematicians but also provides powerful tools in solving problems in science. New computational tools are making this even more feasible. To name a few, one may find applications in physics, coding theory and cryptography. On the other hand representation theory is useful in different areas of mathematics such as algebraic geometry and algebraic topology. Due to this wide range of applications, new algorithmic methods are being developed to study finite groups and their representations from a computational perspective.

Recent developments in computer algebra systems and more specifically computational linear algebra, provide tools for developments in computational aspects of finite groups and their representations. The aim of this minisymposium is to gather experts in the area to discuss the recent achievements and potential new directions.

Organizers: Armin Jamshidpey (University of Waterloo, Canada), Eric Schost (University of Waterloo, Canada), and Mark Giesbrecht (University of Waterloo, Canada)

Construction and enumeration of finite groups
Bettina Eick (Technische Universität Braunschweig)

Linear Time Fourier Transforms of S_{n-k}-invariant Functions on the Symmetric Group S_n
Michael Clausen (University of Bonn)

Quadratic Probabilistic Algorithms for Normal Bases
Armin Jamshidpey (University of Waterloo)

MS172, part 2: Algebraic statistics

Wednesday, July 10, 10:00–12:00
Room: Unitobler, F-121

Algebraic statistics studies statistical models through the lens of algebra, geometry, and combinatorics. From model selection to inference, this interdisciplinary field has seen applications in a wide range of statistical procedures. This session will focus broadly on new developments in algebraic statistics, both on the theoretical side and the applied side.

Organizers: Jose Israel Rodriguez (UW Madison) and Elizabeth Gross (University of Hawai'i at Mānoa)

Geometry of Exponential Graph Models
Ha Khanh Nguyen (The Ohio State University)

Moment Varieties of Measures on Polytopes
Kathlén Kohn (University of Oslo)

The stratification of the maximum likelihood degree for toric varieties
Serkan Hosten (SFSU)

Nested Determinantal Constraints in Linear Structural Equation Models
Elina Robeva (MIT)

MS177, part 2: Algebraic and combinatorial phylogenetics

Wednesday, July 10, 10:00–12:00
Room: Unitobler, F011

Since late eighties, algebraic tools have been present in phylogenetic theory and have been crucial in understanding the limitations of models and methods and in proposing improvements to the existing tools. In this session we intend to present some of the most recent work in this area.

Organizers: Marta Casanellas (Universitat Politècnica de Catalunya), Jane Coons (North Carolina State University), and Seth Sullivant (North Carolina State University)

Weighting the Coalescent
Joseph Rusinko (Hobart and William Smith Colleges)

Identifiability of 2-tree mixtures for the Kimura 3ST model
Jesús Fernández-Sánchez (Universitat Politècnica de Catalunya), Marta Casanellas (Universitat Politècnica de Catalunya), and Alessandro Oneto (BGSMath and Universitat Politècnica de Catalunya)

Markov association schemes
Jeremy Sumner (University of Tasmania)

Existence of maximally probable ranked gene tree topologies with a matching unranked topology
Filippo Disanto (University of Pisa), Pasquale Miglionico (Scuola Normale Superiore, Pisa), and Guido Narduzzi (Scuola Normale Superiore, Pisa)

MS182, part 2: Matrix and tensor optimization

Wednesday, July 10, 10:00–12:00
Room: Unitobler, F021

Matrix and tensor optimization has important applications in the context of modern data analysis and high dimensional problems. Specifically, low rank approximations and spectral properties are of interest. Due to their multilinear parametrization, sets of low rank matrices and tensors form sets with interesting, and sometimes challenging, geometric and algebraic structures. Studying such sets of tensors and matrices in the context of algebraic geometry is therefore not only helpful but also necessary for the development of efficient optimization algorithms and a rigorous analysis thereof. In this respect, the area of matrix and tensor optimization relates to the field applied algebraic geometry by the addressed problems and some of the employed concepts. In this minisymposium, we wish to bring the latest developments in both of these aspects to attention.

Organizers: Max Pfeffer (Max Planck Institute MiS, Leipzig, Germany) and André Uschmajew (Max Planck Institute MiS, Leipzig, Germany)

Matrix and Tensor Factorizations with Nonnegativity
Eugene Tyrtyshnikov (Institute of Numerical Mathematics of Russian Academy of Sciences, Lomonosov Moscow State University) and Elena Scherbakova (Lomonosov Moscow State University)

Decompositions and optimizations of conjugate symmetric complex tensors
Zhening Li (University of Portsmouth, UK)

Chebyshev polynomials and best rank-one approximation ratio
Khazhgali Kozhasov (Max Planck Institute MiS, Leipzig, Germany)

Optimization methods for computing low rank eigenspaces
André Uschmajew (Max Planck Institute MiS, Leipzig, Germany)

MS200, part 1: From algebraic geometry to geometric topology: Crossroads on applications

Wednesday, July 10, 10:00–12:00
Room: Unitobler, F007

The purpose of this minisymposium is to bring together researchers who use algebraic, combinatorial and geometric topology in industrial and applied mathematics. These methods have already seen applications in: biology, physics, chemistry, fluid dynamics, distributed computing, robotics, neural networks and data analysis.

Organizers: Jose Carlos Gomez Larrañaga (CIMAT), Renzo Ricca (University of Milano-Bicocca), and De Witt Sumners (Florida State University)

Momentum of vortex tangles by weighted area information
Renzo L. Ricca (University of Milano-Bicocca,)

Alexandrov spaces and topological data analysis
Fernando Galaz-García (KIT)

Geometrical and topological analysis of chromosome conformation capture data
Javier Arsuaga (University of California, Davis)

Asymptotic behavior of the homology of random polyominoes
Érika Roldán-Roa (The Ohio State University)

IP04: Helmut Pottman: Applications of sphere geometries in computational design

Wednesday, July 10, 13:30–14:30
Room: vonRoll, Fabrikstr. 6, 001
Streamed to: vonRoll, Fabrikstr. 6, 004

The classical sphere geometries of Möbius, Laguerre and Lie provide a rich source of knowledge which can be highly useful in the solution of problems in computational design. We will demonstrate this at hand of three application scenarios which also exhibit a relation to algebraic geometry:

(i) Rational curves and surfaces with rational offsets possess various applications in Computer-Aided Manufacturing. Their study and design can be based on Laguerre geometry, where they appear as unconstrained rational curves or surfaces in the so-called isotropic model.

(ii) The most elegant discrete versions of principal curvature parameterizations of surfaces are objects of sphere geometries and they form the basis for the construction of smooth surfaces from low degree algebraic patches.

(iii) The design of various types of circle patterns on surfaces can be effectively based on sphere geometric models. These patterns only exist on those surfaces which carry at least two families of circles. Their complete classification is a problem of algebraic geometry which has been recently solved by R. Krasauskas and M. Skopenkov.

Speaker: Helmut Pottmann (KAUST, Saudi Arabia)

Coffee break

Wednesday, July 10, 14:30–15:00
Room: Unitobler, F wing, floors 0 and -1

MS132, part 3: Polynomial equations in coding theory and cryptography

Wednesday, July 10, 15:00–17:00
Room: Unitobler, F-123

Polynomial equations are central in algebraic geometry, being algebraic varieties geometric manifestations of solutions of systems of polynomial equations. Actually, modern algebraic geometry is based on the use of techniques for studying and solving geometrical problems about these sets of zeros. At the same time, polynomial equations have found interesting applications in coding theory and cryptography. The interplay between algebraic geometry and coding theory is old and goes back to the first examples of algebraic codes defined with polynomials and codes coming from algebraic curves. More recently, polynomial equations have found important applications in cryptography as well. For example, in multivariate cryptography, one of the prominent candidates for post-quantum cryptosystems, the trapdoor one-way function takes the form of a multivariate quadratic polynomial map over a finite field. Furthermore, the efficiency of the index calculus attack to break an elliptic curve cryptosystem relies on the effectiveness of solving a system of multivariate polynomial equations. This session will feature recent progress in these and other applications of polynomial equations to coding theory and cryptography.

Organizers: Alessio Caminata (University of Neuchâtel, Switzerland) and Alberto Ravagnani (University College Dublin, Ireland)

Classical and Quantum Evaluation Codes at the Trace Roots
Diego Ruano (University of Valladolid)

Optimal curves and codes with locality
Gretchen Matthews (Virginia Tech)

The Story of Solving Random Quadratic Multivariate Systems of Equations
Bo Yin Yang (Academia Sinica)

The Zeta Function for Generalized Rank Weights
Eimear Byrne (University College Dublin), *Giuseppe Cotardo* (University College Dublin), and Alberto Ravagnani (University College Dublin)

MS134, part 4: Coding theory and cryptography

Wednesday, July 10, 15:00–17:00
Room: Unitobler, F-122

The focus of this minisymposium is on coding theory and cryptography, with emphasis on the algebraic aspects of these two research fields. Error-correcting codes are mathematical objects that allow reliable communications over noisy/lossy/adversarial channels. Constructing good codes and designing efficient decoding algorithms for them often reduces to solving algebra problems, such as counting rational points on curves, solving equations, and classifying finite rings and modules. Cryptosystems can be roughly defined as functions that are easy to evaluate, but whose inverse is difficult to compute in practice. These functions are in general constructed using algebraic objects and tools, such as polynomials, algebraic varieties, and groups. The security of the resulting cryptosystem heavily relies on the mathematical properties of these. The sessions we propose feature experts of algebraic methods in coding theory and cryptography. All levels of experience are represented, from junior to very experienced researchers.

Organizers: Alessio Caminata (University of Neuchâtel, Switzerland) and Alberto Ravagnani (University College Dublin, Ireland)

Pairing-friendly curves in cryptography
Aurore Guillevic (Inria)

On a question of F.R.K. Chung and its relevance to the discrete logarithm problem in extension fields
Robert Granger (University of Surrey)

Using the ring structure to solve Ring-Learning-with-Errors
Katherine E. Stange (University of Colorado, Boulder)

MDP convolutional codes
Julia Lieb (University of Aveiro)

MS154, part 2: New developments in matroid theory

Wednesday, July 10, 15:00–17:00
Room: Unitobler, F-106

The interactions between Matroid Theory, Algebra, Geometry, and Topology have long been deep and fruitful. Pertinent examples of such interactions include breakthrough results such as the g-Theorem of Billera, Lee and Stanley (1979); the proof that complements of finite complex reflection arrangements are aspherical by Bessis (2014); and, very recently, the proof of Rota's log-concavity conjecture by Adiprasito, Huh, and Katz (2015).

The proposed mini-symposia will focus on the new exciting development in Matroid Theory such as the role played by Bergman fans in tropical geometry, several results on matroids over a commutative ring and over an hyperfield, and the new improvement in valuated matroids and about toric arrangements. We plan to bring together researchers with diverse expertise, mostly from Europe but also from US and Japan. We are going to include a number of postdocs and junior mathematicians.

Organizers: Alex FInk (Queen Mary), Ivan Martino (Northeastern University, United States of America), and Luca Moci (Bologna)

Cohomology rings of projective models of toric arrangements
Giovanni Gaiffi (PIsa)

Arithmetic matroids, posets and cohomology of toric arrangements
Roberto Pagaria (Pisa)

Categories of matroids, Hopf algebras, and Hall algebras
Jaiung Jun (SUNY Binghamton)

MS157, part 2: Graphical models

Wednesday, July 10, 15:00–17:00
Room: Unitobler, F-121

Graphical models are used to express relationships between random variables. They have numerous applications in the natural sciences as well as in machine learning and big data. This minisymposium will feature talks on several different types of graphical models, including latent tree models, max linear models, network models, boltzman machines, and non-Gaussian graphical models, each of which exploits their intrinsic algebraic, geometric, and combinatorial structure.

Organizers: Elina Robeva (Massachusetts Institute of Technology, United States of America)

Interventional Markov Equivalence for Mixed Graph Models
Liam Solus (KTH Royal Institute of Technology)

Sequential Monte Carlo-based inference in decomposable graphical models
Jimmy Olsson (KTH Royal Institute of Technology)

CausalKinetiX: Learning stable structures in kinetic systems
Jonas Peters (University of Copenhagen)

Autoencoders memorize training images
Caroline Uhler (MIT)

MS160, part 2: Numerical methods for structured polynomial system solving

Wednesday, July 10, 15:00–17:00
Room: Unitobler, F012

Improvements in the understanding of numerical methods for dense polynomial system solving led to the complete solution of Smale's 17th problem. At this point, it remains an open challenge to achieve the same success in the solution of structured polynomial systems: explain the typical behavior of current algorithms and devise polynomial-time algorithms for computing roots of polynomial systems. In this minisymposium, researchers will present the current progress on applying numerical methods to structured polynomial systems.

Organizers: Alperen Ergur (TU Berlin), Pierre Lairez (INRIA), Gregorio Malajovich (Universidade Federal do Rio de Janeiro, Brazil), and Josue Tonelli-Cueto (TU Berlin)

Polyhedral Real Homotopy Continuation
Timo de Wolff (TU Berlin) and Alperen Ergür (TU Berlin)

Root counts of structured algebraic systems
Ioannis Z. Emiris (National and Kapodistrian University of Athens), Raimundas Vidunas (U.Vilnius, Lithuania), Evangelos Bartzos (NKU Athens), and Josef Schicho (JKU Linz, Austria)

A local complexity theory
Teresa Krick (Universidad de Buenos Aires) and Felipe Cucker (City University of Hong Kong)

Low-degree approximation of real singularities
Antonio Lerario (SISSA), Paul Breiding (MPI-MSI Leipzig), Daouda Niang Diatta (Université Assane SECK de Ziguinchor), and Hanieh Keneshlou (MPI-MSI Leipzig)

MS165, part 2: Multiparameter persistence: algebra, algorithms, and applications

Wednesday, July 10, 15:00–17:00
Room: Unitobler, F006

Multiparameter persistent homology is an area of applied algebraic topology that studies topological spaces, often arising from complex data, simultaneously indexed by multiple parameters. In the usual setting, persistent homology studies a single-parameter filtration associated with a topological space. The homology of such a filtration is a persistence module, which can be conveniently described by its barcode decomposition. In many applications, however, a single-parameter filtration is not adequate to encode the structures of interest in complex data; two or more filtrations may be required. Multiparameter persistence studies the homology of spaces equipped with multiple filtrations. The homological invariants of these spaces are far more complicated than in the single-parameter setting, requiring new algebraic, computational, and statistical techniques. This work has deep connections to representation theory and commutative algebra, with compelling applications to data analysis.

Recent years have seen considerable advances in multiparameter persistent homology, including algorithms for working with large multiparameter persistence modules, software for computing and visualizing invariants, statistical techniques, and applications. This minisymposium will highlight recent work in multiparameter persistence. Talks will include including theoretical results, algorithmic advances, and applications to data analysis. As many important questions remain to be answered in order to advance the theory and to increase the applicability of multiparameter persistence, this minisymposium seeks to cultivate discussion and collaboration that will lead to new results in the practical use of multiparameter persistent homology.

Organizers: Matthew Wright (St. Olaf College, United States of America)

Algebraic distances for persistent homology
Peter Bubenik (Florida)

Multiparameter persistence landscapes
Oliver Vipond (Oxford)

Geometric perspectives on multiparameter persistence
Michael Catanzaro (Iowa State University)

Persistent homology of noise
Ryan Budney (University of Victoria)

MS167, part 1: Computational tropical geometry

Wednesday, July 10, 15:00–17:00
Room: Unitobler, F013

This session will highlight recent advances in tropical geometry, algebra, and combinatorics, focusing on computational aspects and applications. The area enjoys close interactions with max-plus algebra, polyhedral geometry, combinatorics, Groebner theory, and numerical algebraic geometry.

Organizers: Kalina Mincheva (Yale University) and Yue Ren (Max Planck Institute for Mathematics in the Sciences, Germany)

The tropical geometry of shortest paths
Michael Joswig (Technische Universität Berlin) and Benjamin Schröter (Binghamton University)

Tropicalization of semialgebraic sets arising in convex optimization
Xavier Allamigeon (INRIA & CMAP), Stephane Gaubert (INRIA & CMAP), and *Mateusz Skomra* (École normale supérieure de Lyon)

Linear algebra and convexity over symmetrized semirings, hyperfields and systems
Marianne Akian (INRIA & CMAP), Stephane Gaubert (INRIA & CMAP), and Lois Rowen (Bar-Ilan University)

Linear algebra and convexity over symmetrized semirings, hyperfields and systems.
Marianne Akian (INRIA & CMAP), Xavier Allamigeon (INRIA & CMAP), *Stephane Gaubert* (INRIA & CMAP), and Marin Boyet (INRIA & CMAP)

MS168, part 2: Riemann Surfaces

Wednesday, July 10, 15:00–17:00
Room: Unitobler, F-107

In the past decades, the central role played by Riemann surfaces in pure mathematics has been strengthened with their surprising appearance in string theory, cryptography and material science. This minisymposium is intended for the curve theorists and the avant-garde applied mathematician. Our emphasis will be on the computational aspects of Riemann surfaces that are prominent in pure mathematics but are not yet part of the canon of applied mathematics. Some of the subjects that will be touched upon by our speakers are integrable systems, Teichmüller curves, Arakelov geometry, tropical geometry, arithmetic geometry and cryptography of curves.

Organizers: Daniele Agostini (Humboldt-Universität), Türkü Özlüm Çelik (Max Planck Institute for Mathematics in the Sciences), Christian Klein (Institut de Mathématiques de Bourgogne), and Emre Can Sertöz (Max Planck Institute for Mathematics in the Sciences)

Computing endomorphism rings of Jacobians
Jeroen Sijsling (Universität Ulm)

Inverse Jacobian problem for cyclic plane quintic curves
Anna Somoza (Universitat Politècnica de Catalunya, Universiteit Leiden)

Teichmüller curves, Kobayashi geodesics and Hilbert modular forms
David Torres-Teigell (Goethe-Universität)

Counting special points on teichmüller curves
Jonathan Zachhuber (Goethe-Universität)

MS175, part 1: Algebraic geometry and combinatorics of jammed structures

Wednesday, July 10, 15:00–17:00
Room: Unitobler, F-111

The minisymposium will combine the classical rigidity theory of linkages in discrete and computational geometry with the theory of circle packing, and patterns, on surfaces that arose from the study of 2- and 3-manifolds in geometry and topology. The aim being to facilitate interaction between these two areas. The classical theory of rigidity goes back to work by Euler and Cauchy on triangulated Euclidean polyhedra. The general area is concerned with the problem of determining the nature of the configuration space of geometric objects. In the modern theory the objects are geometric graphs (bar-joint structures) and the graph is rigid if the configuration space is finite (up to isometries). More generally one can consider tensegrity structures where distance constraints between points can be replaced by inequality constraints. The theory of (circle, disk and sphere) packings is vast and well known, with numerous practical applications. Of particular relevance here are conditions that result in the packing being non-deformable (jammed) as well as recent work on inversive distance packings. These inversive distance circle packings generalised the much studied tangency and overlapping packings by allowing "adjacent" circles to be disjoint, but with the control of an inversive distance parameter that measures the separation of the circles. The potential for overlap between these areas can be easily seen by modelling a packing of disks in the plane by a tensegrity structure where each disk is replaced by a point at its centre and the constraint that the disks cannot overlap becomes the constraint that the points cannot get closer together.

Organizers: Anthony Nixon (Lancaster) and Louis Theran (St Andrews)

Flexibility of graphs on the sphere: the case of $K_{3,3}$
Matteo Gallet (JKU Linz)

Algebraic Geometry for Counting Realizations of Minimally Rigid Graphs
Georg Grasegger (JKU Linz)

Pairing symmetry groups for spherical and Euclidean frameworks
Bernd Schulze (Lancaster)

MS178: Geometric design for fabrication

Wednesday, July 10, 15:00–17:00
Room: Unitobler, F-112

Geometric modeling in the early design phase typically consists of pure shape design with little or no consideration of material properties, functionality and fabrication. The separation of geometry from engineering and manufacturing results in a costly product development process with multiple feedback loops. This minisymposium presents recent research on computational design tools which respect material properties and constraints imposed by function and fabrication. To achieve high performance, the additional constraints are closely tied to an adapted geometric representation or even formulated in terms of geometry.

Organizers: Helmut Pottmann (KAUST, Saudi Arabia)

Geometric modeling of flank CNC machining
Michael Barton (BCAM, Bilbao)

Modeling developable surfaces through orthogonal geodesics
Michael Rabinovich (ETH Zurich)

Developability of triangle meshes
Oded Stein (Columbia University)

Statics-aware design of freeform architecture
Johannes Wallner (TU Graz)

MS183, part 1: Polyhedral geometry methods for biochemical reaction networks

Wednesday, July 10, 15:00–17:00
Room: Unitobler, F-105

This minisymposium focuses on geometric objects arising in the study of parametrized polynomial ODEs given by biochemical reaction networks. In particular, we consider recent work that employs techniques from convex, polyhedral, and tropical geometry in order to extract properties of interest from the ODE system and to relate them to the choice of parameter values.

Specific problems covered in the minisimposium include the analysis of forward-invariant regions of the ODE system, the determination of parameter regions for multistationarity or oscillations, the performance of model reduction close to metastable regimes, and the characterization of unique existence of equilibria using oriented matroids.

Organizers: Elisenda Feliu (University of Copenhagen, Denmark) and Stefan Müller (University of Vienna)

Endotactic Networks and Toric Differential Inclusions
Gheorghe Craciun (University of Wisconsin (Madison)) and *Abhishek Deshpande* (University of Wisconsin (Madison))

Approximating Convex Hulls of Curves by Polytopes
Nidhi Kaihnsa (MPI Leipzig)

Multistationarity conditions in a network motif describing ERK activation
Carsten Conradi (HTW Berlin)

Oscillations in a mixed phosphorylation mechanism
Maya Mincheva (Northern Illinois University)

MS184, part 2: Algebraic geometry for kinematics, mechanism science, and rigidity

Wednesday, July 10, 15:00–17:00
Room: Unitobler, F-113

Mathematicians became interested in problems concerning mobility and rigidity of mechanisms as soon as study of the subject began. Algebraists and geometers among them, notably Clifford and Study, developed tools still used today to investigate pertinent questions in the field. Recent renewed interest in techniques of algebraic geometry applied to kinematics and rigidity led to a modern classification of mechanisms, discovery of new families, development of algorithms for path planning and overall better understanding of rigid structures and configurations. A wide variety of techniques has been used in this regard and it is reasonable to expect that further influence of algebraic geometry upon kinematics and rigidity will produce deeper understanding leading to useful advancement of technology. We will focus on topics in algebraic geometry motivated by kinematics and rigidity or algebraic geometry methodology with potential application in kinematics and rigidity.

Organizers: Matteo Gallet (SISSA, Trieste, Italy), Josef Schicho (JKU University Linz, Austria), and Hans-Peter Schröcker (University of Innsbruck, Austria)

Bond theory and linkages with joints of helical type
Tiago Guerreiro (Loughborough University, United Kingdom)

Polygon spaces and other compactifications of $\mathbf{M}_{0,n}$: Chow ring, ψ-classes and intersection numbers
Gaiane Panina (St. Petersburg Department of Steklov Mathematical Institute, Russia) and Ilia Nekrasov (University of Michigan, St. Petersburg State University)

Distinguishing metal-organic frameworks
Senja Barthel (EPFL)

Degree Reduction of Rational Motions
Johannes Siegele (University of Innsbruck), Daniel Scharler (University of Innsbruck), and Hans-Peter Schröcker (University of Innsbruck)

MS187, part 2: Signature tensors of paths

Wednesday, July 10, 15:00–17:00
Room: Unitobler, F023

Given a path X in $\mathbb{R}^n$, it is possible to naturally associate an infinite list of tensors, called the iterated-integral signature of X. These tensors were introduced in the 1950s by Kuo-Tsai Chen, who proved that every (smooth enough) path is uniquely determined by its signature. Over the years this topic became central in control theory, stochastic analysis and, lately, in time series analysis.

In applications the following inverse problem appears: given a finite collection of tensors, can we find a path that yields them as its signature? One usually introduces additional requirements, like minimal length, or a parameterized class of functions (say, piecewise linear). It then becomes crucial to know when there are only finitely many paths having a given signature that satisfy the constraints. This problem, called identifiability, can be tackled with an algebraic-geometric approach.

On the other hand, by fixing a class of paths (polynomial, piecewise linear, lattice paths, ..), one can look at the variety carved out by the signatures of those paths inside the tensor algebra. Besides identifiability, the geometry of these signature varieties can give a lot of information on paths of that class. One important class is that of rough paths. Apart from applications to stochastic analysis, its signature variety has a strong geometric significance and it exhibits surprising similarities with the classical Veronese variety.

In time series analysis, it is often necessary to extract features that are invariant under some group action of the ambient space. The signature of iterated signals is a general way of feature extraction; one can think of it as a kind of nonlinear Fourier transform. Understanding its invariant elements relates to classical invariant theory but poses new algebraic questions owing to the particularities of iterated integrals.

Recent developments in these aspects will be explored in this minisymposium.

Organizers: Carlos Améndola (TU Munich), Joscha Diehl (MPI Leipzig), Francesco Galuppi (MPI Leipzig), and Anna Seigal (UC Berkeley)

Invariants of the iterated-integral signature
Joscha Diehl (MPI Leipzig)

The areas of areas problem
Jeremy Reizenstein (University of Warwick)

Persistence paths and signature features in topological data analysis
Ilya Chevyrev (Oxford University)

Character groups of Hopf algebras and their applications
Alexander Schmeding (TU Berlin)

MS191, part 2: Algebraic and geometric methods in optimization.

Wednesday, July 10, 15:00–17:00
Room: Unitobler, F021
Recently advanced techniques from algebra and geometry have been used to prove remarkable results in Optimization. Some examples of the techniques used are polynomial algebra for non-convex polynomial optimization problems, combinatorial tools like Helly's theorem from combinatorial geometry to analyze and solve stochastic programs through sampling, and using ideal bases to find optimality certificates. Test-set augmentation algorithms for integer programming involving Graver sets for block-structured integer programs, come from concepts in commutative algebra. In this sessions experts will present a wide range of results that illustrate the power of the above mentioned methods and their connections to applied algebra and geometry.

Organizers: Jesus A. De Loera (University of California, Davis, United States of America) and Rekha Thomas (University of Washington)

Convergence analysis of measure-based bounds for polynomial optimization on the box, ball and sphere
Monique Laurent (CWI, Netherlands)

Dynamic programming algorithms for integer programming
Frederich Eisenbrand (EPFL, Switzerland)

The support of integer optimal solutions
Timm Oertel (Cardiff University, UK)

New Fourier interpolation formulas and optimization in Euclidean space
Maryna Viazovska (EPFL, Switzerland)

MS195, part 2: Algebraic methods for convex sets

Wednesday, July 10, 15:00–17:00
Room: Unitobler, F022
Convex relaxations are extensively used to solve intractable optimization instances in a wide range of applications. For example, convex relaxations are prominently utilized to find solutions of combinatorial problems that are computationally hard. In addition, convexity-based regularization functions are employed in (potentially ill-posed) inverse problems, e.g., regression, to impose certain desirable structure on the solution.

In this mini-symposium, we discuss the use of convex relaxations and the study of convex sets from an algebraic perspective. In particular, the goal of this minisymposium is to bring together experts from algebraic geometry (real and classical), commutative algebra, optimization, statistics, functional analysis and control theory, as well as discrete geometry to discuss recent connections and discoveries at the interfaces of these fields.

Organizers: Rainer Sinn (Freie Universität Berlin, Germany), Greg Blekherman (Georgia Institute of Technology), Daniel Plaumann (Technische Universität Dortmund), Yong Sheng Soh (Institute of High Performance Computing, Singapore), and Dogyoon Song (Massachusetts Institute of Technology)

Determinantal representations of stable and hyperbolic polynomials
Victor Vinnikov (Ben Gurion University of the Negev)

Noncommutative polynomials describing convex sets
Jurij Volcic (Texas A&M University)

Semidefinite Programming and Nash Equilibria in Bimatrix Games
Jeffrey Zhang (Princeton University)

Low Rank Tensor Methods in High Dimensional Data Analysis
Ming Yuan (Columbia University)

MS199, part 1: Applications of topology in neuroscience

Wednesday, July 10, 15:00–17:00
Room: Unitobler, F011

Research at the interface of topology and neuroscience is growing rapidly and has produced many remarkable results in the past five years. In this minisymposium, speakers will present a wide and exciting array of current applications of topology in neuroscience, including classification and synthesis of neuron morphologies, analysis of synaptic plasticity, and diagnosis of traumatic brain injuries.

Organizers: Kathryn Hess Bellwald (Laboratory for topology and neuroscience, EPFL, Switzerland) and Ran Levi (University of Aberdeen, UK)

Understanding neuronal shapes with algebraic topology
Lida Kanari (Blue Brain Project, EPFl, Switzerland)

Computing homotopy types of directed flag complexes
Dejan Govc (University of Aberdeen, UK)

Applications of persistent homology to stroke therapy
Philip Egger (Hummel Lab, EPFL. Switzerland)

Neural decoding using TDA
Erik Rybakken (NTNU, Norway)

MS200, part 2: From algebraic geometry to geometric topology: Crossroads on applications

Wednesday, July 10, 15:00–17:00
Room: Unitobler, F007

The purpose of this minisymposium is to bring together researchers who use algebraic, combinatorial and geometric topology in industrial and applied mathematics. These methods have already seen applications in: biology, physics, chemistry, fluid dynamics, distributed computing, robotics, neural networks and data analysis.

Organizers: Jose Carlos Gomez Larrañaga (CIMAT), Renzo Ricca (University of Milano-Bicocca), and De Witt Sumners (Florida State University)

Privileged topologies of self-assembling molecular knots
Cristian Micheletti (SISSA)

Why are there knots in proteins?
Sophie Jackson (University Of Cambridge)

The study of 2-stratifolds as models for applications (Part 1)
Jose Carlos Gomez Larrañaga (CIMAT), Wofgang Heil (FSU), and Francisco Gonzalez Acuña (UNAM and CIMAT)

The study of 2-stratifolds as models for applications (Part 2)
Jose Carlos Gomez Larrañaga (CIMAT), *Wolfgang Heil* (FSU), and Francisco Gonzalez Acuña (UNAM)

MS147, part 2: SC-square 2019 workshop on satisfiability checking and symbolic computation

Wednesday, July 10, 15:00–17:30
Room: Unitobler, F005

Symbolic Computation is concerned with the algorithmic determination of exact solutions to complex mathematical problems; some recent developments in the area of Satisfiability Checking are starting to tackle similar problems, however with different algorithmic and technological solutions. The two communities share many central interests, but so far researchers from these two communities rarely interact. Furthermore, the lack of compatible interfaces for tools from the two areas is an obstacle to their fruitful combination. Bridges between the communities in the form of common platforms and road-maps are necessary to initiate a mutually beneficial exchange, and to support and direct their interaction. The aim of this workshop is to provide fertile ground to discuss, share knowledge and experience across both communities.

The topics of interest include but are not limited to:

- Decision procedures and their embedding into SMT solvers and computer algebra systems
- Satisfiability Checking for Symbolic Computation
- Symbolic Computation for Satisfiability Checking
- Symbolic Computation and Satisfiability Checking
- Symbolic Computation and Satisfiability Checking tools.

The 2016 and 2017 editions of the workshop were affiliated to conferences in Symbolic Computation. The 2018 edition was affiliated to FLoC, the international federated logic conference.

Organizers: John Abbott (Universitaet Passau, Germany) and Alberto Griggio (Fondazione Bruno Kessler, Italy)

Regular Paper 3 of SC-Square: Algorithmically generating new algebraic features of polynomial systems for machine learning
Dorian Florescu (Coventry University) and *Matthew England* (Coventry University)

Extended Abstract 1 of SC-Square: On variable orderings in MCSAT for non-linear real arithmetic
Jasper Nalbach (RWTH Aachen) and Gereon Kremer (RWTH Aachen)

Extended Abstract 2 of SC-Square: On Benefits of Equality Constraints in Lex-Least Invariant CAD
Akshar Nair (University of Bath), James Davenport (University of Bath), and Gregory Sankaran (University of Bath)

Extended Abstract 3 of SC-Square: Evolutionary Virtual Term Substitution in a Quantifier Elimination System
Zak Tonks (University of Bath)

Extended Abstract 4 of SC-Square: Lemmas for Satisfiability Modulo Transcendental Functions via Incremental Linearization
Ahmed Irfan (Fondazione Bruno Kessler), Alessandro Cimatti (Fondazione Bruno Kessler), *Alberto Griggio* (Fondazione Bruno Kessler), Marco Roveri (Fondazione Bruno Kessler), and Roberto Sebastiani (Fondazione Bruno Kessler)

SI(AG)^2 Early Career Prize Lecture: Elina Robeva: Orthogonal Tensor Decomposition

Wednesday, July 10, 17:15–18:00
Room: vonRoll, Fabrikstr. 6, 001
Streamed to: vonRoll, Fabrikstr. 6, 004

Tensor decomposition has many applications. However, it is often a hard problem. In this talk we will discuss a family of tensors, called orthogonally decomposable, which retain some of the properties of matrices that general tensors don't. A symmetric tensor is orthogonally decomposable if it can be written as a linear combination of tensor powers of n orthonormal vectors. As opposed to general tensors, such tensors can be decomposed efficiently. We study the spectral properties of symmetric orthogonally decomposable tensors and give a formula for all of their eigenvectors. We also give polynomial equations defining the set of all such tensors. Analogously, we study nonsymmetric orthogonally decomposable tensors, describing their singular vector tuples and giving polynomial equations that define them. To extend the definition to a larger set of tensors, we define tight-frame decomposable tensors and study their properties. Finally, we conclude with some open questions and future research directions.

Speaker: Elina Robeva (Massachusetts Institute of Technology, United States of America)

Thursday, July 11

Announcements

Thursday, July 11, 08:25–08:30
Room: vonRoll, Fabrikstr. 6, 001

IP05: Alicia Dickenstein: Algebra and geometry in the study of enzymatic cascades

Thursday, July 11, 08:30–09:30
Room: vonRoll, Fabrikstr. 6, 001
Streamed to: vonRoll, Fabrikstr. 6, 004

In recent years, techniques from computational and real algebraic geometry have been successfully used to address mathematical challenges in systems biology. The algebraic theory of chemical reaction systems aims to understand their dynamic behavior by taking advantage of the inherent algebraic structure in the kinetic equations, and does not need the determination of the parameters a priori, which can be theoretically or practically impossible.I will give a gentle introduction to general results based on the network structure. In particular, I will describe a general framework for biological systems, called MESSI systems, that describe Modifications of type Enzyme-Substrate or Swap with Intermediates, and include many networks that model post-translational modifications of proteins inside the cell. I will also outline recent methods to address the important question of multistationarity, in particular in the study of enzymatic cascades, and will point out some of the mathematical challenges that arise from this application.

Speaker: Alicia Dickenstein (Universidad de Buenos Aires, Argentine Republic)

Coffee break

Thursday, July 11, 09:30–10:00
Room: Unitobler, F wing, floors 0 and -1

MS124, part 1: The algebra and geometry of tensors 1: general tensors

Thursday, July 11, 10:00–12:00
Room: Unitobler, F023
Tensors are ubiquitous in mathematics and science. Tensor decompositions and approximations are an important tool in artificial intelligence, chemometrics, complexity theory, signal processing, statistics, and quantum information theory. These topics raise challenging computational problems, but also the theory behind them is far from fully understood. Algebraic geometry has already played an important role in the study of tensors. It has shed light on: the ill-posedness of tensor approximation problems, the generic number of decompositions of a rank-r tensor, the number and structure of tensor eigen- and singular tuples, the number and structure of the critical points of tensor approximation problems, and on the sensitivity of tensor decompositions among many others. This minisymposium focuses on recent developments on the geometry of tensors and their decompositions, their applications, and mathematical tools for studying them, and is a sister minisymposium to "The algebra and geometry of tensors 2: structured tensors" organized by E. Angelini, E. Carlini, and A. Oneto.

Organizers: Yang Qi (University of Chicago, United States of America) and Nick Vannieuwenhoven (KU Leuven)

The distance function from a real algebraic variety
Giorgio Ottaviani (Università di Firenze)

Algorithms for rank, tangential and cactus decompositions of polynomials
Alessandra Bernardi (University of Trento)

Pencil-based algorithms for tensor rank decomposition are not stable
Paul Breiding (Max-Planck-Institute for Mathematics in the Sciences)

Identifiability of a general polynomial
Francesco Galuppi (Max-Planck-Institute for Mathematics in the Sciences)

MS126, part 1: Euclidean distance geometry and its applications

Thursday, July 11, 10:00–12:00
Room: Unitobler, F011
Given a natural number d and a weighted graph G=(V,E), the fundamental problem in Euclidean distance geometry is to determine whether there exists a realization of the graph G in Rd such that distances between pairs of points are equal to the corresponding edge weights. This problem naturally arises in many applications that require recovering locations of objects from the distances between these objects. Usually, measurements of the distances are noisy and there can be missing data. Examples of applications are sensor network localization, molecular conformation, genome reconstruction, robotics and data visualization. Algebraic varieties and semialgebraic sets naturally come up in Euclidean distance geometry, since distances between objects are given by polynomials. Hence questions about uniqueness and finiteness of realizations are often algebraic in nature, whereas realizations are found using semidefinite or nonconvex optimization methods. The goal of this minisymposium is to present theory and applications of Euclidean distance geometry, and connect researchers working in Euclidean distance geometry with applied algebraic geometers.

Organizers: Kaie Kubjas (Sorbonne Université)

Isometries in Euclidean, Homogeneous, and Conformal Spaces
Carlile Lavor (University of Campinas, Brazil)

Auxetic deformations of triply periodic minimal surfaces
Ciprian S. Borcea (Rider University, USA)

Voronoi Cells of Varieties
Maddie Weinstein (University of California, Berkeley, USA)

Critical points of the Hamming and taxicab distance functions
Jonathan Hauenstein (University of Notre Dame, USA)

MS130, part 2: Polynomial optimization and its applications

Thursday, July 11, 10:00–12:00
Room: Unitobler, F022

The importance of polynomial (aka semi-algebraic) optimization is highlighted by the large number of its interactions with different research domains of mathematical sciences. These include, but are not limited to, automatic control, combinatorics, and quantum information. The mini-symposium will focus on the development of methods and algorithms dedicated to the general polynomial optimization problem. Both the theoretical and more applicative viewpoints will be covered.

Organizers: Timo de Wolff (Technische Universität Berlin, Germany), Simone Naldi (Université de Limoges, France), and João Gouveia (Universidade de Coimbra, Portugal)

Moments and convex optimization for analysis and control of nonlinear partial differential equations
Milan Korda (CNRS-LAAS, Toulouse, France), Didier Henrion (CNRS-LAAS, Toulouse, France), and Jean-Bernard Lasserre (CNRS-LAAS, Toulouse, France)

Two-player games between polynomial optimizers and semidefinite solvers.
Victor Magron (CNRS-LAAS, Toulouse, France), Mohab Safey El Din (Sorbonne Université, Paris, France), and Jean-Bernard Lasserre (CNRS-LAAS, Toulouse, France)

A Generalization of SAGE Certificates for Constrained Optimization
Riley Murray (Caltech, Los Angeles, CA, USA) and Venkat Chandrasekaran (Caltech, Los Angeles, CA, USA)

On positive duality gaps in semidefinite programming
Gabor Pataki (University of North Carolina at Chapel Hill, NC, USA)

MS137, part 1: Symbolic Combinatorics

Thursday, July 11, 10:00–12:00
Room: Unitobler, F005

In recent years algorithms and software have been developed that allow researchers to discover and verify combinatorial identities as well as understand analytic and algebraic properties of generating functions. The interaction of combinatorics and symbolic computation has had a beneficial impact on both fields. This minisymposium will feature 12 speakers describing recent research combining these areas.

Organizers: Shaoshi Chen (Chinese Academy of Sciences), Manuel Kauers (Johannes Kepler University, Linz, Austria), and Stephen Melczer (University of Pennsylvania)

Enumeration of walks in three quarters of the plane
Axel Bacher (University Paris 13)

On the growth of algebras
Jason Bell (University of Waterloo)

A Gessel way to the diagonal theorem on D-finite power series
Shaoshi Chen (Chinese Academy of Sciences)

Inhomogeneous Lattice Walks
Manfred Buchacher (Johannes Kepler University Linz)

MS140, part 3: Multivariate spline approximation and algebraic geometry

Thursday, July 11, 10:00–12:00
Room: Unitobler, F-107

The focus of the proposed minisymposium is on problems in approximation theory that may be studied using techniques from commutative algebra and algebraic geometry. Research interests of the participants relevant to the minisymposium fall broadly under multivariate spline theory, interpolation, and geometric modeling. For instance, a main problem of interest is to study the dimension of the vector space of splines of a bounded degree on a simplicial complex; recently there have been several advances on this front using notions from algebraic geometry. Nevertheless this problem remains elusive in low degree; the dimension of the space of piecewise cubics on a planar triangulation (especially relevant for applications) is still unknown in general.

Organizers: Michael DiPasquale (Colorado State University, United States of America) and Nelly Villamizar (Swansea University)

Bivariate Semialgebraic Splines
Frank Sottile (Texas A&M University) and Michael DiPasquale (Colorado State University)

Geometrically smooth spline bases for geometric modeling
Ahmed Blidia (Inria) and Bernard Mourrain (Inria)

Splines, Stable Bundles, and PDE's
Peter Stiller (Texas A&M University)

Computing the dimension of spline spaces using homological techniques
Andrea Bressan (University of Oslo)

MS144: Tropical geometry in machine learning

Thursday, July 11, 10:00–12:00
Room: Unitobler, F013

A connection between tropical polynomials and neural networks has been recently established. This connection remains to be explored in full. Currently, most basic notions from tropical geometry are used to quantify the number of linear regions in a neural network. Purpose of this session is to present what is currently know about the relationship between tropical polynomials and neural networks and promote further exploration of tropical algebra in the context of machine learning at neural networks.

Organizers: Gregory Naisat (The University of Chicago, United States of America)

Tropical geometry of deep neural networks
Gregory Naisat (The University of Chicago, United States of America)

Tropical geometry and weighted lattices
Petros Maragos (FNational Technical University of Athens)

A Tropical Approach to Neural Networks with Piecewise Linear Activations
Vasileios Charisopoulos (Cornell University)

MS145, part 2: Isogenies in Cryptography

Thursday, July 11, 10:00–12:00
Room: Unitobler, F-123

The isogeny graph of elliptic curves over finite fields has long been a subject of study in algebraic geometry and number theory. During the past 10 years several authors have shown multiple applications in cryptology. One interesting feature is that systems built on isogenies seem to resist attacks by quantum computers, making them the most recent family of cryptosystems studied in post-quantum cryptography.

This mini-symposium brings together presentations on cryptosystems built on top of isogenies, their use in applications, and different approaches to the cryptanalysis, including quantum cryptanalysis.

Organizers: Tanja Lange (Eindhoven University of Technology, Netherlands, The), Chloe Martindale (Eindhoven University of Technology, Netherlands, The), and Lorenz Panny (Eindhoven University of Technology, Netherlands, The)

Constant-time isogeny implementations
David Jao (University of Waterloo)

Isogeny-based cryptography: a cryptanalysis perspective
Christophe Petit (Birmingham University)

Fast isogeny-based signatures
Frederik Vercauteren (KU Leuven)

Orienting supersingular isogeny graphs
David Kohel (University of Marseilles)

MS146, part 1: Random geometry and topology

Thursday, July 11, 10:00–12:00
Room: Unitobler, F006

This minisymposium is meant to report on the recent activity in the field of random geometry and topology. The idea behind the field is summarized as follows: take a geometric or topological quantity associated to a set of instances, endow the space of instances with a probability distribution and compute the expected value, the variance or deviation inequalities of the quantity. The most prominent example of this is probably Kostlan, Shub and Smales celebrated result on the expected number of real zeros of a real polynomial. Random geometry and topology offers a fresh view on classical mathematical problems. At the same time, since randomness is inherent to models of the physical, biological, and social world, the field comes with a direct link to applications.

Organizers: Paul Breiding (Max-Planck Institute for Mathematics in the Sciences, Germany), Lerario Antonio (SISSA), Lundberg Erik (Florida Atlantic University), and Kozhasov Khazhgali (Max-Planck Institute for Mathematics in the Sciences, Germany)

Zero-sets of 3D random waves
Federico Dalmao (Universidad de la Republica de Uruguay)

Curvature and randomness
Emil Horobet (Sapientia Hungarian University)

Random sections of line bundles over real Riemann surfaces
Michele Ancona (Univ. Claude Bernard Lyon 1)

On the topology of real components of real sections of vector bundles
Chris Peterson (Colorado State University)

MS149, part 3: Stability of moment problems and superresolution imaging

Thursday, July 11, 10:00–12:00
Room: Unitobler, F-111

Algebraic techniques have proven useful in different imaging tasks such as spike reconstruction (single molecule microscopy), phase retrieval (X-ray crystallography), and contour reconstruction (natural images). The available data typically consists of (trigonometric) moments of low to moderate order and one asks for the reconstruction of fine details modeled by zero- or positive-dimensional algebraic varieties. Often, such reconstruction problems have a generically unique solution when the number of data is larger than the degrees of freedom in the model.

Beyond that, the minisymposium concentrates on simple a-priori conditions to guarantee that the reconstruction problem is well or only mildly ill conditioned. For the reconstruction of points on the complex torus, popular results ask the order of the moments to be larger than the inverse minimal distance of the points. Moreover, simple and efficient eigenvalue based methods achieve this stability numerically in specific settings. Recently, the situation of clustered points, points with multiplicities, and positive-dimensional algebraic varieties have been studied by similar methods and shall be discussed within the minisymposium.

Organizers: Stefan Kunis (University Osnabrueck, Germany) and Dmitry Batenkov (MIT Boston)

Learning algebraic decompositions using Prony structures
Ulrich v. d. Ohe (University Genova)

Multidimensional Superresolution in Sonar and Radar Imaging
Annie Cuyt (University Antwerpen) and Wen-shin Lee (University of Stirling)

Recovery of surfaces and inference on surfaces: theory & applications to image recovery
Mathews Jacob (University of Iowa) and *Qing Zou* (University of Iowa)

Looking beyond Pixels: Continuous-domain Sparse Recovery with an Application to Radioastronomy
Martin Vetterli (EPFL) and *Pan Hanjie* (EPFL)

MS150, part 1: Fitness landscapes and epistasis

Thursday, July 11, 10:00–12:00
Room: Unitobler, F-112

Studying relations, effects and properties of modified genes or organisms is an important topic in biology with implications in evolution, drug resistance and targeting, and much more. Biological data can many times be represented in digital form, a mutation has occurred or not, a species is present in an ecological system, or not. A fitness landscape is a function from such bit strings to some measured quality. A property of fitness landscapes is epistasis, which is a phenomenon describing dependency relations among effects of combinations of modified genes. Polyhedral decompositions, such as cube triangulations induced by fitness landscapes, provide a systematic approach to epistasis. In this session, we aim at bringing researches of various areas of science together to discuss contact points between applied polyhedral geometry, statistics and biology, and present recent developments in the field.

Organizers: Kristina Crona (American University, Washington, USA), Joachim Krug (Uni Koeln, Germany), and Lisa Lamberti (ETHZ, Switzerland)

Introduction to fitness landscapes and epistasis
Lisa Lamberti (ETHZ, Switzerland)

Cluster partitions and fitness landscapes of the Drosophila fly microbiome
Holger Eble (TU Berlin, Germany), Michael Joswig (TU Berlin, Germany), Lisa Lamberti (ETHZ, Switzerland), and William Ludington (Carnegie Institution for Science, Baltimore, USA)

A mechanistic approach to understanding multi-way interactions between mutations
Michael Harms (University of Oregon, USA)

Understanding the biophysics of molecules from large functional assays
Jakub Otwinowski (MPI for Dynamics and Self-Organization, Germany)

MS153, part 1: Symmetry in algorithmic questions of real algebraic geometry

Thursday, July 11, 10:00–12:00
Room: Unitobler, F021

Symmetry arises quite naturally in many computational problems and from a computational perspective, it allows to reduce the complexity of problems. The mini-symposium aims to presents various instances of computational problems in real algebraic geometry, where symmetry playes an important role.

Organizers: Cordian Riener (UiT - The Arctic University of Norway, Norway) and Philippe Moustrou (UiT - The Arctic University of Norway, Norway)

Complete positivity and distance-avoiding sets
Fernando de Oliveira Filho (Technical University of Delft)

Kissing number of the hemisphere in dimension 8
Maria Dostert (EPFL Lausanne)

Pair correlation estimates for the zeros of the zeta function via semidefinite programming
David de Laat (MIT)

Cut polytopes and minors in graphs
Tim Römer (Universität Osnabrück)

MS164, part 1: Algebra, geometry, and combinatorics of subspace packings

Thursday, July 11, 10:00–12:00
Room: Unitobler, F-106

Frame theory studies special vector arrangements which arise in numerous signal processing applications. Over the last decade, the need for frame-theoretic research has grown alongside the emergence of new methods in signal processing. Modern advances in frame theory involve techniques from algebraic geometry, semidefinite programming, algebraic and geometric combinatorics, and representation theory. This minisymposium will explore a multitude of these algebraic, geometric, and combinatorial developments in frame theory.The theme of the first session is "Systems with non-abelian group symmetry."

Organizers: Emily Jeannette King (University of Bremen, Germany) and Dustin Mixon (Ohio State University)

Algebra, Geometry, and Combinatorics of Subspace Packings: Gabor-Steiner Equiangular Tight Frames
Emily King (University of Bremen)

Group frames, full spark, and other topics
Romanos-Diogenes Malikiosis (Aristotle University of Thessaloniki)

Equiangular tight frames from non-abeilan groups
John Jasper (South Dakota State University)

SIC-POVM existence and the Stark conjectures
Gene Kopp (University of Bristol)

MS173, part 1: Numerical methods in algebraic geometry

Thursday, July 11, 10:00–12:00
Room: Unitobler, F012

This minisymposium is meant to report on recent advances in using numerical methods in algebraic geometry: the foundation of algebraic geometry is the solving of systems of polynomial equations. When the equations to be considered are defined over a subfield of the complex numbers, numerical methods can be used to perform algebraic geometric computations forming the area of numerical algebraic geometry (NAG). Applications which have driven the development of this field include chemical and biological reaction networks, robotics and kinematics, algebraic statistics, and tropical geometry. The minisymposium will feature a diverse set of talks, ranging from the application of NAG to problems in either theory and practice, to discussions on how to implement new insights from numerical mathematics to improve existing methods.

Organizers: Jose Israel Rodriguez (UW Madison, United States of America) and Paul Breiding (MPI MiS)

Minimal problems in multiview 3D reconstruction via homotopy continuation
Anton Leykin (Georgia Tech)

Computing the real CANDECOMP/PARAFAC decomposition of real tensors
Tsung-Lin Lee (National Sun Yat-sen University)

Computing transcendental invariants of hypersurfaces via homotopy
Emre Sertoz (Max-Planck-Institute MiS, Leipzig)

On the nonlinearity interval in parametric semidefinite optimization
Tingting Tang (University of Notre Dame)

MS174, part 1: Algebraic aspects of biochemical reaction networks

Thursday, July 11, 10:00–12:00
Room: Unitobler, F-105

ODE models for biochemical reaction networks usually give rise to dynamical systems defined by polynomial or rational functions. These systems are often high-dimensional, very sparse, and involve many parameters. This minisymposium deals with recent progress on applying and adapting techniques from (real) algebraic geometry and computational algebra for analyzing such systems. The minisymposium consists of three parts focusing on positive steady states, multistationarity and the corresponding parameter regions, and dynamical aspects.

Organizers: Alicia Dickenstein (Universidad de Buenos Aires) and Georg Regensburger (Johannes Kepler University Linz)

Network models and polynomial positivity
Murad Banaji (Middlesex University, London)

Some approaches to understand the parameter region of multistationarity
Elisenda Feliu (University of Copenhagen)

On the bijectivity of families of exponential maps
Stefan Müller (University of Vienna)

An algebraic approach to detecting bistability in chemical reaction networks
Angélica Torres (University of Copenhagen)

MS180, part 1: Network coding and subspace designs

Thursday, July 11, 10:00–12:00
Room: Unitobler, F-113

This symposium collects presentations about results on codes for linear network coding, either in the rank metric or in the subspace metric. Codes in the rank metric are usually subsets of the matrix space $\mathbb{F}_q^{m\times n}$, where $\mathbb{F}_q$ is a finite field; codes in the subspace metric are usually subsets of a finite Grassmann variety. Many interesting questions arise in this topic, e.g., about good packings in these two spaces, as well as fast encoding and decoding algorithms.

Organizers: Daniele Bartoli (University of Perugia) and Anna-Lena Horlemann-Trautmann (University of St. Gallen, Switzerland)

More on exceptional scattered polynomials
Daniele Bartoli (University of Perugia)

The size of linear sets on a finite projective line
Jan de Beule (University of Brussels)

Rank Metric Codes and Subspace Codes in a Convolutional Setting
Joachim Rosenthal (University of Zurich)

Partitions of Matrix Spaces and q-Rook Polynomials
Alberto Ravagnani (University College Dublin)

MS181, part 1: Integral and algebraic geometric methods in the study of Gaussian random fields

Thursday, July 11, 10:00–12:00
Room: Unitobler, F007

Integral and algebraic geometry are at the heart of a number of contributions pertaining to the study of Gaussian random fields and related topics, not only from probabilistic and statistical viewpoints but also from the realm of interpolation and function approximation. This minisymposium will gather a team of junior researchers and established experts presenting original research results reflecting diverse challenges of geometrical and applied geometrical nature primarily involving Gaussian fields.

These encompass the study of geometrical and topological properties of sets implicitly defined by random fields such as zeros of random polynomials, excursion sets, as well as integral curves stemming for instance from filament estimation. Also, Gaussian field approximations dedicated to the estimation of excursion probabilities and more general geometric questions will be tackled, as well as algebraic methods in sparse grids for polynomial and Gaussian process interpolation.

Organizers: David Ginsbourger (Idiap Research Institute and University of Bern, Switzerland) and Jean-Marc Azaïs (Institut de Mathématiques de Toulouse)

Asymptotic normality for the Volume of the nodal set for Kostlan-Shub-Smale polynomial systems
Jean-Marc Azaïs (Institut de Mathématiques de Toulouse)

Euler characteristic and bicovariogram of random excursions
Raphaël Lachieze-Rey (Université Paris Descartes)

Bayesian approach to filament estimation with a latent Gaussian random field model
Wolfgang Polonik (UC David) and Johannes Krebs (UC Davis)

On the universality of roots of random polynomials
Guillaume Poly (Université de Rennes I)

MS185, part 1: Algebraic Geometry Codes

Thursday, July 11, 10:00–12:00
Room: Unitobler, F-122

The problem of finding good codes is central to the theory of error correcting codes. For many years coding theorists have addressed this problem by adding algebraic and combinatorial structure to C.

In the early 80s Goppa used algebraic curves to construct linear error correcting codes, the socalled algebraic geometric codes (AG codes). The construction of an AG code with alphabet a finite field $\mathbb{F}_q$ requires that the underlying curve is $\mathbb{F}_q$-rational and involves two $\mathbb{F}_q$-rational divisors D and G on the curve.

In this minisymposium we will present results on Algebraic Geometry codes and their performances.

Organizers: Daniele Bartoli (Univerity of Perugia, Italy) and Anna-Lena Horlemann (University of St. Gallen)

Weierstrass semigroups on, and a generalization of the Giulietti-Korchmáros curve
Maria Montanucci (University of Padua)

Codes from the GGS maximal curves
Giovanni Zini (University of Milan)

An Open Source Environment for Research on AG Codes
Kwankyu Lee (Chosun University)

Multi-point Codes from the GGS Curves
Shudi Yang (Qufu Normal University)

MS194: Latent graphical models

Thursday, July 11, 10:00–12:00
Room: Unitobler, F-121

Algebro-geometric methods have been extensively applied to study probabilistic graphical models. They became particularly useful in the context of graphical models with hidden variables (latent graphical models). Latent variables appear in graphical models in several important contexts: to represent processes that cannot be observed or measured (e.g. economic activity in business cycle dating, ancestral species in phylogenetics), in causal modelling (confounders), and in machine learning (deep learning, dimension reduction).

Graphical models with latent variables lead to sophisticated geometry problems. The simplest examples, like the latent class model, link directly to secant varieties of the Segre variety and low rank tensors. Understanding the underlying geometry proved to be the driving force behind designing new learning algorithms and was essential to understand fundamental limits of these models. This minisession features three speakers who have been leading this research in the last couple of years.

Organizers: Piotr Zwiernik (Universitat Pompeu Fabra, Spain)

Latent-variable graphical modeling with generalized linear models
Venkat Chandrasekaran (California Institute of Technology)

Representation of Markov kernels with deep graphical models
Guido Montúfar (University of California Los Angeles)

Conditional independence statements with hidden variables
Fatemeh Mohammadi (Bristol University)

IP06: Jonas Peters: Data Science and Causality

Thursday, July 11, 13:30–14:30
Room: vonRoll, Fabrikstr. 6, 001
Streamed to: vonRoll, Fabrikstr. 6, 004

In data science, we are used to infer models that predict the observed data as well as possible. In causality, we try to understand how a system reacts under interventions, e.g., in gene knock-out experiments. Bringing together data science and causality may yield two benefits:

(i) One may try to learn causal models from observations, and

(ii) enhancing standard regression or classification techniques with causal ideas may yield models that generalize better to unseen experiments.

In this talk, we introduce the concept of causality, discuss ideas for addressing the above goals, and mention open problems that could benefit from an algebraic geometry point of view. No prior knowledge about causality is required.

Speaker: Jonas Peters (University of Copenhagen, Denmark)

Coffee break

Thursday, July 11, 14:30–15:00
Room: Unitobler, F wing, floors 0 and -1

MS124, part 2: The algebra and geometry of tensors 1: general tensors

Thursday, July 11, 15:00–17:00
Room: Unitobler, F023
Tensors are ubiquitous in mathematics and science. Tensor decompositions and approximations are an important tool in artificial intelligence, chemometrics, complexity theory, signal processing, statistics, and quantum information theory. These topics raise challenging computational problems, but also the theory behind them is far from fully understood. Algebraic geometry has already played an important role in the study of tensors. It has shed light on: the ill-posedness of tensor approximation problems, the generic number of decompositions of a rank-r tensor, the number and structure of tensor eigen- and singular tuples, the number and structure of the critical points of tensor approximation problems, and on the sensitivity of tensor decompositions among many others. This minisymposium focuses on recent developments on the geometry of tensors and their decompositions, their applications, and mathematical tools for studying them, and is a sister minisymposium to "The algebra and geometry of tensors 2: structured tensors" organized by E. Angelini, E. Carlini, and A. Oneto.

Organizers: Yang Qi (University of Chicago, United States of America) and Nick Vannieuwenhoven (KU Leuven)

Bounds on the rank general and special results
Enrico Carlini (Politecnico di Torino)

On the identifiability of ternary forms beyond the Kruskal's bound
Elena Angelini (Universita di Siena)

Variants of Comon's problem via simultaneous ranks
Alessandro Oneto (Universitat Politècnica de Catalunya)

Complex best r-term approximations almost always exist in finite dimensions
Lek-Heng Lim (University of Chicago)

MS132, part 4: Polynomial equations in coding theory and cryptography

Thursday, July 11, 15:00–17:00
Room: Unitobler, F-123
Polynomial equations are central in algebraic geometry, being algebraic varieties geometric manifestations of solutions of systems of polynomial equations. Actually, modern algebraic geometry is based on the use of techniques for studying and solving geometrical problems about these sets of zeros. At the same time, polynomial equations have found interesting applications in coding theory and cryptography. The interplay between algebraic geometry and coding theory is old and goes back to the first examples of algebraic codes defined with polynomials and codes coming from algebraic curves. More recently, polynomial equations have found important applications in cryptography as well. For example, in multivariate cryptography, one of the prominent candidates for post-quantum cryptosystems, the trapdoor one-way function takes the form of a multivariate quadratic polynomial map over a finite field. Furthermore, the efficiency of the index calculus attack to break an elliptic curve cryptosystem relies on the effectiveness of solving a system of multivariate polynomial equations. This session will feature recent progress in these and other applications of polynomial equations to coding theory and cryptography.

Organizers: Alessio Caminata (University of Neuchâtel, Switzerland) and Alberto Ravagnani (University College Dublin, Ireland)

Linearized Polynomials in Finite Geometry and Rank-Metric Coding
John Sheekey (University College Dublin)

Quantum Algorithms for Optimization over Finite Fields and Applications in Cryptanalysis
Xiao-Shan Gao (Academy of Mathematics and Systems Science, Chinese Academy of Sciences)

On the Complexity of "Superdetermined" Minrank Instances
Daniel Cabarcas (Universidad Nacional de Colombia)

MinRank Problems Arising from Rank-based Cryptography
Ray Perlner (NIST)

MS134, part 5: Coding theory and cryptography

Thursday, July 11, 15:00–17:00
Room: Unitobler, F-122

The focus of this minisymposium is on coding theory and cryptography, with emphasis on the algebraic aspects of these two research fields. Error-correcting codes are mathematical objects that allow reliable communications over noisy/lossy/adversarial channels. Constructing good codes and designing efficient decoding algorithms for them often reduces to solving algebra problems, such as counting rational points on curves, solving equations, and classifying finite rings and modules. Cryptosystems can be roughly defined as functions that are easy to evaluate, but whose inverse is difficult to compute in practice. These functions are in general constructed using algebraic objects and tools, such as polynomials, algebraic varieties, and groups. The security of the resulting cryptosystem heavily relies on the mathematical properties of these. The sessions we propose feature experts of algebraic methods in coding theory and cryptography. All levels of experience are represented, from junior to very experienced researchers.

Organizers: Alessio Caminata (University of Neuchâtel, Switzerland) and Alberto Ravagnani (University College Dublin, Ireland)

Classifications of some partial MDS codes
Anna-Lena Horlemann-Trautmann (University of St. Gallen)

Batch properties of Affine Cartesian Codes
Felice Manganiello (Clemson University)

Improved quantum codes from the Hermitian curve
Olav Geil (Aalborg University)

Concatenated constructions of LCD and LCP of codes
Cem Güneri (Sabancı University)

MS136, part 1: Syzygies and applications to geometry

Thursday, July 11, 15:00–17:00
Room: Unitobler, F-107

In this minisymposium, we will focus on the striking results and applications that the study of syzygies provides in algebraic geometry, in a wide sense. Topics should include but are not limited to the study of rational and birational maps, singularities, residual intersections and the defining equations of blow-up algebras. We plan to focus on recent progress in this area that result in explicit and effective computations to detect certain geometrical property or invariant. Applications to geometric modeling are very welcome.

Organizers: Laurent Busé (INRIA Sophia Antipolis), Yairon Cid Ruiz (Universitat de Barcelona), and Carlos D'Andrea (Universitat de Barcelona)

Fibers of multi-graded rational maps and orthogonal projection onto rational surfaces
Fatmanur Yildrim (INRIA Sophia Antipolis, France)

Complete intersection points in product of projective spaces
Navid Nemati (Université Pierre et Marie Curie)

Fibers of rational maps and Jacobian matrices
Marc Chardin (Université Pierre et Marie Curie)

Syzygies and the geometry of rational maps (introductory talk)
Laurent Busé (INRIA Sophia Antipolis)

MS139, part 1: Combinatorics and algorithms in decision and reason

Thursday, July 11, 15:00–17:00
Room: Unitobler, F-121

Combinatorial, or discrete, structures are a fundamental tool for modeling decision-making processes in a wide variety of fields including machine learning, biology, economics, sociology, and causality. Within these various contexts, the goal of key problems can often be phrased in terms of learning or manipulating a combinatorial object, such as a network, permutation, or directed acyclic graph, that exhibits pre-specified optimal features. In recent decades, major break-throughs in each of these fields can be attributed to the development of effective algorithms for learning and analyzing combinatorial models. Many of these advancements are tied to new developments connecting combinatorics, algebra, geometry, and statistics, particularly through the introduction of geometric and algebraic techniques to the development of combinatorial algorithms. The goal of this session is to bring together researchers from each of these fields who are using combinatorial or discrete models in data science so as to encourage further breakthroughs in this important area of mathematical research.

Organizers: Liam Solus (KTH Royal Institute of Technology, Sweden) and Svante Linusson (KTH Royal Institute of Technology)

(Machine) Learning Non-Linear Algebra
Jesus De Loera (University of California, Davis)

Network Flows in Semi-Supervised Learning via Total Variation Minimization
Alexander Jung (Aalto University)

Scalably vertex-programmable ideological forests from certain political twitterverses around US (2016), UK(2017) and Swedish (2018) national elections
Raazesh Sainudiin (Uppsala University)

The Kingman Coalescent as a density on a space of trees
Lena Walter (Freie Universität Berlin)

MS150, part 2: Fitness landscapes and epistasis

Thursday, July 11, 15:00–17:00
Room: Unitobler, F-112

Studying relations, effects and properties of modified genes or organisms is an important topic in biology with implications in evolution, drug resistance and targeting, and much more. Biological data can many times be represented in digital form, a mutation has occurred or not, a species is present in an ecological system, or not. A fitness landscape is a function from such bit strings to some measured quality. A property of fitness landscapes is epistasis, which is a phenomenon describing dependency relations among effects of combinations of modified genes. Polyhedral decompositions, such as cube triangulations induced by fitness landscapes, provide a systematic approach to epistasis. In this session, we aim at bringing researches of various areas of science together to discuss contact points between applied polyhedral geometry, statistics and biology, and present recent developments in the field.

Organizers: Kristina Crona (American University, Washington, USA), Joachim Krug (Uni Koeln, Germany), and Lisa Lamberti (ETHZ, Switzerland)

Shape theory, landscape topography and evolutionary dynamics
Joachim Krug (Uni Koeln, Germany) and Malvika Srivastava (Uni Koeln, Germany)

Graphs, polytopes, and unpredictable evolution
Kristina Crona (American University, Washington, USA)

Computational complexity as an ultimate constraint on evolution
Artem Kaznatcheev (University of Oxford, UK)

Tropical Principal Component Analysis and its Applications to Phylogenomics
Ruriko Yoshida (Naval Postgraduate School, USA), Leon Zhang (University of California, Berkeley, USA), and Xu Zhang (University of Kentucky, USA)

MS154, part 3: New developments in matroid theory

Thursday, July 11, 15:00–17:00
Room: Unitobler, F-106

The interactions between Matroid Theory, Algebra, Geometry, and Topology have long been deep and fruitful. Pertinent examples of such interactions include breakthrough results such as the g-Theorem of Billera, Lee and Stanley (1979); the proof that complements of finite complex reflection arrangements are aspherical by Bessis (2014); and, very recently, the proof of Rota's log-concavity conjecture by Adiprasito, Huh, and Katz (2015).

The proposed mini-symposia will focus on the new exciting development in Matroid Theory such as the role played by Bergman fans in tropical geometry, several results on matroids over a commutative ring and over an hyperfield, and the new improvement in valuated matroids and about toric arrangements. We plan to bring together researchers with diverse expertise, mostly from Europe but also from US and Japan. We are going to include a number of postdocs and junior mathematicians.

Organizers: Alex FInk (Queen Mary), Ivan Martino (Northeastern University, United States of America), and Luca Moci (Bologna)

Characterizing quotients of positroids
Anastasia Chavez (UC Berkeley)

Algebraic matroids and flocks
Rudi Pendavingh (TU Eindhoven)

Tropical Ideals
Jeffrey Herschel Giansiracusa (Swansea)

MS155, part 1: Massively parallel computations in algebraic geometry

Thursday, July 11, 15:00–17:00
Room: Unitobler, F-113

Massively parallel methods have been a success story in high performance numerical simulation, but so far have rarely been used in computational algebraic geometry. Recent developments like the combination of the parallelization framework GPI-Space with the computer algebra system Singular have made such approaches accessible to the mathematician without the need to deal with a multitude of technical details. The minisymposium aims at bringing together researchers pioneering this approach, discussing the current state of the art and possible future developments. We plan to address applications in classical algebraic geometry, tropical geometry, geometric invariant theory and links to high energy physics.

Organizers: Janko Böhm (TU Kaiserlautern, Germany) and Anne Frühbis-Krüger (Leibniz Universität Hannover)

GPI-Space - Fraunhofer's integrated solution to solve big problems on ultra scale machines
Franz-Josef Pfreundt (Fraunhofer ITWM), Mirko Rahn (Fraunhofer ITWM), and *Alexandra Carpen-Amarie* (Fraunhofer ITWM)

Using Petri nets for parallelizing algorithms in algebraic geometry
Lukas Ristau (TU Kaiserslautern / Fraunhofer ITWM)

Parallel enumeration of triangulations
Lars Kastner (TU Berlin)

Module intersection method for multi-loop Feynman integral reduction
Yang Zhang (Max Planck Institute for Physics, Munich)

MS158, part 1: Structured sums of squares

Thursday, July 11, 15:00–17:00
Room: Unitobler, F021

A description of a nonnegative polynomial as a sum of squares gives a concise proof of its nonnegativity. Computationally, such sum-of-squares decompositions are appealing because we can search for them by solving a semidefinite feasibility problem. This connection means that optimization and decision problems arising in a range of areas, from robotics to extremal combinatorics, can be reformulated as, or approximated with, semidefinite optimization problems.

This minisymposium highlights the roles of various kinds of additional structures, including symmetry and sparsity, in understanding when (structured) sum of squares decompositions do and do not exist. It will also showcase interesting connections between sums of squares and a range of areas, such as extremal combinatorics, dynamical systems and control, and algorithms and complexity theory.

Organizers: James Saunderson (Monash University, Australia) and Mauricio Velasco (Universidad de los Andes)

Learning dynamical systems with side information
Amir Ali Ahmadi (Princeton University) and Bachir El Khadir (Princeton University)

Convergence analysis of measure-based bounds for polynomial optimization on compact sets
Lucas Slot (CWI Amsterdam) and Monique Laurent (CWI Amsterdam)

Sums-of-squares for extremal discrete geometry on the unit sphere
Frank Vallentin (Universität zu Köln)

Computing spectral bounds for geometric graphs via polynomial optimization
Philippe Moustrou (UiT - The Arctic University of Norway)

MS160, part 3: Numerical methods for structured polynomial system solving

Thursday, July 11, 15:00–17:00
Room: Unitobler, F012

Improvements in the understanding of numerical methods for dense polynomial system solving led to the complete solution of Smale's 17th problem. At this point, it remains an open challenge to achieve the same success in the solution of structured polynomial systems: explain the typical behavior of current algorithms and devise polynomial-time algorithms for computing roots of polynomial systems. In this minisymposium, researchers will present the current progress on applying numerical methods to structured polynomial systems.

Organizers: Alperen Ergur (TU Berlin), Pierre Lairez (INRIA), Gregorio Malajovich (Universidade Federal do Rio de Janeiro, Brazil), and Josue Tonelli-Cueto (TU Berlin)

Certifying solutions to a square system involving analytic functions
Michael Burr (Clemson University), *Kisun Lee* (Georgia Institute of Technology), and Anton Leykin (Georgia Institute of Technology)

Toric witness sets for sampling positive dimensional solution sets of polynomial systems
Tianran Chen (Auburn University at Montgomery)

Farewell to Weyl: Condition-based analysis with a Banach norm in numerical algebraic geometry
Josue Tonelli-Cueto (TU Berlin), Felipe Cucker (City University of Hong Kong), and Alperen Ergür (TU Berlin)

Singular polynomial eigenvalue problems are not ill-conditioned
Martin Lotz (Warwick University) and Vanni Noferini (Aalto University)

MS166, part 2: Computational aspects of finite groups and their representations

Thursday, July 11, 15:00–17:00
Room: Unitobler, F011

The theory of finite groups and their representations is not only an interesting topic for mathematicians but also provides powerful tools in solving problems in science. New computational tools are making this even more feasible. To name a few, one may find applications in physics, coding theory and cryptography. On the other hand representation theory is useful in different areas of mathematics such as algebraic geometry and algebraic topology. Due to this wide range of applications, new algorithmic methods are being developed to study finite groups and their representations from a computational perspective.

Recent developments in computer algebra systems and more specifically computational linear algebra, provide tools for developments in computational aspects of finite groups and their representations. The aim of this minisymposium is to gather experts in the area to discuss the recent achievements and potential new directions.

Organizers: Armin Jamshidpey (University of Waterloo, Canada), Eric Schost (University of Waterloo, Canada), and Mark Giesbrecht (University of Waterloo, Canada)

Calculations with Symplectic Hypergeometric Groups
Alexander Hulpke (Colorado State University)

Algorithmic factorization of noncommutative polynomials
Viktor Levandovskyy (RWTH Acchen University)

Finite groups of Lie type and computer algebra
Meinolf Geck (Universität Stuttgart)

Classification of regular parametrized one-relation operads
Murray Bremner (University of Saskatchewan)

MS167, part 2: Computational tropical geometry

Thursday, July 11, 15:00–17:00
Room: Unitobler, F013
This session will highlight recent advances in tropical geometry, algebra, and combinatorics, focusing on computational aspects and applications. The area enjoys close interactions with max-plus algebra, polyhedral geometry, combinatorics, Groebner theory, and numerical algebraic geometry.

Organizers: Kalina Mincheva (Yale University) and Yue Ren (Max Planck Institute for Mathematics in the Sciences, Germany)

Connectivity of tropical varieties
Diane Maclagan (Warwick University) and Josephine Yu (Georgia Tech)

Tropical convex hull of polytopes
Cvetelina Hill (Georgia Tech), *Sara Lamboglia* (Goethe Universität Frankfurt), and Faye Pasley Simon (North Carolina State University)

Algorithmic questions around tropical Carathéodory
Georg Peter Loho (London School of Economics)

Convergent Puiseux series and tropical geometry of higher rank
Ben Smith (Queen Mary University of London)

MS175, part 2: Algebraic geometry and combinatorics of jammed structures

Thursday, July 11, 15:00–17:00
Room: Unitobler, F-111
The minisymposium will combine the classical rigidity theory of linkages in discrete and computational geometry with the theory of circle packing, and patterns, on surfaces that arose from the study of 2- and 3-manifolds in geometry and topology. The aim being to facilitate interaction between these two areas. The classical theory of rigidity goes back to work by Euler and Cauchy on triangulated Euclidean polyhedra. The general area is concerned with the problem of determining the nature of the configuration space of geometric objects. In the modern theory the objects are geometric graphs (bar-joint structures) and the graph is rigid if the configuration space is finite (up to isometries). More generally one can consider tensegrity structures where distance constraints between points can be replaced by inequality constraints. The theory of (circle, disk and sphere) packings is vast and well known, with numerous practical applications. Of particular relevance here are conditions that result in the packing being non-deformable (jammed) as well as recent work on inversive distance packings. These inversive distance circle packings generalised the much studied tangency and overlapping packings by allowing "adjacent" circles to be disjoint, but with the control of an inversive distance parameter that measures the separation of the circles. The potential for overlap between these areas can be easily seen by modelling a packing of disks in the plane by a tensegrity structure where each disk is replaced by a point at its centre and the constraint that the disks cannot overlap becomes the constraint that the points cannot get closer together.

Organizers: Anthony Nixon (Lancaster) and Louis Theran (St Andrews)

Rigid realizations of planar graphs with few locations in the plane
Csaba Király (Eotvos Lorand)

Global rigidity of linearly constrained frameworks
Anthony Nixon (Lancaster)

Hyperbolic polyhedra and discrete uniformization
Boris Springborn (TU Berlin)

Symmetric frameworks in normed spaces
Derek Kitson (Lancaster)

MS183, part 2: Polyhedral geometry methods for biochemical reaction networks

Thursday, July 11, 15:00–17:00
Room: Unitobler, F-105

This minisymposium focuses on geometric objects arising in the study of parametrized polynomial ODEs given by biochemical reaction networks. In particular, we consider recent work that employs techniques from convex, polyhedral, and tropical geometry in order to extract properties of interest from the ODE system and to relate them to the choice of parameter values.

Specific problems covered in the minisimposium include the analysis of forward-invariant regions of the ODE system, the determination of parameter regions for multistationarity or oscillations, the performance of model reduction close to metastable regimes, and the characterization of unique existence of equilibria using oriented matroids.

Organizers: Elisenda Feliu (University of Copenhagen, Denmark) and Stefan Müller (University of Vienna)

Algorithmic Aspects of Computing Tropical Prevarieties Parametrically
Andreas Weber (University of Bonn)

Empiric investigations on the number and structure of solution polytopes for tropical equilibration problems arising from biological networks
Christoph Lüders (University of Bonn)

Perturbations of exponents of exponential maps: robustness of bijectivity
Georg Regensburger (Johannes Kepler University Linz)

Weakly reversible mass-action systems with infinitely many positive steady states
Balázs Boros (University of Vienna)

MS188: Probability and randomness in commutative algebra and algebraic geometry

Thursday, July 11, 15:00–17:00
Room: Unitobler, F005

Randomness has long been used to study polynomials. Several classical instances include Lit- tlewood and Offord's examination of the expected number of real roots of an algebraic equation defined by random coefficients, as well as work of Kac and Kouchnirenko on varieties defined by random coefficients on a fixed Newton polytope support. Additionally, the use of smooth analysis, which measures the expected performance of an algorithm under slight random perturbations of worst-case inputs, has been used in the context of algebraic geometry. The aim of this minisymposium is to highlight a recent surge of interactions between the fields of probability and commutative algebra/algebraic geometry, in which questions of expected (average, typical) or unlikely (rare, non-generic) behavior of ideals and varieties are studied formally using probability distributions. Recent work has seen the successful application of techniques from statistics and probabilistic combinatorics in this setting. Our goal is to bring researchers working in this intersection together to share their work and form potential new collaborations.

Organizers: Dane Wilburne (Brown University, United States of America) and Christopher O'Neill (San Diego State University)

What can be predicted in algebraic geometry?
Lily Silverstein (UC Davis)

Degree of Random Monomial Ideals
Jay Yang (University of Minnesota)

Stochastic Exploration of Real Varieties
David Kahle (Baylor University)

Random numerical semigroups
Christopher O'Neill (San Diego State University)

MS189, part 1: Geometry and topology in applications.

Thursday, July 11, 15:00–17:00
Room: Unitobler, F006

This symppsium will bring together leading practitioners, mid-carreer scientists as well as PhD students and postdoctoral fellows who are interested in the theory and practice of the applications of geometry and topology in real life problems. The spectrum of possible applications is very wide, and covers the sciences, biology, medicine, materials science, and many others. The talks will address the theoretical foundations of the methodology as well as the state of the art of geometric and topological modelling.

Organizers: Jacek Brodzki (University of Southampton, United Kingdom) and Heather Harrington (University of Oxford)

Topological data analysis in materials science
Yasu Hiraoka (Kyoto University)

Optimal transport in tropical geometric phylogenetic tree space
Anthea Monod (Columbia University)

Primary distance for multipersistence
Ezra Miller (Duke)

Outlier robust subsampling techniques for persistent homology
Bernadette Stolz (Oxford)

MS195, part 3: Algebraic methods for convex sets

Thursday, July 11, 15:00–17:00
Room: Unitobler, F022

Convex relaxations are extensively used to solve intractable optimization instances in a wide range of applications. For example, convex relaxations are prominently utilized to find solutions of combinatorial problems that are computationally hard. In addition, convexity-based regularization functions are employed in (potentially ill-posed) inverse problems, e.g., regression, to impose certain desirable structure on the solution.

In this mini-symposium, we discuss the use of convex relaxations and the study of convex sets from an algebraic perspective. In particular, the goal of this minisymposium is to bring together experts from algebraic geometry (real and classical), commutative algebra, optimization, statistics, functional analysis and control theory, as well as discrete geometry to discuss recent connections and discoveries at the interfaces of these fields.

Organizers: Rainer Sinn (Freie Universität Berlin, Germany), Greg Blekherman (Georgia Institute of Technology), Daniel Plaumann (Technische Universität Dortmund), Yong Sheng Soh (Institute of High Performance Computing, Singapore), and Dogyoon Song (Massachusetts Institute of Technology)

Average-Case Algorithm Design Using Sum-of-Squares
Pravesh Kothari (Princeton University)

Fitting Semidefinite-Representable Sets to Support Function Evaluations
Yong Sheng Soh (Institute of High Performance Computing, Singapore)

Measuring Optimality Gap in Conic Programming Approximations with Gaussian Width
Dogyoon Song (Massachusetts Institute of Technology)

False discovery and its control for low rank estimation
Armeen Taeb (California Institute of Technology)

MS200, part 3: From algebraic geometry to geometric topology: Crossroads on applications

Thursday, July 11, 15:00–17:00
Room: Unitobler, F007

The purpose of this minisymposium is to bring together researchers who use algebraic, combinatorial and geometric topology in industrial and applied mathematics. These methods have already seen applications in: biology, physics, chemistry, fluid dynamics, distributed computing, robotics, neural networks and data analysis.

Organizers: Jose Carlos Gomez Larrañaga (CIMAT), Renzo Ricca (University of Milano-Bicocca), and De Witt Sumners (Florida State University)

Time-reversal homotopical properties of concurrent systems
Eric Goubault (École Polytechnique)

Efficient computation of multiparameter persistent homology
Abraham Martín del Campo Sánchez (CONACYT-CIMAT)

Classification of Streamline Topologies for Hamiltonian vector fields and its applications to Topological Flow Data Analysis
Takashi Sakajo (Kyoto University)

Robot motion planning and equivariant cohomology
Michael Farber (Queen Mary, University of London)

SIAGA meeting for corresponding and associate editors

Thursday, July 11, 17:15–18:30
Room: Unitobler, F011

Friday, July 12

Announcements

Friday, July 12, 08:25–08:30
Room: vonRoll, Fabrikstr. 6, 001

IP07: Kristin Lauter: Supersingular Isogeny Graphs in Cryptography

Friday, July 12, 08:30–09:30
Room: vonRoll, Fabrikstr. 6, 001
Streamed to: vonRoll, Fabrikstr. 6, 004

As we move towards a world where quantum computers can be built at scale, we are forced to consider the question of what hard problems in mathematics our next generation of cryptographic systems will be based on. Supersingular Isogeny Graphs were proposed for use in cryptography in 2006 by Charles, Goren, and Lauter. Supersingular Isogeny Graphs are examples of Ramanujan graphs, which are optimal expander graphs. These graphs have the property that relatively short walks on the graph approximate the uniform distribution, and for this reason, walks on expander graphs are often used as a good source of randomness in computer science. But the reason these graphs are important for cryptography is that finding paths in these graphs, i.e. routing, is hard: there are no known subexponential algorithms to solve this problem, either classically or on a quantum computer. For this reason, cryptosystems based on the hardness of problems on Supersingular Isogeny Graphs are currently under consideration for standardization in the NIST Post-Quantum Cryptography (PQC) Competition, and have advanced to the second round of the competition. This talk will introduce these graphs, the cryptographic applications, and the various algorithmic approaches which have been tried to attack these systems.

Speaker: Kristin Lauter (Microsoft Research, United States of America)

Coffee break

Friday, July 12, 09:30–10:00
Room: Unitobler, F wing, floors 0 and -1

MS124, part 3: The algebra and geometry of tensors 1: general tensors

Friday, July 12, 10:00–12:00
Room: Unitobler, F023
Tensors are ubiquitous in mathematics and science. Tensor decompositions and approximations are an important tool in artificial intelligence, chemometrics, complexity theory, signal processing, statistics, and quantum information theory. These topics raise challenging computational problems, but also the theory behind them is far from fully understood. Algebraic geometry has already played an important role in the study of tensors. It has shed light on: the ill-posedness of tensor approximation problems, the generic number of decompositions of a rank-r tensor, the number and structure of tensor eigen- and singular tuples, the number and structure of the critical points of tensor approximation problems, and on the sensitivity of tensor decompositions among many others. This minisymposium focuses on recent developments on the geometry of tensors and their decompositions, their applications, and mathematical tools for studying them, and is a sister minisymposium to "The algebra and geometry of tensors 2: structured tensors" organized by E. Angelini, E. Carlini, and A. Oneto.

Organizers: Yang Qi (University of Chicago, United States of America) and Nick Vannieuwenhoven (KU Leuven)

Apolarity for border rank
Jarosław Buczyński (Polish Academy of Sciences)

Symmetric tensor decompositions on varieties
Ke Ye (Chinese Academy of Sciences)

Tensors under the congruence action
Anna Seigal (UC Berkeley)

Rank additivity for small three-way tensors
Filip Rupniewski (Polish Academy of Sciences)

MS125: Efficient algorithms for geometric invariant theory

Friday, July 12, 10:00–12:00
Room: Unitobler, F-107
Recently, motivated by the polynomial identity testing problem from computer science, and by questions arising in quantum information theory, efficient numerical algorithms for solving the null cone problem from geometric invariant theory have been proposed. The goal of the minisymposium is to review this progress and to report on recent advances.

Organizers: Peter Burgisser (Technische Universität Berlin, Germany) and Michael Walter (University of Amsterdam)

Algorithms for the separation of orbits of matrices
Harm Derksen (University of Michigan)

Analytic algorithms for the null cone problem
Ankit Garg (Microsoft India)

Non-commutative rank of linear matrices, related structures and applications
Gabor Ivanyos (Hungarian Academy of Sciences)

Analytic algorithms for the moment polytope
Cole Franks (Rutgers University)

MS126, part 2: Euclidean distance geometry and its applications

Friday, July 12, 10:00–12:00
Room: Unitobler, F011

Given a natural number d and a weighted graph G=(V,E), the fundamental problem in Euclidean distance geometry is to determine whether there exists a realization of the graph G in Rd such that distances between pairs of points are equal to the corresponding edge weights. This problem naturally arises in many applications that require recovering locations of objects from the distances between these objects. Usually, measurements of the distances are noisy and there can be missing data. Examples of applications are sensor network localization, molecular conformation, genome reconstruction, robotics and data visualization. Algebraic varieties and semialgebraic sets naturally come up in Euclidean distance geometry, since distances between objects are given by polynomials. Hence questions about uniqueness and finiteness of realizations are often algebraic in nature, whereas realizations are found using semidefinite or nonconvex optimization methods. The goal of this minisymposium is to present theory and applications of Euclidean distance geometry, and connect researchers working in Euclidean distance geometry with applied algebraic geometers.

Organizers: Kaie Kubjas (Sorbonne Université)

Rigidity theory and algebraic matroids
Jessica Sidman (Mount Holyoke College, USA)

Periodic framework enhancements
Ileana Streinu (Smith College, USA)

Barvinok's Naive Algorithm in Distance Geometry
Leo Liberti (CNRS and Ecole Polytechnique, France) and Ky Vu (Chinese University of Hong Kong, P.R. China)

Mathematics of 3D genome reconstruction in diploid organisms
Kaie Kubjas (Sorbonne Université, France)

MS128, part 1: Symbolic-numeric methods for non-linear equations: Algorithms and applications

Friday, July 12, 10:00–12:00
Room: Unitobler, F-112

Modeling real-world systems or processes in areas such as control theory, geometric modeling, biochemistry, coding theory, cryptology, and so on, almost certainly involves non-linear equations. Higher degree equations are the first step away from linear models. Available tools for recovering their solutions range from numerical methods such as Newton-Raphson, homotopy continuation algorithms, subdivision-based solvers, to symbolic tools such as Groebner bases, border bases, characteristic sets and multivariate resultants. There is continuous progress in combining symbolic methods and numerical solving, in order to devise new algorithms with varying blends of exactness, stability and robustness as well as computational complexity, that are tailored for different applications. Among the challenges which occur in the process is reliable root isolation, certification and approximation, treatment of singular solutions, the exploitation of structure coming from specific applications as well as efficient interpolation.The mini-symposium will host presentations related to state-of-the-art solution strategies for these problems, theoretical and algorithmic advances as well as emerging application areas.

Organizers: Angelos Mantzaflaris (Inria, France), Bernard Mourrain (Inria, France), and Elias Tsigaridas (Inria, France)

Multilinear systems, determinantal resultants and the multiparameter eigenvalue problem
Matias Bender (Inria, France), Jean-Charles Faugère (Inria, France), *Angelos Mantzaflaris* (Inria, France), and Elias Tsigaridas (Inria, France)

Algorithmic aspects of the rational interpolation problem
Carlos D'Andrea (University of Barcelona)

Computing Gröbner basis for sparse polynomial systems
Matias Bender (Inria, France), Jean-Charles Faugère (Inria, France), and Elias Tsigaridas (Inria, France)

Real solving polynomial systems with interval method
Zafeirakis Zafeirakopoulos (Gebze Technical University) and Mahmut Levent Doğan (ODTÜ)

MS130, part 3: Polynomial optimization and its applications

Friday, July 12, 10:00–12:00
Room: Unitobler, F022

The importance of polynomial (aka semi-algebraic) optimization is highlighted by the large number of its interactions with different research domains of mathematical sciences. These include, but are not limited to, automatic control, combinatorics, and quantum information. The mini-symposium will focus on the development of methods and algorithms dedicated to the general polynomial optimization problem. Both the theoretical and more applicative viewpoints will be covered.

Organizers: Timo de Wolff (Technische Universität Berlin, Germany), Simone Naldi (Université de Limoges, France), and João Gouveia (Universidade de Coimbra, Portugal)

Limitations on the expressive power of convex cones without long chains of faces
James Saunderson (Monash University, Melbourne, Australia)

On the exactness of Lasserre relaxations and pure states over real closed fields
Markus Schweighofer (Universität Konstanz, Germany) and Tom-Lukas Kriel (TNG Technology Consulting GmbH)

High-dimensional estimation via sum-of-squares proofs
David Steurer (ETH Zürich, Switzerland), Prasad Raghavendra (University of California, Berkeley, CA, USA), and Tselil Schramm (MIT, Cambridge, MA, USA)

Exact Optimization via Sums of Nonnegative Circuits and Sums of AM/GM ExponentialsLog-concave polynomials, entropy, and approximate counting
Henning Seidler (Technische Universität Berlin, Germany), Victor Magron (CNRS-LAAS, Toulouse, France), and Timo de Wolff (Technische Universität Berlin, Germany)

MS137, part 2: Symbolic Combinatorics

Friday, July 12, 10:00–12:00
Room: Unitobler, F005

In recent years algorithms and software have been developed that allow researchers to discover and verify combinatorial identities as well as understand analytic and algebraic properties of generating functions. The interaction of combinatorics and symbolic computation has had a beneficial impact on both fields. This mini-symposium will feature 12 speakers describing recent research combining these areas.

Organizers: Shaoshi Chen (Chinese Academy of Sciences), Manuel Kauers (Johannes Kepler University, Linz, Austria), and Stephen Melczer (University of Pennsylvania)

Mahlerian analogues of Riccati equations and proofs of hypertranscendence
Frederic Chyzak (INRIA)

Walk in the quarter plain and differential Galois theory
Thomas Dreyfus (Université de Strasbourg)

Systems of equations for sets of permutations and limit shapes
Valentin Féray (Universität Zürich)

The location of variables in lambda-terms with bounded De Bruijn levels
Bernhard Gittenberger (TU Wien)

MS141, part 1: Chip-firing and tropical curves

Friday, July 12, 10:00–12:00
Room: Unitobler, F013

The chip-firing game on metric graphs is a simple combinatorial model that serves as a tropical analogue of divisor theory on algebraic curves, and it has been an active and fruitful research direction over the last decade. The behaviors of chip-firing resemble, but not always completely match, the classical situation in algebraic geometry. So on one hand, chip-firing can often be used to prove results (old and new) in algebraic geometry; while on the other hand, the combinatorics of chip-firing is interesting and surprising in its own right. We will focus on three main topics: (I) Tropical analogues (or failure thereof) of classical results of algebraic curves, (II) applications of chip-firing in algebraic geometry and other subjects, and (III) complexity issues of computational problems related to chip-firing.

Organizers: Chi Ho Yuen (University of Bern) and Alejandro Vargas (University of Bern)

Introduction to chip firing
Alejandro Vargas (University of Bern)

Computing divisorial gonality is hard
Dion Gijswijt (TU Delft)

Recognizing hyperelliptic graphs
Marieke van der Wegen (University of Utrecht)

Graphs of gonality three
Ralph Morrison (Williams College)

MS145, part 3: Isogenies in Cryptography

Friday, July 12, 10:00–12:00
Room: Unitobler, F-123

The isogeny graph of elliptic curves over finite fields has long been a subject of study in algebraic geometry and number theory. During the past 10 years several authors have shown multiple applications in cryptology. One interesting feature is that systems built on isogenies seem to resist attacks by quantum computers, making them the most recent family of cryptosystems studied in post-quantum cryptography.

This mini-symposium brings together presentations on cryptosystems built on top of isogenies, their use in applications, and different approaches to the cryptanalysis, including quantum cryptanalysis.

Organizers: Tanja Lange (Eindhoven University of Technology, Netherlands, The), Chloe Martindale (Eindhoven University of Technology, Netherlands, The), and Lorenz Panny (Eindhoven University of Technology, Netherlands, The)

Superspecial genus 2 curves in cryptography
Thomas Decru (KU Leuven)

Quantum algorithms for finding isogenies between supersingular elliptic curves
Jean-François Biasse (University of South Florida)

Horizontal isogeny graphs
Benjamin Wesolowski (CWI)

Isogeny Graphs of Ordinary Abelian Surfaces and Endomorphism Rings
Dimitar Jetchev (EPFL)

MS146, part 2: Random geometry and topology

Friday, July 12, 10:00–12:00
Room: Unitobler, F006

This minisymposium is meant to report on the recent activity in the field of random geometry and topology. The idea behind the field is summarized as follows: take a geometric or topological quantity associated to a set of instances, endow the space of instances with a probability distribution and compute the expected value, the variance or deviation inequalities of the quantity. The most prominent example of this is probably Kostlan, Shub and Smales celebrated result on the expected number of real zeros of a real polynomial. Random geometry and topology offers a fresh view on classical mathematical problems. At the same time, since randomness is inherent to models of the physical, biological, and social world, the field comes with a direct link to applications.

Organizers: Paul Breiding (Max-Planck Institute for Mathematics in the Sciences, Germany), Lerario Antonio (SISSA), Lundberg Erik (Florida Atlantic University), and Kozhasov Khazhgali (Max-Planck Institute for Mathematics in the Sciences, Germany)

Grassmann Integral Geometry
Leo Mathis (SISSA)

Topology of Gaussian Random Fields
Michele Stecconi (SISSA)

Spectrum of the Laplace Operator for Random Geometric Graphs
Raffaella Mulas (MPI MiS Leipzig)

Sampling from the uniform distribution on a variety
Orlando Marigliano (MPI MiS Leipzig)

MS164, part 2: Algebra, geometry, and combinatorics of subspace packings

Friday, July 12, 10:00–12:00
Room: Unitobler, F-106

Frame theory studies special vector arrangements which arise in numerous signal processing applications. Over the last decade, the need for frame-theoretic research has grown alongside the emergence of new methods in signal processing. Modern advances in frame theory involve techniques from algebraic geometry, semidefiniteprogramming, algebraic and geometric combinatorics, and representation theory. This minisymposium will explore a multitude of these algebraic, geometric, and combinatorial developments in frame theory.

The theme of the second session is "Equiangular lines."

Organizers: Emily Jeannette King (University of Bremen, Germany) and Dustin Mixon (Ohio State University)

Equiangular tight frames from group divisible designs
Matthew Fickus (Air Force Inst. of Technology)

Using Biangular Gabor Frames to Construct Equiangular Tight Frames
Mark Magsino (Ohio State University)

Doubly transitive lines: Symmetry implies optimality
Joseph Iverson (Iowa State University)

Equiangular lines in $\mathbb{R}^{17}$ and the characteristic polynomial of a Seidel matrix
Gary Greaves (Nanyang Technological University)

MS169, part 1: Applications of Algebraic geometry to quantum information

Friday, July 12, 10:00–12:00
Room: Unitobler, F-111

Quantum information science attempts to use quantum phenomena as non-classical resources to perform new communication protocols and develop new computational paradigms. The theoretical advantages of quantum communication and quantum algorithms were proved in the 80-90's and nowadays experimentalists are working on making that technology available. One of the quantum phenomena responsible for the speed up of quantum algorithms and the security of quantum communication is entanglement. A system of m-particules (a multipartite quantum state) is said to be entangled when the state of a particle of the system cannot be described independently of the others. Entanglement is a consequence of the superposition principle in quantum physics which mathematically translates to the fact that the Hilbert space of a composite system is the tensor product of the Hilbert space of each part. Algebraic geometry entered the study of entanglement of multipartite systems when it was both noticed in the early 2000s that the rank of tensors could be interpreted as a measure of entanglement and also that invariant theory could be used to distinguish different classes of entanglement. Since then a large amount of research has been produced in the mathematical-physics literature to classify and/or measure entanglement using techniques from classical invariant theory, representation theory, and geometric invariant theory. Because of the exponential growth of the dimension of the multipartite Hilbert spaces, when the number of factors increases, only a few examples of explicit classifications are known. Therefore to study entanglement in larger Hilbert spaces, techniques from tensor decomposition and asymptotic geometry of tensors have been recently introduced. These techniques establish new connections between entanglement and algebraic complexity theory. This minisymposium on applications of algebraic geometry to quantum information will propose talks by mathematicians and physicists who have been studying entanglement from a geometrical perspective with classical and more recent techniques.

Organizers: Frédéric Holweck (University of Bourgogne Franche-Comté)

Tensor rank, border rank, multiplicativity and entanglement
Fulvio Gesmundo (University of Copenhagen)

Hyperdeterminants form E_8
Luke Oeding (Auburn University)

Tensor network representations from the geometry of entangled states
Matthias Christandl (University of Copenhagen)

Tensor scaling, quantum marginals, and moment polytopes
Michael Walter (University of Amsterdam)

MS173, part 2: Numerical methods in algebraic geometry

Friday, July 12, 10:00–12:00
Room: Unitobler, F012

This minisymposium is meant to report on recent advances in using numerical methods in algebraic geometry: the foundation of algebraic geometry is the solving of systems of polynomial equations. When the equations to be considered are defined over a subfield of the complex numbers, numerical methods can be used to perform algebraic geometric computations forming the area of numerical algebraic geometry (NAG). Applications which have driven the development of this field include chemical and biological reaction networks, robotics and kinematics, algebraic statistics, and tropical geometry. The minisymposium will feature a diverse set of talks, ranging from the application of NAG to problems in either theory and practice, to discussions on how to implement new insights from numerical mathematics to improve existing methods.

Organizers: Jose Israel Rodriguez (UW Madison, United States of America) and Paul Breiding (MPI MiS)

Numerical Root Finding via Cox Rings
Simon Telen (KU Leuven)

Numerical computation of monodromy action over R
Margaret Regan (University of Notre Dame)

Adaptive step size control for homotopy continuation methods
Sascha Timme (TU Berlin)

Numerical homotopies from Khovanskii bases
Elise Walker (Texas A&M)

MS174, part 2: Algebraic aspects of biochemical reaction networks

Friday, July 12, 10:00–12:00
Room: Unitobler, F-105

ODE models for biochemical reaction networks usually give rise to dynamical systems defined by polynomial or rational functions. These systems are often high-dimensional, very sparse, and involve many parameters. This minisymposium deals with recent progress on applying and adapting techniques from (real) algebraic geometry and computational algebra for analyzing such systems. The minisymposium consists of three parts focusing on positive steady states, multistationarity and the corresponding parameter regions, and dynamical aspects.

Organizers: Alicia Dickenstein (Universidad de Buenos Aires) and Georg Regensburger (Johannes Kepler University Linz)

Expected number of positive real solutions to systems of polynomial equations arising from reaction networks
AmirHosein Sadeghimanesh (University of Copenhagen)

Absolute concentration robustness: an algebraic perspective
Anne Shiu (Texas A&M University)

On the Stability of the Steady States in the n-site Futile Cycle
Carsten Wiuf (University of Copenhagen)

The DSR graph and dynamical properties of reaction networks
Casian Pantea (West Virginia University)

MS179, part 1: Algebraic methods for polynomial system solving

Friday, July 12, 10:00–12:00
Room: Unitobler, F021

Polynomial system solving is at the heart of computational algebra and computational algebraic geometry. It arises in many applications ranging from computer security and coding theory (where computations must be done over finite fields) and engineering sciences such as chemistry, biology, signal theory or robotics among many others (here computations are done over inifinite domains such as complex or real numbers). The need of reliable algorithms for solving these problems is prominent because of the non-linear nature of the problems we have in hand.

Algebraic methods provide a nice framework for designing efficient and reliable algorithms solving polynoial systems. This mini-symposium will cover many aspects of this topic, including design of symbolic computation algorithms as well as the use of numerical methods in this framework with an emphasis on reliability.

Organizers: Mohab Safey El Din (Sorbonne Université, France) and Éric Schost (University of Waterloo)

Exploiting fast linear algebra in the computation of multivariate relations
Vincent Neiger (Univ. Limoges)

Certification via squaring-up
Timothy Duff (Georgia Tech)

Efficient and complete certification of roots in solving polynomial systems
Michael Burr (Clemson Univ.)

Reconstruction of an Algebraic Surface from a 2D Projection
Joseph Schicho (Johannes Kepler Univ.)

MS180, part 2: Network coding and subspace designs

Friday, July 12, 10:00–12:00
Room: Unitobler, F-113

This symposium collects presentations about results on codes for linear network coding, either in the rank metric or in the subspace metric. Codes in the rank metric are usually subsets of the matrix space $\mathbb{F}_q^{m\times n}$, where $\mathbb{F}_q$ is a finite field; codes in the subspace metric are usually subsets of a finite Grassmann variety. Many interesting questions arise in this topic, e.g., about good packings in these two spaces, as well as fast encoding and decoding algorithms.

Organizers: Daniele Bartoli (University of Perugia) and Anna-Lena Horlemann-Trautmann (University of St. Gallen, Switzerland)

Sum-Rank Codes and Linearized Reed-Solomon Codes
Umberto Martinez-Penas (University of Toronto)

On some automorphisms of polynomial rings and their applications in rank metric codes
Tovohery Randrianarisoa (IIT Bombay)

Invariants of rank-metric codes via Galois group action
Alessandro Neri (University of Zurich)

MS181, part 2: Integral and algebraic geometric methods in the study of Gaussian random fields

Friday, July 12, 10:00–12:00
Room: Unitobler, F007

Integral and algebraic geometry are at the heart of a number of contributions pertaining to the study of Gaussian random fields and related topics, not only from probabilistic and statistical viewpoints but also from the realm of interpolation and function approximation. This minisymposium will gather a team of junior researchers and established experts presenting original research results reflecting diverse challenges of geometrical and applied geometrical nature primarily involving Gaussian fields.

These encompass the study of geometrical and topological properties of sets implicitly defined by random fields such as zeros of random polynomials, excursion sets, as well as integral curves stemming for instance from filament estimation. Also, Gaussian field approximations dedicated to the estimation of excursion probabilities and more general geometric questions will be tackled, as well as algebraic methods in sparse grids for polynomial and Gaussian process interpolation.

Organizers: David Ginsbourger (Idiap Research Institute and University of Bern, Switzerland) and Jean-Marc Azaïs (Institut de Mathématiques de Toulouse)

On some Karhunen-Loève expansions related to two-point homogeneous spaces
Jean-Renaud Pycke (Université d'Évry Val d'Essonne)

Geometry-driven finite-rank approximations of Gaussian random fields
Cédric Travelletti (Idiap Research Institute and University of Bern), David Ginsbourger (Idiap Research Institute and Unversity of Bern), and Dario Azzimonti (Istituto "Dalle Molle" di Studi sull'Intelligenza Artificiale)

Algebraic methods in sparse grids for interpolation
Henry Wynn (London School of Economics) and Hugo Maruri-Aguilar (Queen Mary University of London)

MS185, part 2: Algebraic Geometry Codes

Friday, July 12, 10:00–12:00
Room: Unitobler, F-122

The problem of finding good codes is central to the theory of error correcting codes. For many years coding theorists have addressed this problem by adding algebraic and combinatorial structure to C.

In the early 80s Goppa used algebraic curves to construct linear error correcting codes, the socalled algebraic geometric codes (AG codes). The construction of an AG code with alphabet a finite field $\mathbb{F}_q$ requires that the underlying curve is $\mathbb{F}_q$-rational and involves two $\mathbb{F}_q$-rational divisors D and G on the curve.

In this minisymposium we will present results on Algebraic Geometry codes and their performances.

Organizers: Daniele Bartoli (Univerity of Perugia, Italy) and Anna-Lena Horlemann (University of St. Gallen)

Algebraic Geometric Codes on Hirzebruch surfaces
Jade Nardi (University of Toulouse)

Codes and gap sequences of Hermitian curves
Marco Timpanella (University of Basilicata)

On the weight distribution of dual AG codes from the GK curve
Matteo Bonini (University of Trento)

Subcovers and codes on a class of trace-defining curves
Herivelto Borges (University of Sao Paolo)

MS198: Positive and negative association

Friday, July 12, 10:00–12:00
Room: Unitobler, F-121

Positive and negative association form strong and useful conditions on probability distributions that appear in several applications. Algebraic and combinatorial methods have led to methods for understanding and sampling from important classes of these distributions. This session aims to explore some of the recent breakthroughs and applications of positive and negative association.

Organizers: Caroline Uhler (MIT) and Cynthia Vinzant (North Carolina State)

Negative dependence and sampling
Stephanie Jegelka (MIT)

Log-concave polynomials: Polynomials that a drunkard can (almost) evaluate
Nima Anari (Stanford), Kuikui Liu (U. Washington), Shayan Oveis Gharan (U. Washington), and Cynthia Vinzant (North Carolina State)

Total positivity in structured binary distributions
Steffen Lauritzen (University of Copenhagen), Caroline Uhler (MIT), and Piotr Zwiernik (Universitat Pompeu Fabra)

Geometric problems in nonparametric statistics
Elina Robeva (MIT), *Bernd Sturmfels* (MPI Leipzig, UC Berkeley), Ngoc Tran (U Texas, Austin), and Caroline Uhler (MIT)

IP08: Jeremy Gunawardena: Some mathematical aspects of gene regulation

Friday, July 12, 13:30–14:30
Room: vonRoll, Fabrikstr. 6, 001
Streamed to: vonRoll, Fabrikstr. 6, 004

The "linear framework" describes biochemical systems under timescale separation in terms of a finite directed graph with labelled edges. When applied to gene regulation, the framework gives a gene's input-output response as a rational function of the graph labels. The sharpness of the response, or the sensitivity of output to changes in inputs, is important for understanding how gene-regulatory mechanisms control the the development of the organism during ontogeny as well as how such mechanisms evolve during phylogeny. We outline some mathematical problems relating to the sharpness of genetic input-output responses, with a focus on the role of energy expenditure away from thermodynamic equilibrium.

Speaker: Jeremy Gunawardena (Harvard Medical School, United States of America)

Coffee break

Friday, July 12, 14:30–15:00
Room: Unitobler, F wing, floors 0 and -1

MS127, part 1: The algebra and geometry of tensors 2: structured tensors

Friday, July 12, 15:00–17:00
Room: Unitobler, F023

Tensors are ubiquitous in mathematics and science. Tensor decompositions and approximations are an important tool in artificial intelligence, chemometrics, complexity theory, signal processing, statistics, and quantum information theory. Often, due to the nature of the problem under investigation, it might be natural to consider tensors equipped with additional structures or might be useful to consider tensor decompositions which respect particular structures. Among many interesting constructions, we might think of: symmetric, partially-symmetric and skew-symmetric tensors; tensor networks; Hadamard products of tensors or non-negative ranks. This minisymposium focuses on how exploiting these additional structures from algebraic and geometric perspectives recently gave new tools to study these special classes of tensors and decompositions. This is a sister minisymposium to "The algebra and geometry of tensors 1: general tensors" organized by Y. Qi and N. Vannieuwenhoven.

Organizers: Elena Angelini (Università degli studi di Siena), Enrico Carlini (Politecnico di Torino), and Alessandro Oneto (Barcelona Graduate School of Mathematics)

Projective geometry and tensor identifiability
Massimiliano Mella (Università di Ferrara)

A bound for the Waring rank of the determinant via syzygies
Zach Teitler (Boise State University)

On the identifiability of ternary forms
Luca Chiantini (Università degli studi di Siena)

Real Waring Rank Geometry of Quaternary Forms
Hyunsuk Moon (National Institute for Mathematical Sciences)

MS129, part 1: Sparsity in polynomial systems and applications

Friday, July 12, 15:00–17:00
Room: Unitobler, F022

In this session we bring together researchers working in different areas involving sparsity in applications and sparse polynomial systems. The principle of sparsity is to represent a structure by functions, e.g., polynomials, with as few variables or terms as possible. It is ubiquitous in various areas and problems, where algebra and geometry play a key role. Recently, it has been succesfully applied to problems such as sparse interpolation, polynomial optimization, sparse elimination, fewnomial theory, or tensor decomposition.

This minisymposium provides an opportunity to learn about a selection of these recent developments and explore new potential applications of sparsity.

Organizers: Timo de Wolff (Technische Universität Berlin, Germany) and Mareike Dressler (University of California, San Diego)

Optimal Descartes' rule of signs for polynomial systems supported on circuits
Frédéric Bihan (Université Savoie Mont Blanc, France), Alicia Dickenstein (Universidad de Buenos Aires, Argentina), and Jens Forsgaard (Universiteit Utrecht, The Netherlands)

Polyhedral Approximations to the Cone of Nonnegative Polynomials
Alperen Ergür (Technische Universität Berlin, Germany)

Nonegativity and Discriminants
Jens Forsgaard (Universiteit Utrecht, The Netherlands) and Timo de Wolff (Technische Universität Berlin, Germany)

Exploiting Sparsity for Semi-Algebraic Set Volume Computation
Jean-Bernard Lasserre (CNRS-LAAS, Toulouse, France), Matteo Tacchi (CNRS-LAAS, Toulouse, France), Tillmann Weisser (Los Alamos National Lab, NM, USA), and Didier Henrion (CNRS-LAAS, Toulouse, France)

MS131, part 1: Computations in algebraic geometry

Friday, July 12, 15:00–17:00
Room: Unitobler, F005

This minisymposium highlights the use of computation inside algebraic geometry. Computations enter algebraic geometry in several different ways including numerical strategies, symbolic calculations, experimentation, and simply as a fundamental conceptual tool. Our speakers will showcase many of these aspects together with some applications.

Organizers: Diane Maclagan (University of Warwick) and Gregory G. Smith (Queen's University)

Regularity of S_n-invariant monomial ideals
Claudiu Raicu (University of Notre Dame)

A homological approach to numerical Godeaux surfaces
Wolfram Decker (University of Kaiserslautern)

Asymptotic syzygies for products of projective space
Juliette Bruce (University of Wisconsin)

Where can toric syzygies live?
Milena Hering (University of Edinburgh)

MS134, part 6: Coding theory and cryptography

Friday, July 12, 15:00–17:00
Room: Unitobler, F-122

The focus of this minisymposium is on coding theory and cryptography, with emphasis on the algebraic aspects of these two research fields. Error-correcting codes are mathematical objects that allow reliable communications over noisy/lossy/adversarial channels. Constructing good codes and designing efficient decoding algorithms for them often reduces to solving algebra problems, such as counting rational points on curves, solving equations, and classifying finite rings and modules. Cryptosystems can be roughly defined as functions that are easy to evaluate, but whose inverse is difficult to compute in practice. These functions are in general constructed using algebraic objects and tools, such as polynomials, algebraic varieties, and groups. The security of the resulting cryptosystem heavily relies on the mathematical properties of these. The sessions we propose feature experts of algebraic methods in coding theory and cryptography. All levels of experience are represented, from junior to very experienced researchers.

Organizers: Alessio Caminata (University of Neuchâtel, Switzerland) and Alberto Ravagnani (University College Dublin, Ireland)

New results on graph-based codes
Christine Kelley (University of Nebraska-Lincoln)

Large constant dimension subspace codes consisting of k-dimensional subspaces, pairwise intersecting in at least $(k-2)$-dimensional subspaces
Leo Storme (Ghent University)

Algebraic properties of codes with symmetries
Martino Borello (Université Paris 8 - LAGA)

Quantum codes coming from J-affine variety codes
Carlos Galindo (Universidad Jaume I)

MS136, part 2: Syzygies and applications to geometry

Friday, July 12, 15:00–17:00
Room: Unitobler, F-107

In this minisymposium, titled "Syzygies and applications to geometry", we will focus on the striking results and applications that the study of syzygies provides in algebraic geometry, in a wide sense. Topics should include but are not limited to the study of rational and birational maps, singularities, residual intersections and the defining equations of blow-up algebras. We plan to focus on recent progress in this area that result in explicit and effective computations to detect certain geometrical property or invariant. Applications to geometric modeling are very welcome.

Organizers: Laurent Busé (INRIA Sophia Antipolis), Yairon Cid Ruiz (Universitat de Barcelona), and Carlos D'Andrea (Universitat de Barcelona)

Implicitization of Tensor Product Surfaces via Virtual Projective Resolutions (Part I)
Alexandra Seceleneau (University of Nebraska-Lincoln)

Implicitization of Tensor Product Surfaces via Virtual Projective Resolutions (Part II)
Eliana Duarte (Otto-von-Guericke Universität Magdeburg)

The Hilbert quasipolynomial of a polynomial ring and generating functions related the Frobenius complexity for various classes of singularities
Florian Enescu (Georgia State University)

Generalized Stanley-Reisner rings
Nelly Villamizar (Swansea University)

MS137, part 3: Symbolic Combinatorics

Friday, July 12, 15:00–17:00
Room: Unitobler, F-112

In recent years algorithms and software have been developed that allow researchers to discover and verify combinatorial identities as well as understand analytic and algebraic properties of generating functions. The interaction of combinatorics and symbolic computation has had a beneficial impact on both fields. This minisymposium will feature 12 speakers describing recent research combining these areas.

Organizers: Shaoshi Chen (Chinese Academy of Sciences), Manuel Kauers (Johannes Kepler University, Linz, Austria), and Stephen Melczer (University of Pennsylvania)

Polynomial Reduction and Super Congruences
Qing-Hu Hou (Tianjin University)

Diagonals, determinants, and rigidity
Christoph Koutschan (Radon Institute for Computational and Applied Mathematics)

Central Limit Theorems from the Location of Roots of Probability Generating Functions
Marcus Michelen (University of Pennsilvania)

Periodic Pólya urns and an application to Young tableaux
Michael Wallner (TU Wien)

MS139, part 2: Combinatorics and algorithms in decision and reason

Friday, July 12, 15:00–17:00
Room: Unitobler, F-121

Combinatorial, or discrete, structures are a fundamental tool for modeling decision-making processes in a wide variety of fields including machine learning, biology, economics, sociology, and causality. Within these various contexts, the goal of key problems can often be phrased in terms of learning or manipulating a combinatorial object, such as a network, permutation, or directed acyclic graph, that exhibits pre-specified optimal features. In recent decades, major break-throughs in each of these fields can be attributed to the development of effective algorithms for learning and analyzing combinatorial models. Many of these advancements are tied to new developments connecting combinatorics, algebra, geometry, and statistics, particularly through the introduction of geometric and algebraic techniques to the development of combinatorial algorithms. The goal of this session is to bring together researchers from each of these fields who are using combinatorial or discrete models in data science so as to encourage further breakthroughs in this important area of mathematical research.

Organizers: Liam Solus (KTH Royal Institute of Technology, Sweden) and Svante Linusson (KTH Royal Institute of Technology)

On the Graphs of Graphical Models
Rina Dechter (Donald Bren School of Information and Computer Sciences, UC Irvine)

Causal Inference with Unknown Intervention Targets
Yuhao Wang (Massachusetts Institute of Technology)

On attempts to characterize facets of the chordal graph polytope
Milan Studeny (Academy of Sciences of the Czech Republic)

MS154, part 4: New developments in matroid theory

Friday, July 12, 15:00–17:00
Room: Unitobler, F-106

The interactions between Matroid Theory, Algebra, Geometry, and Topology have long been deep and fruitful. Pertinent examples of such interactions include breakthrough results such as the g-Theorem of Billera, Lee and Stanley (1979); the proof that complements of finite complex reflection arrangements are aspherical by Bessis (2014); and, very recently, the proof of Rota's log-concavity conjecture by Adiprasito, Huh, and Katz (2015).

The proposed mini-symposia will focus on the new exciting development in Matroid Theory such as the role played by Bergman fans in tropical geometry, several results on matroids over a commutative ring and over an hyperfield, and the new improvement in valuated matroids and about toric arrangements. We plan to bring together researchers with diverse expertise, mostly from Europe but also from US and Japan. We are going to include a number of postdocs and junior mathematicians.

Organizers: Alex FInk (Queen Mary), Ivan Martino (Northeastern University, United States of America), and Luca Moci (Bologna)

Gain matroids and their applications
Viktoria Kasznitzky (Eötvös Loránd University)

Matroid threshold hypergraphs
José Alejandro Samper (Miami)

Whitney Numbers for Cones
Galen Dorpalen-Barry (Minnesota)

MS155, part 2: Massively parallel computations in algebraic geometry

Friday, July 12, 15:00–17:00
Room: Unitobler, F-113

Massively parallel methods have been a success story in high performance numerical simulation, but so far have rarely been used in computational algebraic geometry. Recent developments like the combination of the parallelization framework GPI-Space with the computer algebra system Singular have made such approaches accessible to the mathematician without the need to deal with a multitude of technical details. The minisymposium aims at bringing together researchers pioneering this approach, discussing the current state of the art and possible future developments. We plan to address applications in classical algebraic geometry, tropical geometry, geometric invariant theory and links to high energy physics.

Organizers: Janko Böhm (TU Kaiserlautern, Germany) and Anne Frühbis-Krüger (Leibniz Universität Hannover)

Tools for perturbative calculations from algebraic geometry
Alessandro Georgoudis (Uppsala University)

A massively parallel fan traversal with applications to geometric invariant theory
Christian Reinbold (TU Munich)

Parallel algorithms for computing tropical varieties with symmetry
Dominik Bendle (TU Kaiserslautern)

Space sextics and their tritangents
Yue Ren (MPI Leipzig)

MS158, part 2: Structured sums of squares

Friday, July 12, 15:00–17:00
Room: Unitobler, F021

A description of a nonnegative polynomial as a sum of squares gives a concise proof of its nonnegativity. Computationally, such sum-of-squares decompositions are appealing because we can search for them by solving a semidefinite feasibility problem. This connection means that optimization and decision problems arising in a range of areas, from robotics to extremal combinatorics, can be reformulated as, or approximated with, semidefinite optimization problems.

This minisymposium highlights the roles of various kinds of additional structures, including symmetry and sparsity, in understanding when (structured) sum of squares decompositions do and do not exist. It will also showcase interesting connections between sums of squares and a range of areas, such as extremal combinatorics, logic, dynamical systems and control, and algorithms and complexity theory.

Organizers: James Saunderson (Monash University, Australia) and Mauricio Velasco (Universidad de los Andes)

Simple Graph Density Inequalities with no Sum of Squares Proofs
Annie Raymond (University of Massachusetts Amherst), Greg Blekherman (Georgia Institute of Technology), Mohit Singh (Georgia Institute of Technology), and Rekha Thomas (University of Washington)

Symmetry and Nonnegativity
Greg Blekherman (Georgia Institute of Technology)

Symmetry and the Sum of Squares Hierarchy
Aaron Potechin (University of Chicago)

MS160, part 4: Numerical methods for structured polynomial system solving

Friday, July 12, 15:00–17:00
Room: Unitobler, F012

Improvements in the understanding of numerical methods for dense polynomial system solving led to the complete solution of Smale's 17th problem. At this point, it remains an open challenge to achieve the same success in the solution of structured polynomial systems: explain the typical behavior of current algorithms and devise polynomial-time algorithms for computing roots of polynomial systems. In this minisymposium, researchers will present the current progress on applying numerical methods to structured polynomial systems.

Organizers: Alperen Ergur (TU Berlin), Pierre Lairez (INRIA), Gregorio Malajovich (Universidade Federal do Rio de Janeiro, Brazil), and Josue Tonelli-Cueto (TU Berlin)

Numerical Schubert Calculus via the Littlewood-Richardson Homotopy Algorithm
Jan Verschelde (University of Illinois at Chicago), Anton Leykin (GeorgiaTech), Abraham Martín del Campo (CIMAT, Guanajuato), Frank Sottile (Texas A&M University), and Ravi Vakil (Stanford University)

Computing Verified Real Solutions of Polynomials Systems via Low-rank Moment Matrix Completion
Lihong Zhi (Academia Sinica), Yue Ma (Academia Sinica), and Zhengfeng Yang (Academia Sinica)

Computing the Canonical Polyadic Decomposition of Tensors with Damped Gauss-Newton Method
Felipe Diniz (Universidade Federal do Rio de Janeiro)

A most outrageous action
Gregorio Malajovich (Universidade Federal do Rio de Janeiro)

MS162, part 1: Applications of finite fields theory

Friday, July 12, 15:00–17:00
Room: Unitobler, F-123

The theory of finite fields is one of the most important meeting points of Algebraic Geometry, Computer Science, and Number Theory. One of the most important challenges in the area is to develope the theory of finite fields in connection with useful applications, in particular in secure communication, coding theory, and pseudorandom number generation. In this minysimposium we plan to bring together experts from many different areas of the mathematics of communication who share the common interest towards the theory of finite fields. Our main purpose is to provide an overview of some of the cutting-edge research in the field, and to lay the fundations for new collaborations among researchers interested in applications of the theory of finite fields.In the cryptographic setting, we focus on new post-quantum cryptographic schemes (Marco Baldi, Antoine Joux) and cryptanalysis (Gohar Kyureghyan, Yann Rotella). For pseudorandomness we propose construction of new pseudorandom generators (Federico Amadio Guidi, Laszlo Merai) and construction of polynomials over finite fields with given properties which are interesting for applications (Andrea Ferraguti).

Organizers: Antoine Joux (University of Sorbonne), Giacomo Micheli (EPFL), and Violetta Weger (University of Zurich, Switzerland)

Introductory Talk
Giacomo Micheli (EPFL)

Using Mersenne and Fermat numbers in Cryptosystems
Antoine Joux (University of Sorbonne)

Cryptographic attacks against filter generator using monomial mapping
Yann Rotella (Inria)

Permutation and complete rational functions via Chebotarev theorem for function fields
Andrea Ferraguti (Max Planck Institute for Mathmatics)

MS167, part 3: Computational tropical geometry

Friday, July 12, 15:00–17:00
Room: Unitobler, F013

This session will highlight recent advances in tropical geometry, algebra, and combinatorics, focusing on computational aspects and applications. The area enjoys close interactions with max-plus algebra, polyhedral geometry, combinatorics, Groebner theory, and numerical algebraic geometry.

Organizers: Kalina Mincheva (Yale University) and Yue Ren (Max Planck Institute for Mathematics in the Sciences, Germany)

Tropicalized quartics and curves of genus 3
Marvin Hahn (Goethe Universität Frankfurt), *Hannah Markwig* (Eberhard Karls Universität Tübingen), Yue Ren (Max Planck Institute for Mathematics in the Sciences, Germany), and Ilya Tyomkin (Ben Gurion University)

Tropical Jucys Covers and refined quasimodularity
Marvin Hahn (Goethe Universität Frankfurt), Felix Leid (Universität des Saarlandes), Danilo Lewanski (Max Planck Institute for Mathematics), and Jan-Willem van Ittersum (universiteit utrecht)

Tropical lines on tropical surfaces
Michael Joswig (Technische Universität Berlin), *Marta Panizzut* (Technische Universität Berlin), Bernd Sturmfels (Max Planck Institute for Mathematics in the Sciences, UC Berkeley), and Magnus Dehli Vigeland (University of Oslo)

Polyhedral tropical geometry of higher rank
Marcel Celaya (Georgia Tech) and Josephine Yu (Georgia Tech)

MS186, part 1: Algebraic vision

Friday, July 12, 15:00–17:00
Room: Unitobler, F011

There has been a burst of recent activity focused on the applications of modern abstract and numerical algebraic geometry to problems in computer vision, ranging from highly-optimized Gröbner-basis techniques, to homotopy continuation methods, to Ulrich sheaves and Chow forms, to functorial moduli theory. We will discuss this recent progress, with a focus on multiview geometry, both in theory and in practice.

Organizers: Max David Lieblich (University of Washington, United States of America), Tomas Pajdla (Czech Technical University in Prague), and Matthew Trager (Courant Institute of Mathematical Sciences at NYU)

"Real" Algebraic Vision
Sameer Agarwal (Google)

A geometric construction of the essential variety
Lucas Van Meter (University of Washington)

Classification of Point-Line Minimal Problems in Complete Multi-View Visibility
Timothy Duff (Georgia Tech), Kathlén Kohn (University of Oslo), Anton Leykin (Georgia Tech), *Tomas Pajdla* (CIIRC, CTU Prague)

MS189, part 2: Geometry and topology in applications.

Friday, July 12, 15:00–17:00
Room: Unitobler, F006
This symppsium will bring together leading practitioners, mid-carreer scientists as well as PhD students and postdoctoral fellows who are interested in the theory and practice of the applications of geometry and topology in real life problems. The spectrum of possible applications is very wide, and covers the sciences, biology, medicine, materials science, and many others. The talks will address the theoretical foundations of the methodology as well as the state of the art of geometric and topological modelling.

Organizers: Jacek Brodzki (University of Southampton, United Kingdom) and Heather Harrington (University of Oxford)

Persistent Betti numbers of random Cech complexes
Florian Pausinger (Queen's Univeristy Belfast)

Topological Analyses of Time Series
Nikki Sanderson (Lawrence Berkeley National Laboratory)

On the Robustness of the Homological Scaffold
Francesco Vaccarino (Politecnico di Torino)

Stable and discriminative topological invariants
Martina Scolamiero (KTH)

MS193: Algebraic geometry, data science and fundamental physics

Friday, July 12, 15:00–17:00
Room: Unitobler, F-111
There has been an increasing interaction between computational algebraic geometry, data science and fundamental theoretical physics.

This is rooted in the tradition that the 2 pillars of theoretical physics- general relativity and the standard model of particle physics, as well as their best candiate unified theory of superstrings - are physical realizations of the study of gauge connections and Riemannian metrics on manifolds.

In the last couple of years, problems such as mapping the Calabi-Yau landscape, translating problems in particle theory to precise problems in algebraic and differential geometry, using the latest techniques in machine-learning, etc., have taken off in the theoretical physics community.

This session in SIAM AG 2019 is a perfect venue for further explorations.

Organizers: Yang-Hui He (City, University of London, Oxford University & Nankai), Fabian Ruehle (CERN & Oxford University), and Heather Harrington (Oxford University)

The Calabi-Yau landscape & machine learning
Yang-Hui He (City, University of London, Oxford University & Nankai)

Machine Learning for String Vacua
Fabian Ruehle (CERN & Oxford University)

Knot Theory and Machine Learning
Jim Halverson (Northeastern)

Machine-learning a virus assembly fitness landscape
Pierre-Philippe Dechant (York St John)

MS200, part 4: From algebraic geometry to geometric topology: Crossroads on applications

Friday, July 12, 15:00–17:00
Room: Unitobler, F007
The purpose of this minisymposium is to bring together researchers who use algebraic, combinatorial and geometric topology in industrial and applied mathematics. These methods have already seen applications in: biology, physics, chemistry, fluid dynamics, distributed computing, robotics, neural networks and data analysis.

Organizers: Jose Carlos Gomez Larrañaga (CIMAT), Renzo Ricca (University of Milano-Bicocca), and De Witt Sumners (Florida State University)

Reconnection in Biology and Physics
De Witt Sumners (FSU)

On the real geometric hypothesis of Banach
Luis Montejano (UNAM)

The Cucker-Smale flocking model on manifolds: Geometric & topological effects, and flocking realizability
Franz Wilhelm Schlöder (University of Milano-Bicocca)

Topological modeling of local reconnection
Mariel Vazquez (UC davis)

SI(AG)^2 business meeting

Friday, July 12, 17:15–19:00
Room: vonRoll, Fabrikstr. 6, 001 For all members of SI(AG)^2.

Saturday, July 13

Announcements

Saturday, July 13, 08:25–08:30
Room: vonRoll, Fabrikstr. 6, 001

IP09: Mauricio Velasco: Extremal properties of 2-regular varieties

Saturday, July 13, 08:30–09:30
Room: vonRoll, Fabrikstr. 6, 001
Streamed to: vonRoll, Fabrikstr. 6, 004

A projective variety is called two regular if it is defined by quadrics and all matrices in the minimal free resolutions of its homogeneous coordinate ring have linear entries. In an objective sense these are "the simplest" projective varieties and perhaps for this very reason they are ubiquitous in algebraic geometry. In this talk I will explain several novel contexts of interest for the SIAGA community where these varieties play a prominent role. In the process we will describe other properties which characterize two-regular varieties highlighting the fruitful interplay between classical and convex algebraic geometry.

Speaker: Mauricio Velasco (Universidad de los Andes, Colombia)

Coffee break

Saturday, July 13, 09:30–10:00
Room: Unitobler, F wing, floors 0 and -1

MS127, part 2: The algebra and geometry of tensors 2: structured tensors

Saturday, July 13, 10:00–12:00
Room: Unitobler, F023
Tensors are ubiquitous in mathematics and science. Tensor decompositions and approximations are an important tool in artificial intelligence, chemometrics, complexity theory, signal processing, statistics, and quantum information theory. Often, due to the nature of the problem under investigation, it might be natural to consider tensors equipped with additional structures or might be useful to consider tensor decompositions which respect particular structures. Among many interesting constructions, we might think of: symmetric, partially-symmetric and skew-symmetric tensors; tensor networks; Hadamard products of tensors or non-negative ranks. This minisymposium focuses on how exploiting these additional structures from algebraic and geometric perspectives recently gave new tools to study these special classes of tensors and decompositions. This is a sister minisymposium to "The algebra and geometry of tensors 1: general tensors" organized by Y. Qi and N. Vannieuwenhoven.

Organizers: Elena Angelini (Università degli studi di Siena), Enrico Carlini (Politecnico di Torino), and Alessandro Oneto (Humboldt Fundation, and Otto-von-Guericke-Universität Magdeburg)

The monic rank
Jan Draisma (Universität Bern)

The average condition number of tensor rank decomposition is infinite
Nick Vannieuwenhoven (KU Leuven)

Symmetry groups of tensors
Emanuele Ventura (Texas A&M)

On the rank preserving property of linear sections and its applications in tensors
Yang Qi (University of Chicago)

MS128, part 2: Symbolic-numeric methods for non-linear equations: Algorithms and applications

Saturday, July 13, 10:00–12:00
Room: Unitobler, F-112
Modeling real-world systems or processes in areas such as control theory, geometric modeling, biochemistry, coding theory, cryptology, and so on, almost certainly involves non-linear equations. Higher degree equations are the first step away from linear models. Available tools for recovering their solutions range from numerical methods such as Newton-Raphson, homotopy continuation algorithms, subdivision-based solvers, to symbolic tools such as Groebner bases, border bases, characteristic sets and multivariate resultants. There is continuous progress in combining symbolic methods and numerical solving, in order to devise new algorithms with varying blends of exactness, stability and robustness as well as computational complexity, that are tailored for different applications. Among the challenges which occur in the process is reliable root isolation, certification and approximation, treatment of singular solutions, the exploitation of structure coming from specific applications as well as efficient interpolation. The mini-symposium will host presentations related to state-of-the-art solution strategies for these problems, theoretical and algorithmic advances as well as emerging application areas.

Organizers: Angelos Mantzaflaris (Inria, France), Bernard Mourrain (Inria, France), and Elias Tsigaridas (Inria, France)

On hybrid univariate polynomial root-finders
Victor Pan (Lehman College CUNY)

A robust path tracking algorithm for polynomial homotopy continuation
Marc Van Barel (KU Leuven), Simon Telen (KU Leuven), and Jan Verschelde (University of Illinois at Chicago)

On the relationship of well conditioned polynomials and elliptic Fekete points
Jinsan Cheng (Chinese Academy of Mathematics and Systems Science) and Junyi Wen (Chinese Academy of Mathematics and Systems Science)

A sequence of polynomials with optimal condition number
Maria De Ujue Etayo Rodriguez (University of Cantabria), Carlos Beltrán (University of Cantabria), Jordi Marzo (University of Cantabria), and Joaquim Ortega-Cerdà (University of Cantabria)

MS130, part 4: Polynomial optimization and its applications

Saturday, July 13, 10:00–12:00
Room: Unitobler, F022
The importance of polynomial (aka semi-algebraic) optimization is highlighted by the large number of its interactions with different research domains of mathematical sciences. These include, but are not limited to, automatic control, combinatorics, and quantum information. The mini-symposium will focus on the development of methods and algorithms dedicated to the general polynomial optimization problem. Both the theoretical and more applicative viewpoints will be covered.

Organizers: Timo de Wolff (Technische Universität Berlin, Germany), Simone Naldi (Université de Limoges, France), and João Gouveia (Universidade de Coimbra, Portugal)

Tighter bounds through rank-one convexification
Tillmann Weisser (Los Alamos National Lab, NM, USA), Sidhant Misra (Los Alamos National Laboratory, Los Alamos, NM, USA), and Hassan Hijzai (Los Alamos National Laboratory, Los Alamos, NM, USA)

Sieve-SDP: a simple facial reduction algorithm to preprocess semidefinite programs
Yuzixuan Zhu (University of North Carolina at Chapel Hill, NC, USA), Pataki Gabor (University of North Carolina at Chapel Hill, NC, USA), and Tran-Dinh Quoc (University of North Carolina at Chapel Hill, NC, USA)

Phaseless rank
António Goucha (Universidade de Coimbra) and João Gouveia (Universidade de Coimbra, Portugal)

Log-concave polynomials, entropy, and approximate counting
Cynthia Vinzant (North Carolina State University, NC, USA), Nima Anari (Stanford University, CA, USA), Kuikui Liu (University of Washington, Seattle, WA, USA), and Shayan Oveis Gharan (University of Washington, Seattle, WA, USA)

MS141, part 2: Chip-firing and tropical curves

Saturday, July 13, 10:00–12:00
Room: Unitobler, F013
The chip-firing game on metric graphs is a simple combinatorial model that serves as a tropical analogue of divisor theory on algebraic curves, and it has been an active and fruitful research direction over the last decade. The behaviors of chip-firing resemble, but not always completely match, the classical situation in algebraic geometry. So on one hand, chip-firing can often be used to prove results (old and new) in algebraic geometry; while on the other hand, the combinatorics of chip-firing is interesting and surprising in its own right. We will focus on three main topics: (I) Tropical analogues (or failure thereof) of classical results of algebraic curves, (II) applications of chip-firing in algebraic geometry and other subjects, and (III) complexity issues of computational problems related to chip-firing.

Organizers: Chi Ho Yuen (University of Bern) and Alejandro Vargas (University of Bern)

Chip-firing and the tropical inverse problem
Dhruv Ranganathan (University of Cambridge)

Tropical Prym Varieties
Yoav Len (Georgia Institute of Technology)

Equidistribution of tropical Weierstrass points
Harry Richman (University of Michigan)

Submodular functions in tropical geometry: the existence of semibreak divisors
Lilla Tóthmérész (Eötvös Loránd University)

MS145, part 4: Isogenies in Cryptography

Saturday, July 13, 10:00–12:00
Room: Unitobler, F-123

The isogeny graph of elliptic curves over finite fields has long been a subject of study in algebraic geometry and number theory. During the past 10 years several authors have shown multiple applications in cryptology. One interesting feature is that systems built on isogenies seem to resist attacks by quantum computers, making them the most recent family of cryptosystems studied in post-quantum cryptography.

This mini-symposium brings together presentations on cryptosystems built on top of isogenies, their use in applications, and different approaches to the cryptanalysis, including quantum cryptanalysis.

Organizers: Tanja Lange (Eindhoven University of Technology, Netherlands, The), Chloe Martindale (Eindhoven University of Technology, Netherlands, The), and Lorenz Panny (Eindhoven University of Technology, Netherlands, The)

Post-quantum signature schemes and more from supersingular isogenies
Ward Beullens (KU Leuven)

Algorithmic aspects of cryptographic invariant maps from isogenies
Florian Hess (University of Oldenburg)

Verifiable Delay Functions from Isogenies and Pairings
Luca De Feo (Ecole Polytechnique)

Cryptographic goals beyond key exchange and signatures
Jeff Burdges (GNUnet)

MS146, part 3: Random geometry and topology

Saturday, July 13, 10:00–12:00
Room: Unitobler, F006

This minisymposium is meant to report on the recent activity in the field of random geometry and topology. The idea behind the field is summarized as follows: take a geometric or topological quantity associated to a set of instances, endow the space of instances with a probability distribution and compute the expected value, the variance or deviation inequalities of the quantity. The most prominent example of this is probably Kostlan, Shub and Smales celebrated result on the expected number of real zeros of a real polynomial. Random geometry and topology offers a fresh view on classical mathematical problems. At the same time, since randomness is inherent to models of the physical, biological, and social world, the field comes with a direct link to applications.

Organizers: Paul Breiding (Max-Planck Institute for Mathematics in the Sciences, Germany), Lerario Antonio (SISSA), Lundberg Erik (Florida Atlantic University), and Kozhasov Khazhgali (Max-Planck Institute for Mathematics in the Sciences, Germany)

The integer homology threshold for random simplicial complexes
Andrew Newman (TU Berlin)

The real tau-conjecture is true on average
Peter Bürgisser (TU Berlin)

Geometric limit theorems in topological data analysis
Christian Lehn (Universität Chemnitz)

Quantitative Singularity theory for Random Polynomials
Hanieh Keneshlou (MPI MiS Leipzig)

MS159: Intersections in practice

Saturday, July 13, 10:00–12:00
Room: Unitobler, F-107

This mini-symposium will focus on practical computational methods in intersection theory and their applications. At its most basic, intersection theory gives a means to study the geometric and enumerative properties of intersections of two varieties within another. These questions are fundamental to both algebraic geometry and its applications. Fulton-MacPherson intersection theory provides a powerful toolset with which to study these intersections; however, many mathematical objects which are needed in this framework have long been computationally inaccessible. This barrier has limited the use of these ideas in computations and applications. In recent years several new and computable expressions for Segre classes, Polar classes, Euler characteristics, Euler obstructions, and other fundamental objects in intersection theory have been developed. This has led to a variety of computationally effective symbolic and numeric algorithms and opened the way for ideas from intersection theory to be applied to solve both mathematical and scientific problems. Some of this recent work will be highlighted in this mini-symposium. The first talk in the session will be an introductory talk, which will demonstrate the natural relations between intersection theory and numerical algebraic geometry and will highlight how intersection theory can be applied to solve classical problems such as testing ideal membership (without computing a Groebner basis). Subsequent talks will explore computational aspects of intersection theory in more detail and will highlight their practical applications.

Organizers: Martin Helmer (Australian National University)

Segre-driven ideal membership testing
Martin Helmer (Australian National University)

The bottleneck degree of a variety
Sandra Di Rocco (KTH Royal Institute of Technology in Stockholm)

Symbolic Computation of Invariants of Local Rings
Mahrud Sayrafi (University of Minnesota)

MS164, part 3: Algebra, geometry, and combinatorics of subspace packings

Saturday, July 13, 10:00–12:00
Room: Unitobler, F-106

Frame theory studies special vector arrangements which arise in numerous signal processing applications. Over the last decade, the need for frame-theoretic research has grown alongside the emergence of new methods in signal processing. Modern advances in frame theory involve techniques from algebraic geometry, semidefinite programming, algebraic and geometric combinatorics, and representation theory. This minisymposium will explore a multitude of these algebraic, geometric, and combinatorial developments in frame theory.

The theme of the third session is "Numerical methods in line configurations and spectral decompositions."

Organizers: Emily Jeannette King (University of Bremen, Germany) and Dustin Mixon (Ohio State University)

k-point semidefinite programming bounds for equiangular lines
Fabrício Machado (Universidade de São Paulo)

Using quantum information techniques to find the number of mutually unbiased bases in any given dimension
Marcin Pawłoski (University of Gdansk)

Fourier expansions of discrepancy kernels
Martin Ehler (Universität Wien)

Detection of Ambiguities in Linear Arrays in Signal Processing
Frederic Matter (TU Damstadt)

MS169, part 2: Applications of Algebraic geometry to quantum information

Saturday, July 13, 10:00–12:00
Room: Unitobler, F-111

Quantum information science attempts to use quantum phenomena as non-classical resources to perform new communication protocols and develop new computational paradigms. The theoretical advantages of quantum communication and quantum algorithms were proved in the 80-90's and nowadays experimentalists are working on making that technology available. One of the quantum phenomena responsible for the speed up of quantum algorithms and the security of quantum communication is entanglement. A system of m-particules (a multipartite quantum state) is said to be entangled when the state of a particle of the system cannot be described independently of the others. Entanglement is a consequence of the superposition principle in quantum physics which mathematically translates to the fact that the Hilbert space of a composite system is the tensor product of the Hilbert space of each part. Algebraic geometry entered the study of entanglement of multipartite systems when it was both noticed in the early 2000s that the rank of tensors could be interpreted as a measure of entanglement and also that invariant theory could be used to distinguish different classes of entanglement. Since then a large amount of research has been produced in the mathematical-physics literature to classify and/or measure entanglement using techniques from classical invariant theory, representation theory, and geometric invariant theory. Because of the exponential growth of the dimension of the multipartite Hilbert spaces, when the number of factors increases, only a few examples of explicit classifications are known. Therefore to study entanglement in larger Hilbert spaces, techniques from tensor decomposition and asymptotic geometry of tensors have been recently introduced. These techniques establish new connections between entanglement and algebraic complexity theory.

This minisymposium on applications of algebraic geometry to quantum information will propose talks by mathematicians and physicists who have been studying entanglement from a geometrical perspective with classical and more recent techniques.

Organizers: Frédéric Holweck (University of Bourgogne Franche-Comté)

Quantum entanglement from single particle perspective
Adam Sawicki (Center for Theoretical Physics Polish Academy of Sciences)

Entanglement indicators for mixed three-qubit states
Szilárd Szalay (Wigner Research Centre for Physics of the Hungarian Academy of Sciences)

Non-displacable manifolds, mutually coherent and mutually entangled states
Karol Zyczkowski (Jagiellonian University)

Relating boundary entanglement to scattering data of the bulk in AdS_3/CFT_2
Péter Lévay (Budapest University of Technology and Economics)

MS171, part 1: Grassmann and flag manifolds in data analysis

Saturday, July 13, 10:00–12:00
Room: Unitobler, F007

A number of applications in large scale geometric data analysis can be expressed in terms of an optimization problem on a Grassmann or flag manifold.The solution of the optimization problem helps one to understand structure underlying a data set for the purposes such as classification, feature selection, and anomaly detection.

For example, given a collection of points on a Grassmann manifold, one could imagine finding a Schubert variety of best fit corresponds to minimizing some function on the flag variety parameterizing the given class of Schubert varieties.

A number of different algorithms that exist for points in a linear space have analogues for points in a Grassmann or flag manifold such as clustering, endmember detection, self organized mappings, etc.

The purpose of this minisymposium is to bring together researchers who share a common interest in algorithms and techniques involving Grassmann and Flag varieties applied to problems in data analysis.

Organizers: Chris Peterson (Colorado State University, United States of America), Michael Kirby (Colorado State University), and Javier Alvarez-Vizoso (Max-Planck Institute for Solar System Research in Göttingen)

PCA Integral Invariants for Manifold Learning
Javier Alvarez-Vizoso (Max-Planck Institute for Solar System Research in Göttingen)

Subspace Averaging in Multi-Sensor Array Processing
Ignacio Santamaria (Universidad de Cantabria), Louis Scharf (Colorado Statew University), Vaibhav Garg (Universidad de Cantabria), and David Ramirez (University Carlos III of Madrid)

Variations on Multidimensional Scaling for non-Euclidean Distance Matrices
Mark Blumstein (Colorado State University)

MS173, part 3: Numerical methods in algebraic geometry

Saturday, July 13, 10:00–12:00
Room: Unitobler, F012

This minisymposium is meant to report on recent advances in using numerical methods in algebraic geometry: the foundation of algebraic geometry is the solving of systems of polynomial equations. When the equations to be considered are defined over a subfield of the complex numbers, numerical methods can be used to perform algebraic geometric computations forming the area of numerical algebraic geometry (NAG). Applications which have driven the development of this field include chemical and biological reaction networks, robotics and kinematics, algebraic statistics, and tropical geometry. The minisymposium will feature a diverse set of talks, ranging from the application of NAG to problems in either theory and practice, to discussions on how to implement new insights from numerical mathematics to improve existing methods.

Organizers: Jose Israel Rodriguez (UW Madison, United States of America) and Paul Breiding (MPI MiS)

Certification of approximate roots of exact ill-posed polynomial systems
Agnes Szanto (NCSU)

Numerical Implicitization
Justin Chen (Georgia Tech)

The Distribution of Numbers of Operating Points of Power Networks
Julia Lindberg (Wisconsin Institute for Discovery)

MS174, part 3: Algebraic aspects of biochemical reaction networks

Saturday, July 13, 10:00–12:00
Room: Unitobler, F-105

ODE models for biochemical reaction networks usually give rise to dynamical systems defined by polynomial or rational functions. These systems are often high-dimensional, very sparse, and involve many parameters. This minisymposium deals with recent progress on applying and adapting techniques from (real) algebraic geometry and computational algebra for analyzing such systems. The minisymposium consists of three parts focusing on positive steady states, multistationarity and the corresponding parameter regions, and dynamical aspects.

Organizers: Alicia Dickenstein (Universidad de Buenos Aires) and Georg Regensburger (Johannes Kepler University Linz)

Reduction of the number of parameters
János Tóth (Budapest University of Technology and Economics)

"Good children" and "bad children"
Nicola Vassena (Free University Berlin)

Tikhonov-Fenichel parameter values for chemical reaction networks
Sebastian Walcher (RWTH Aachen)

Parameter geography
Jeremy Gunawardena (Department of Systems Biology, Harvard Medical School)

MS176: Algebraic geometry for kinematics and dynamics in robotics

Saturday, July 13, 10:00–12:00
Room: Unitobler, F-113

A fundamental problem in robotics is to characterize the kinematics of the robotic mechanism, i.e. to infer the relationship between the joint configuration and the position of the end-effector of the robot, typically the gripper. Motions of robotics mechanisms, essentially composed by rigid links connected by joints, are often characterized using the group of rigid body motions SE(3). Exploiting Lie algebra properties, kinematics problems can be formulated as systems of polynomial equations that can be solved using algebraic geometry tools. Algebraic geometry can further be used to study the dynamics properties of robotics mechanisms, i.e. the effect of forces and torques on the robot motions.

The goal of this minisymposium is to show the practical interest of algebraic geometry to analyze and control kinematic and dynamic motions of robotic systems in various applications such as solving inverse kinematic and dynamic problems, tracking manipulability ellipsoids or analyzing robots workspace. Furthermore, this minisymposium aims at bringing together mathematicians and roboticists to discuss further challenges in robotics involving application and development of algebraic geometry tools.

Organizers: Noémie Jaquier (Idiap Research Institute, Switzerland) and Sylvain Calinon (Idiap Research Institute)

Some Applications of Classical Algebraic Geometry in Robotics
Jon Selig (London South Bank University)

A modular approach for kinematic and dynamic modeling of complex robotic systems using algebraic geometry
Shivesh Kumar (DFKI Bremen) and Andreas Müller (Johannes Kepler University)

Kinematics Analysis of Serial Manipulators via Computational Algebraic Geometry
Zijia Li (Johannes Kepler University)

Robot manipulability tracking and transfer
Noémie Jaquier (Idiap Research Institute) and Sylvain Calinon (Idiap Research Institute)

MS179, part 2: Algebraic methods for polynomial system solving

Saturday, July 13, 10:00–12:00
Room: Unitobler, F021

Polynomial system solving is at the heart of computational algebra and computational algebraic geometry. It arises in many applications ranging from computer security and coding theory (where computations must be done over finite fields) and engineering sciences such as chemistry, biology, signal theory or robotics among many others (here computations are done over inifinite domains such as complex or real numbers). The need of reliable algorithms for solving these problems is prominent because of the non-linear nature of the problems we have in hand.

Algebraic methods provide a nice framework for designing efficient and reliable algorithms solving polynoial systems. This mini-symposium will cover many aspects of this topic, including design of symbolic computation algorithms as well as the use of numerical methods in this framework with an emphasis on reliability.

Organizers: Mohab Safey El Din (Sorbonne Université, France) and Éric Schost (University of Waterloo)

On polynomial and regular images of Euclidean spaces
José Fernando Galvan (Univ. Madrid)

Degree bounds for the sparse Nullstellensatz
Gabriela Jeronimo (Univ. Buenos Aires)

Signature-based Möller's algorithm for strong Gröbner bases over PIDs
Thibaut Verron (Johannes Kepler Univ.)

Witness collections and a numerical algebraic geometry toolkit
Jose Rodriguez (Univ. of Wisconsin)

MS185, part 3: Algebraic Geometry Codes

Saturday, July 13, 10:00–12:00
Room: Unitobler, F-122

The problem of finding good codes is central to the theory of error correcting codes. For many years coding theorists have addressed this problem by adding algebraic and combinatorial structure to C.

In the early 80s Goppa used algebraic curves to construct linear error correcting codes, the socalled algebraic geometric codes (AG codes). The construction of an AG code with alphabet a finite field $\mathbb{F}_q$ requires that the underlying curve is $\mathbb{F}_q$-rational and involves two $\mathbb{F}_q$-rational divisors D and G on the curve.

In this minisymposium we will present results on Algebraic Geometry codes and their performances.

Organizers: Daniele Bartoli (Univerity of Perugia, Italy) and Anna-Lena Horlemann (University of St. Gallen)

Subcovers and codes on a class of trace-defining curves
Guilherme Tizziotti (Federal University of Uberlandia)

On Weierstrass semigroup at m points on curves of the form $f(y) = g(x)$
Alonso Sepúlveda Castellanos (Federal University of Uberlandia)

Pure gaps on curves with many rational places
Ariane Masuda (NYC College of Technology)

Non projective Frobenius algebras and linear codes
Javier Lobillo Borrero (Universidad de Granada)

MS186, part 2: Algebraic vision

Saturday, July 13, 10:00–12:00
Room: Unitobler, F011

There has been a burst of recent activity focused on the applications of modern abstract and numerical algebraic geometry to problems in computer vision, ranging from highly-optimized Gröbner-basis techniques, to homotopy continuation methods, to Ulrich sheaves and Chow forms, to functorial moduli theory. We will discuss this recent progress, with a focus on multiview geometry, both in theory and in practice.

Organizers: Max David Lieblich (University of Washington, United States of America), Tomas Pajdla (Czech Technical University in Prague), and Matthew Trager (Courant Institute of Mathematical Sciences at NYU)

Solving for camera configurations from pairs
Brian Osserman (University of California, Davis)

Ideals of the Multiview Variety
Andrew Pryhuber (University of Washington)

Estimation under group action and fast polynomial solvers, with applications to cryo-EM
Joe Kileel (Princeton)

MS196: Algebro-geometric methods for social network modelling

Saturday, July 13, 10:00–12:00
Room: Unitobler, F-121

Algebraic and geometric methods have recently been proposed for statical random (social) network models. These methods could be described in three categories:

(i) Understanding the geometry of the network models, especially the exponential random graph models (ERGMs) in order to understand the (mis)behaviour of such models in the asymptotic settings, commonly known as degeneracy of such models, which occurs commonly. In addition, many ERGMs are in fact curved exponential families, and understanding the geometry of the parameter space is of great importance.

(ii) Finding the model polytope of network models, i.e. the polytope of all sufficient statistics for every network of fixed size n in order to determine the existence of the MLE for such models and also to demonstrate which parameters are actually estimable.

(iii) Understanding the Markov bases of random network models specified by a multi-homogeneous ideal. This is directly relevant to the goodness-of-fit testing problems for network models as well as simulating from these models. In this minisymposium some of the experts of the field of random network analysis demonstrate the latest developments on the algebro-geometric methods as described above.

Organizers: Kayvan Sadeghi (University College London, United Kingdom)

Goodness-of-fit testing for log-linear network models
Despina Stasi (Illinois Institute of Technology)

Cores, shell indices and the degeneracy of a graph limit
Johannes Rauh (Max-Plack Institute)

On Exchangeability in Network Models
Kayvan Sadeghi (University College London, United Kingdom)

IP10: Kathryn Hess Bellwald: Topological adventures in neuroscience

Saturday, July 13, 13:30–14:30
Room: vonRoll, Fabrikstr. 6, 001
Streamed to: vonRoll, Fabrikstr. 6, 004

Over the past decade, and particularly over the past five years, research at the interface of topology and neuroscience has grown remarkably fast. Topology has, for example, been successfully applied to objective classification of neuron morphologies and to automatic detection of network dynamics. In this talk I will focus on the algebraic topology of brain structure and function, describing results obtained by members of my lab in collaboration with the Blue Brain Project on digitally reconstructed microcircuits of neurons in the rat cortex. In particular, I will describe our on-going work on the topology of synaptic plasticity. The talk will include an overview of the Blue Brain Project and a brief introduction to the topological tools that we use.

Speaker: Kathryn Hess Bellwald (EPFL, Switzerland)

Coffee break

Saturday, July 13, 14:30–15:00
Room: Unitobler, F wing, floors 0 and -1

MS127, part 3: The algebra and geometry of tensors 2: structured tensors

Saturday, July 13, 15:00–17:00
Room: Unitobler, F023

Tensors are ubiquitous in mathematics and science. Tensor decompositions and approximations are an important tool in artificial intelligence, chemometrics, complexity theory, signal processing, statistics, and quantum information theory. Often, due to the nature of the problem under investigation, it might be natural to consider tensors equipped with additional structures or might be useful to consider tensor decompositions which respect particular structures. Among many interesting constructions, we might think of: symmetric, partially-symmetric and skew-symmetric tensors; tensor networks; Hadamard products of tensors or non-negative ranks. This minisymposium focuses on how exploiting these additional structures from algebraic and geometric perspectives recently gave new tools to study these special classes of tensors and decompositions. This is a sister minisymposium to "The algebra and geometry of tensors 1: general tensors" organized by Y. Qi and N. Vannieuwenhoven.

Organizers: Elena Angelini (Università degli studi di Siena), Enrico Carlini (Politecnico di Torino), and Alessandro Oneto (Barcelona Graduate School of Mathematics)

Varieties of tensor decompositions and multi secants to curves and surfaces
Kristian Ranestad (University of Oslo)

Varieties of Hankel matrices and their secant varieties
Hirotachi Abo (University of Idaho)

Tensor decomposition, sparse representation and moment varieties
Bernard Mourrain (INRIA)

The Distance Function from the Variety of Rank One Partially-Symmetric Tensors
Luca Sodomaco (Università di Firenze)

MS129, part 2: Sparsity in polynomial systems and applications

Saturday, July 13, 15:00–17:00
Room: Unitobler, F022

In this session we bring together researchers working in different areas involving sparsity in applications and sparse polynomial systems. The principle of sparsity is to represent a structure by functions, e.g., polynomials, with as few variables or terms as possible. It is ubiquitous in various areas and problems, where algebra and geometry play a key role. Recently, it has been succesfully applied to problems such as sparse interpolation, polynomial optimization, sparse elimination, fewnomial theory, or tensor decomposition.

This minisymposium provides an opportunity to learn about a selection of these recent developments and explore new potential applications of sparsity.

Organizers: Timo de Wolff (Technische Universität Berlin, Germany) and Mareike Dressler (University of California, San Diego, CA, USA)

Filling a much-needed gap in the literature
Bruce Reznick (University of Illinois Urbana-Champaign, IL, USA)

Computing elimination ideals of likelihood equations
Xiaoxian Tang (Texas A&M University, TX, USA), Timo de Wolff (Technische Universität Berlin, Germany), and Rukai Zhao (Texas A&M University, TX, USA)

Nonnegative polynomials and circuit polynomials
Jie Wang (Peking University, China)

An Experimental Classification of Maximal Mediated Sets
Oguzhan Yürük (Technische Universität Berlin, Germany), Timo de Wolff (Technische Universität Berlin, Germany), and Olivia Röhrig (Technische Universität Berlin, Germany)

MS131, part 2: Computations in algebraic geometry

Saturday, July 13, 15:00–17:00
Room: Unitobler, F005

This minisymposium highlights the use of computation inside algebraic geometry. Computations enter algebraic geometry in several different ways including numerical strategies, symbolic calculations, experimentation, and simply as a fundamental conceptual tool. Our speakers will showcase many of these aspects together with some applications.

Organizers: Diane Maclagan (University of Warwick) and Gregory G. Smith (Queen's University)

The semigroup and cone of effective divisor classes on a hypersurface in a toric variety
Michael Stillman (Cornell University)

On subring counting and simultaneous monomialization
Anne Frübhis-Krüger (University of Hanover)

Fröberg-Macaulay conjectures for algebras
Mats Boij (Royal Institute of Technology (KTH))

Singular value decomposition for complexes
Frank-Olaf Schreyer (Saarland University)

MS134, part 7: Coding theory and cryptography

Saturday, July 13, 15:00–17:00
Room: Unitobler, F-122

The focus of this minisymposium is on coding theory and cryptography, with emphasis on the algebraic aspects of these two research fields. Error-correcting codes are mathematical objects that allow reliable communications over noisy/lossy/adversarial channels. Constructing good codes and designing efficient decoding algorithms for them often reduces to solving algebra problems, such as counting rational points on curves, solving equations, and classifying finite rings and modules. Cryptosystems can be roughly defined as functions that are easy to evaluate, but whose inverse is difficult to compute in practice. These functions are in general constructed using algebraic objects and tools, such as polynomials, algebraic varieties, and groups. The security of the resulting cryptosystem heavily relies on the mathematical properties of these. The sessions we propose feature experts of algebraic methods in coding theory and cryptography. All levels of experience are represented, from junior to very experienced researchers.

Organizers: Alessio Caminata (University of Neuchâtel, Switzerland) and Alberto Ravagnani (University College Dublin, Ireland)

An Asymmetric MacWilliams Identity for Quantum Stabilizer Codes
Tefjol Pllaha (Aalto University)

Code-based crypto for small servers
Tanja Lange (Eindhoven University of Technology)

Reproducible Codes and Cryptographic Applications
Edoardo Persichetti (Florida Atlantic University)

Hyperelliptic point-counting in genus 3 and higher, the RM case
Simon Abelard (University of Waterloo)

MS136, part 3: Syzygies and applications to geometry

Saturday, July 13, 15:00–17:00
Room: Unitobler, F-107

In this minisymposium, we will focus on the striking results and applications that the study of syzygies provides in algebraic geometry, in a wide sense. Topics should include but are not limited to the study of rational and birational maps, singularities, residual intersections and the defining equations of blow-up algebras. We plan to focus on recent progress in this area that result in explicit and effective computations to detect certain geometrical property or invariant. Applications to geometric modeling are very welcome.

Organizers: Laurent Busé (INRIA Sophia Antipolis), Yairon Cid Ruiz (Universitat de Barcelona), and Carlos D'Andrea (Universitat de Barcelona)

Inversion of polynomial systems and polar maps
Remi Bignalet Cazalet (Université de Bourgogne)

Singularities and radical initial ideals
Alexandru Constantinescu (Freie Universität Berlin)

Syzygies and gluing for semigroup rings
Philippe Gimenez (Universidad de Valladolid)

Specialization of rational maps
Yairon Cid Ruiz (Universitat de Barcelona)

MS139, part 3: Combinatorics and algorithms in decision and reason

Saturday, July 13, 15:00–17:00
Room: Unitobler, F-121

Combinatorial, or discrete, structures are a fundamental tool for modeling decision-making processes in a wide variety of fields including machine learning, biology, economics, sociology, and causality. Within these various contexts, the goal of key problems can often be phrased in terms of learning or manipulating a combinatorial object, such as a network, permutation, or directed acyclic graph, that exhibits pre-specified optimal features. In recent decades, major break-throughs in each of these fields can be attributed to the development of effective algorithms for learning and analyzing combinatorial models. Many of these advancements are tied to new developments connecting combinatorics, algebra, geometry, and statistics, particularly through the introduction of geometric and algebraic techniques to the development of combinatorial algorithms. The goal of this session is to bring together researchers from each of these fields who are using combinatorial or discrete models in data science so as to encourage further breakthroughs in this important area of mathematical research.

Organizers: Liam Solus (KTH Royal Institute of Technology, Sweden) and Svante Linusson (KTH Royal Institute of Technology)

From random forests to regulatory rules: extracting interactions in high-dimensional genomic data
Karl Kumbier (University of California, Berkeley)

Probabilistic tensors and opportunistic Boolean matrix multiplication
Petteri Kaski (Aalto University)

Discrete Models with Total Positivity
Dane Wilburne (York University)

MS153, part 2: Symmetry in algorithmic questions of real algebraic geometry

Saturday, July 13, 15:00–17:00
Room: Unitobler, F021

Symmetry arises quite naturally in many computational problems and from a computational perspective, it allows to reduce the complexity of problems. The mini-symposium aims to presents various instances of computational problems in real algebraic geometry, where symmetry playes an important role.

Organizers: Cordian Riener (UiT - The Arctic University of Norway, Norway) and Philippe Moustrou (UiT - The Arctic University of Norway, Norway)

Orbit closures in the Zariski spectrum of the infinite polynomial ring
Mario Kummer (TU Berlin)

Sum-of-squares hierarchy for symmetric formulations.
Adam Kurpisz (ETH Zurich)

Symmetry Preserving Interpolation
Erick Rodriguez Bazan (INRIA)

Separating invariants of finite groups
Fabian Reimers (TU Munich)

MS162, part 2: Applications of finite fields theory

Saturday, July 13, 15:00–17:00
Room: Unitobler, F-123

The theory of finite fields is one of the most important meeting points of Algebraic Geometry, Computer Science, and Number Theory. One of the most important challenges in the area is to develope the theory of finite fields in connection with useful applications, in particular in secure communication, coding theory, and pseudorandom number generation. In this minysimposium we plan to bring together experts from many different areas of the mathematics of communication who share the common interest towards the theory of finite fields. Our main purpose is to provide an overview of some of the cutting-edge research in the field, and to lay the fundations for new collaborations among researchers interested in applications of the theory of finite fields.In the cryptographic setting, we focus on new post-quantum cryptographic schemes (Marco Baldi, Antoine Joux) and cryptanalysis (Gohar Kyureghyan, Yann Rotella). For pseudorandomness we propose construction of new pseudorandom generators (Federico Amadio Guidi, Laszlo Merai) and construction of polynomials over finite fields with given properties which are interesting for applications (Andrea Ferraguti).

Organizers: Antoine Joux (University of Sorbonne), Giacomo Micheli (EPFL), and Violetta Weger (University of Zurich, Switzerland)

Public key encryption and key exchange from LDPC codes: LEDAcrypt
Paolo Santini (Marche Polytechnic University)

Cryptological properties of mappings of finite fields
Gohar Kyureghyan (University of Rostock)

Pseudorandom walks on elliptic curves
Laszlo Merai (RICAM)

Fractional Jumps and pseudorandom number generation
Federico Amadio Guidi (University of Oxford)

MS164, part 4: Algebra, geometry, and combinatorics of subspace packings

Saturday, July 13, 15:00–17:00
Room: Unitobler, F-106

Frame theory studies special vector arrangements which arise in numerous signal processing applications. Over the last decade, the need for frame-theoretic research has grown alongside the emergence of new methods in signal processing. Modern advances in frame theory involve techniques from algebraic geometry, semidefinite programming, algebraic and geometric combinatorics, and representation theory. This minisymposium will explore a multitude of these algebraic, geometric, and combinatorial developments in frame theory.

The theme of the fourth session is "Symplectic and real algebraic geometry in frame theory."

Organizers: Emily Jeannette King (University of Bremen, Germany) and Dustin Mixon (Ohio State University)

Symplectic Geometry and Frame Theory
Clayton Shonkwiler (Colorado State University)

Symplectic Geometry, Optimization and Applications to Frame Theory
Tom Needham (Ohio State University)

The optimal packing of eight points in the real projective plane
Hans Parshall (Ohio State University)

Spherical configurations with few angles
William J. Martin (Worcester Polytechnic Institute)

MS167, part 4: Computational tropical geometry

Saturday, July 13, 15:00–17:00
Room: Unitobler, F013

This session will highlight recent advances in tropical geometry, algebra, and combinatorics, focusing on computational aspects and applications. The area enjoys close interactions with max-plus algebra, polyhedral geometry, combinatorics, Groebner theory, and numerical algebraic geometry.

Organizers: Kalina Mincheva (Yale University) and Yue Ren (Max Planck Institute for Mathematics in the Sciences, Germany)

Massively parallel methods with applications in tropical geometry
Dominik Bendle (Technische Universität Kaiserslautern), Kathrin Bringmann (Universität Köln), Arne Buchholz (Universität des Saarlandes), *Janko Boehm* (Technische Universität Kaiserslautern), Christoph Goldner (Eberhard Karls Universität Tübingen), Hannah Markwig (Eberhard Karls Universität Tübingen), Mirko Rahn (Fraunhofer ITWM), Yue Ren (Max Planck Institute for Mathematics in the Sciences, Germany), and Benjamin Schröter (Binghamton University)

Tropical Grassmannians $\mathrm{Gr}_p(3,8)$ and the Dressian $\mathrm{Dr}(3,8)$
Dominik Bendle (Technische Universität Kaiserslautern), Janko Boehm (Technische Universität Kaiserslautern), Yue Ren (Max Planck Institute for Mathematics in the Sciences, Germany), and *Benjamin Schröter* (Binghamton University)

Computing unit groups of curves
Justin Chen (UC Berkeley), *Sameera Vemulapalli* (Princeton University), and Leon Zhang (UC Berkeley)

A numerical algorithm for tropical membership
Taylor Brysiewicz (Texas A&M University)

MS171, part 2: Grassmann and flag manifolds in data analysis

Saturday, July 13, 15:00–17:00
Room: Unitobler, F007

A number of applications in large scale geometric data analysis can be expressed in terms of an optimization problem on a Grassmann or flag manifold.The solution of the optimization problem helps one to understand structure underlying a data set for the purposes such as classification, feature selection, and anomaly detection.

For example, given a collection of points on a Grassmann manifold, one could imagine finding a Schubert variety of best fit corresponds to minimizing some function on the flag variety parameterizing the given class of Schubert varieties.

A number of different algorithms that exist for points in a linear space have analogues for points in a Grassmann or flag manifold such as clustering, endmember detection, self organized mappings, etc

The purpose of this minisymposium is to bring together researchers who share a common interest in algorithms and techniques involving Grassmann and Flag varieties applied to problems in data analysis.

Organizers: Chris Peterson (Colorado State University, United States of America), Michael Kirby (Colorado State University), and Javier Alvarez-Vizoso (Max-Planck Institute for Solar System Research in Göttingen)

A dual subgradient approach to computing an optimal rank Grassmannian circumcenter
Tim Marrinan (Université de Mons)

Low Rank Representations of Matrices using Nuclear Norm Heuristics
Silvia Dinica (Romanian Senate)

Grassmann Tangent-Bundle Means
Justin Marks (Gonzaga University)

MS199, part 2: Applications of topology in neuroscience

Saturday, July 13, 15:00–17:00
Room: Unitobler, F-105

Research at the interface of topology and neuroscience is growing rapidly and has produced many remarkable results in the past five years. In this minisymposium, speakers will present a wide and exciting array of current applications of topology in neuroscience, including classification and synthesis of neuron morphologies, analysis of synaptic plasticity, and diagnosis of traumatic brain injuries.

Organizers: Kathryn Hess Bellwald (Laboratory for topology and neuroscience, EPFL, Switzerland) and Ran Levi (University of Aberdeen, UK)

Simplicial convolutional neural networks for in-painting of cochains
Gard Spreemann (Laboratory for topology and neuroscience, EPFL, Switzerland)

Using topological data analysis to classify certain stimuli in the Blue Brain reconstruction
Jason Smith (University of Abedeen , UK)

Topology and neuroscience
Daniela Egas Santander (Laboratory for topology and neuroscience, EPFL, Switzerland)

Application of topological data analysis to the detection of mild cognitive impairment
Alice Patania (Indiana University)

Local Information

Venues

Registration and plenary talks take place in the foyer and room 001 of *Fabriksstrasse 6* of the *vonRoll area*, respectively. The plenary talks are streamed to room 004 in the same building.

The poster session on Tuesday evening takes place in the foyer of *Fabriksstrasse 8* of the *vonRoll area*.

Minisymposiums and coffee breaks take place in rooms on floors 0 and -1 (basement) of *Unitobler*, a 900-meter walk from the vonRoll area.

Unitobler is a 10-minute walk from the railway station, vonRoll a bit further. To avoid having to climb the hill by foot, in the basement of the railway station follow the signs *Universität* rather than those pointing to the centrum, and take the elevator to the top floor. Alternatively, take bus 12; see below for more on public transport.

Public transport

Bus 12 takes you from the center to Unitobler and to its final stop Länggasse near vonRoll and *Postautos* (yellow busses) 100, 101, 102, 103, 104, 105, 106, 107 bring you from the railway station to either Unitobler, Länggasse, or Güterbahnhof. If you take one of these, please check the map below first where to get out!

Most hotels will give you a public transport ticket, valid on all trams, busses, trolley busses, and trains in zones 100 and 101, as well as in some further public transport, e.g. the *Marzilibahn* that takes you up from near the river to the Bundeshaus, the elevator that takes you from the river to the Münster, and the *Gurtenbahn* that takes you up the nearest hill of 864m. In clear weather, Gurten offers a fantastic view of the Alps.

If you do not have such a public transport ticket: a single fare (valid 60 minutes, within 2 zones) costs CHF 4.60, some short journeys cost CHF 2.60, and a day pass costs CHF 13.00. There are also tickets for 6 journeys, with a small discount (e.g. 25 CHF for 6 single-fares). If you stay in Bern for more than one week, you might consider a month ticket of CHF 79.00 (unfortunately, week tickets were abolished recently).

Food

At *Unitobler*, there will be coffee breaks with coffee, tea, water, orange juice, and croissants or fruit, and on Tuesday evening at the poster session in the *Aula at Fabriksstrasse 8 at vonRoll* there'll be a reception with wine, juice, and snacks. There will be no organised food otherwise.

For lunch, there is a *cafetaria ("Mensa")* with reasonable prices at vonRoll (number 1 on the list below). They will also open for us on Saturday, be it with a reduced number of options. There is also a Mensa at Unitobler, but they cannot handle large numbers of guests, so we discourage going there. Another large Mensa, open Tue-Fri, is number 14 on the list.

Both for lunch and for dinners, there are numerous small lunch options in the *Länggasse*, this quarter of town; see the map below. Alternatively, you can walk or take a bus into the center, where there are many more options.

Plugs and outlets

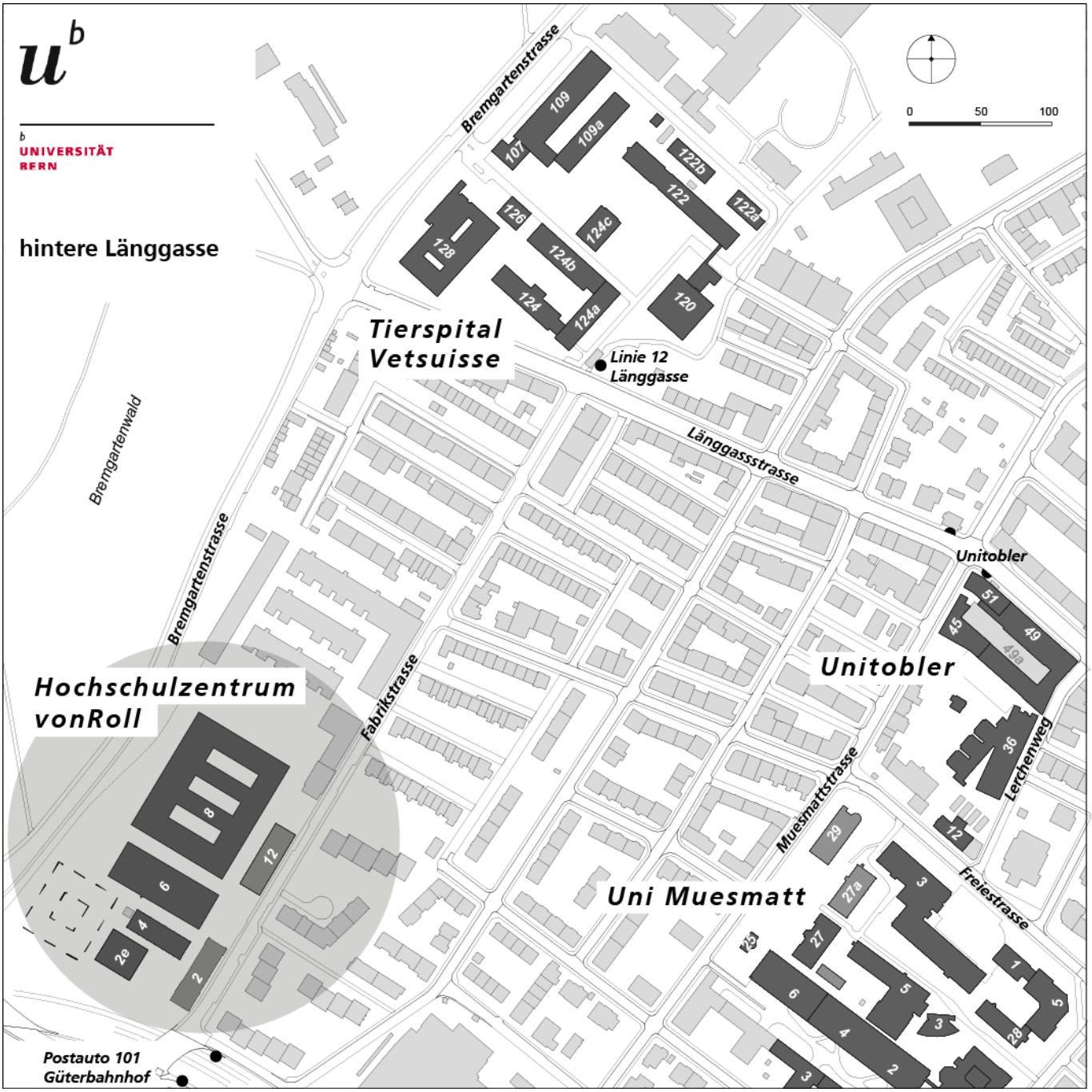
Electricity plugs and outlets in Switzerland differ from some of those used in many other European countries: type-F plugs won't fit, but type-C plugs will. See this site for information.

Activities in Bern

If you have spare time in Bern, recommended activities are:

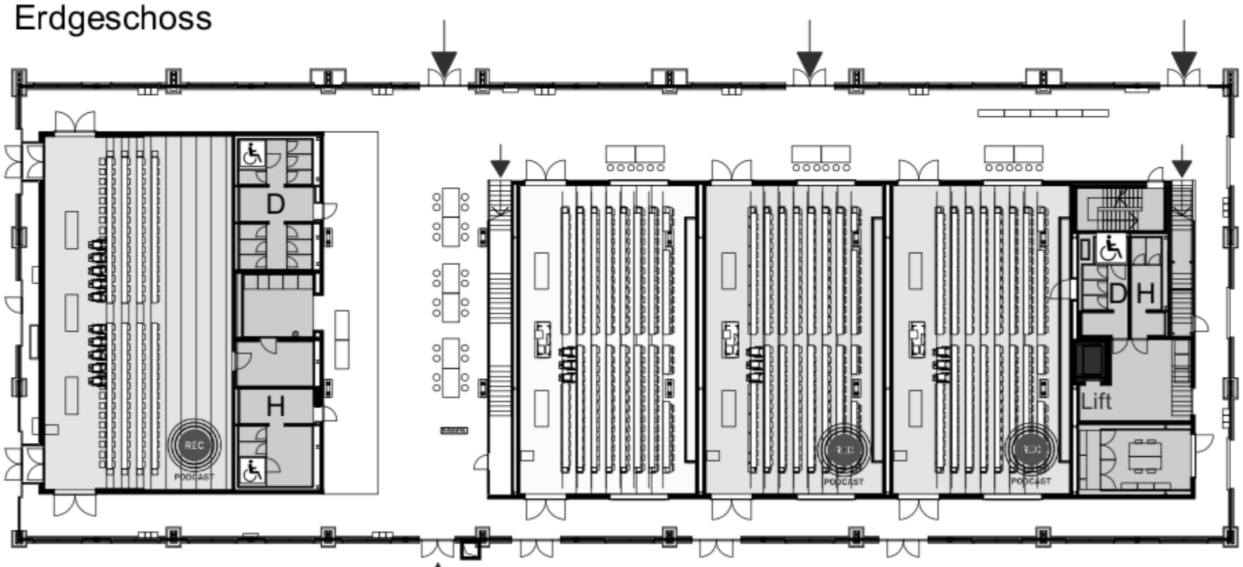
- A walk in the old city center down along the Kramgasse, where Einstein lived at nr. 49, over the bridge, have a look at the bears to your right, then on your left climb towards the Rosengarten, from which you have a fantastic view over the city. If you prefer a shorter city walk, with a view over the city and the alps, go to the Bundeshaus and/or the Münster.
- Walk up on the Gurten (or alternatively, take the funicular up), and enjoy the view over the Alps. If you walk or cycle anywhere in Switzerland, check out `https://map.schweizmobil.ch/` for routes (they also have a free app).
- A swim in the river Aare! Only do this if you are an experienced swimmer, and only after googling *Aare you safe?* to figure out where this is allowed and what to pay attention to. The portion downstream near Lorraine is slower than the portion upstream between Eichholz and Marzili.

Map of the vonRoll area



vonRoll, Fabriksstrasse 6

Erdgeschoss

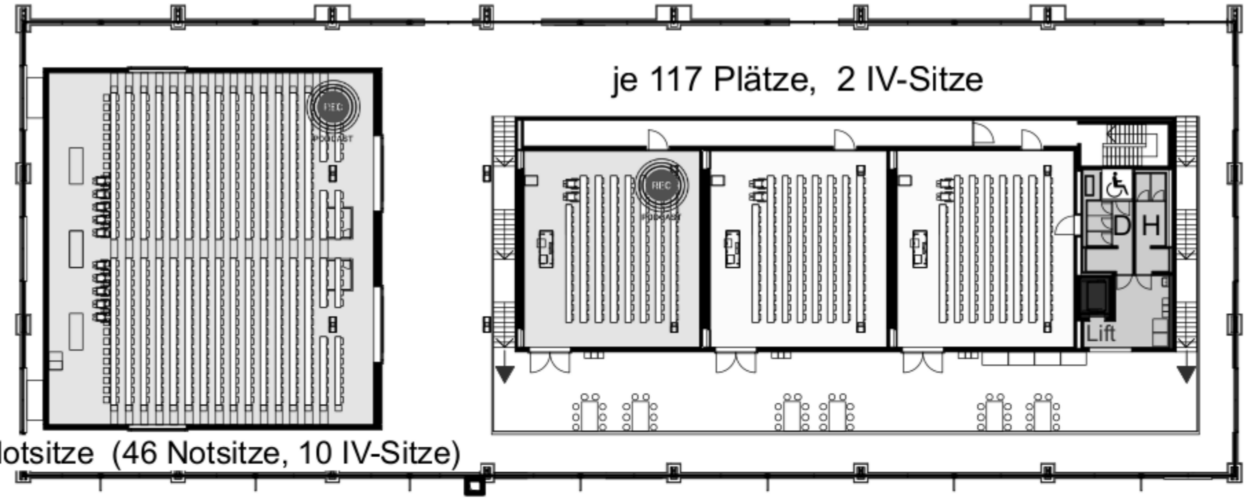


je 199 Plätze, 16 Notsitze, 3 IV-Sitze

001	002	003	004
Hörsaal	Hörraum	Hörraum	Hörraum
siehe OG	218 Plätze	218 Plätze	218 Plätze

Rollstuhlgängig

1. Obergeschoss

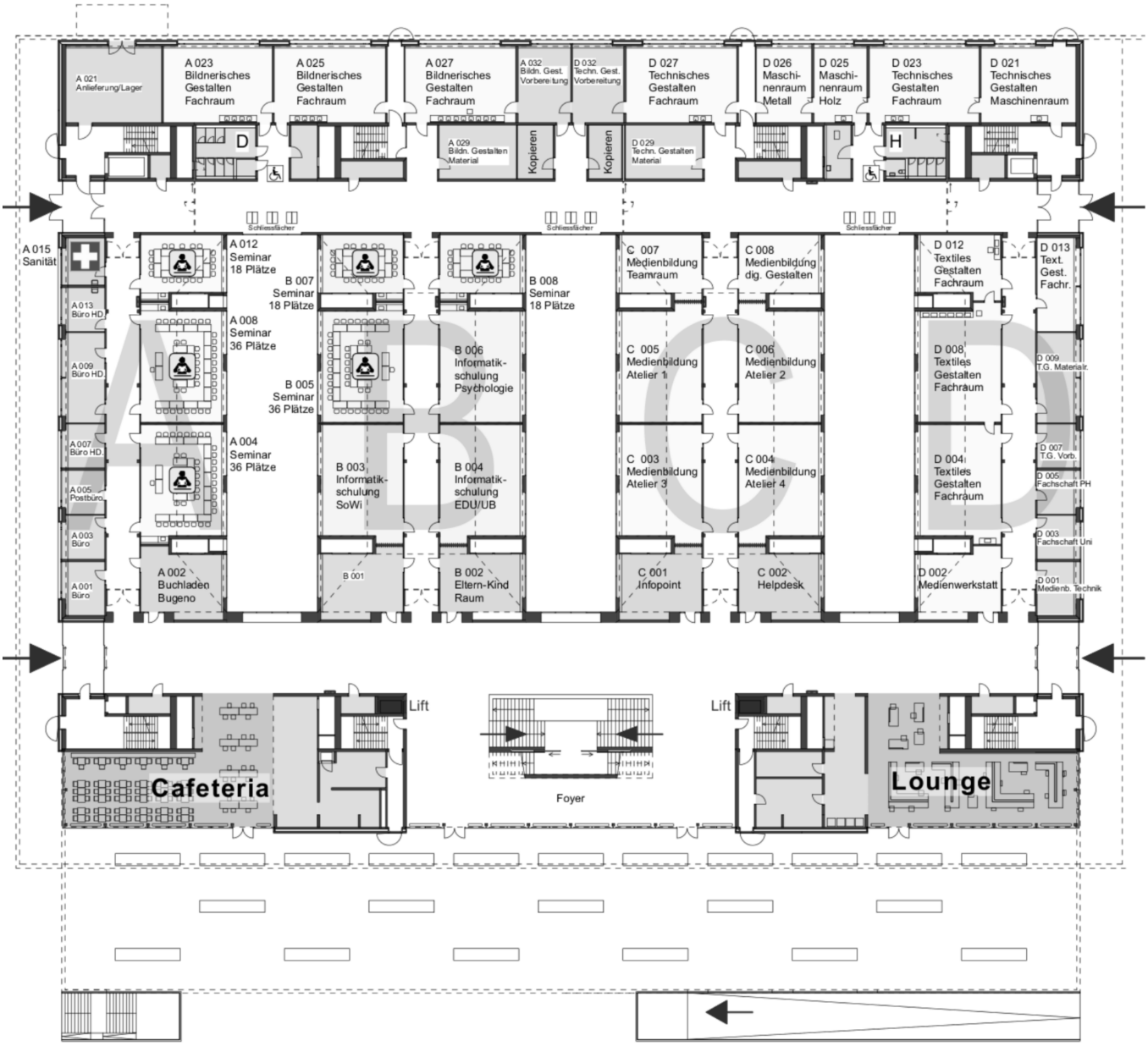


je 117 Plätze, 2 IV-Sitze

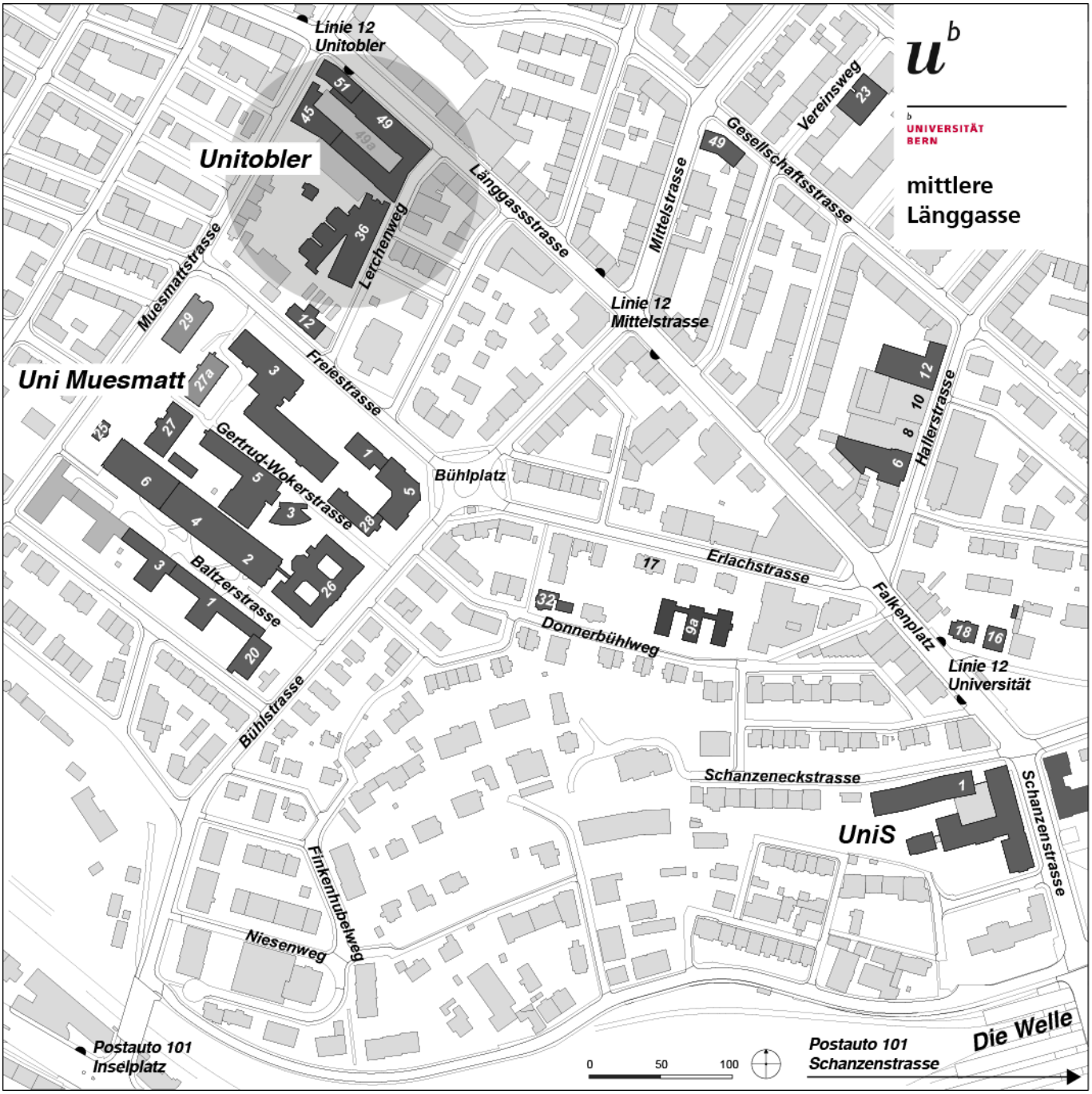
60 Notsitze (46 Notsitze, 10 IV-Sitze)

001	102	103	104
Hörsaal	Hörraum	Hörraum	Hörraum
524 Plätze	119 Plätze	119 Plätze	119 Plätze

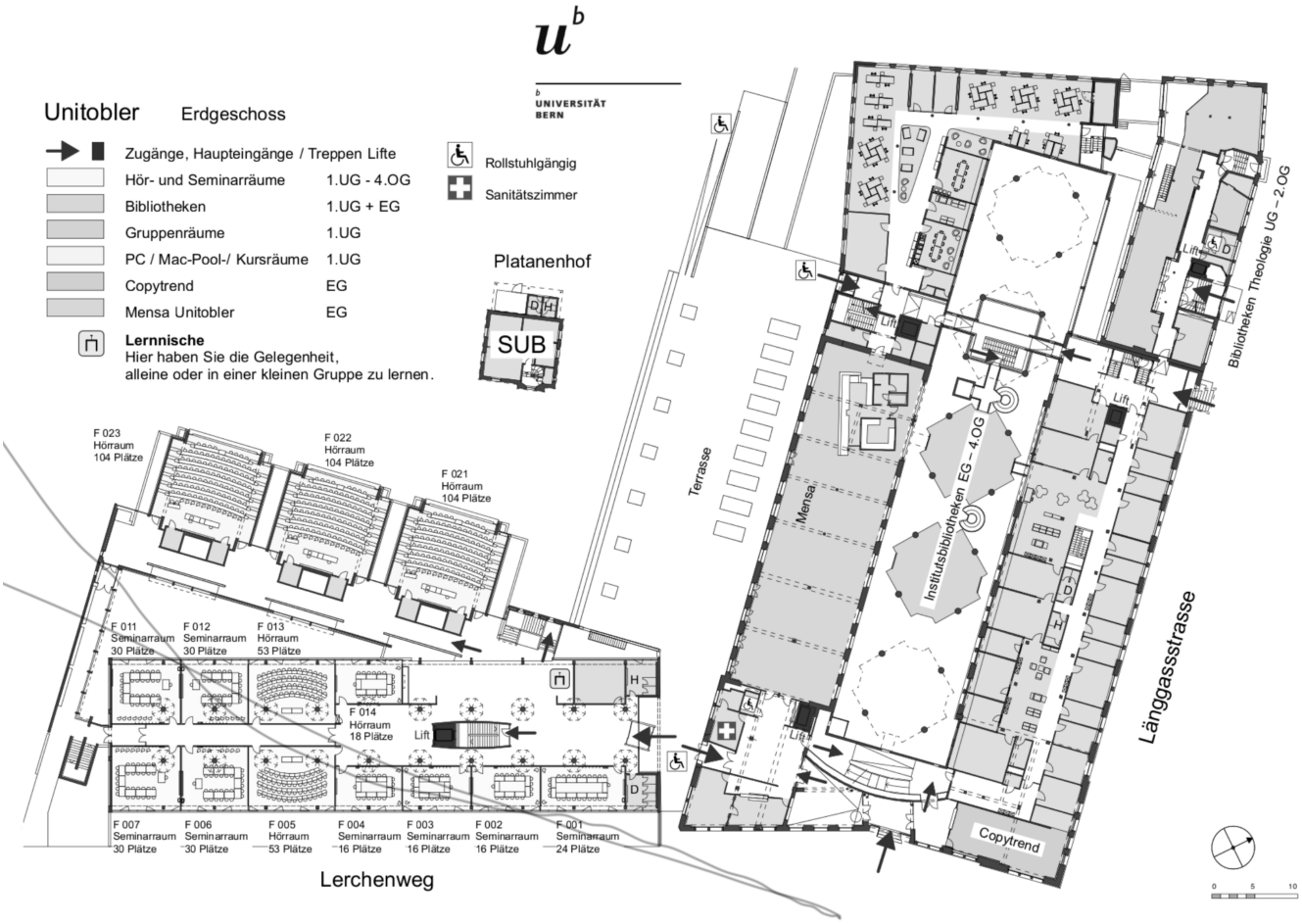
vonRoll, Fabriksstrasse 8



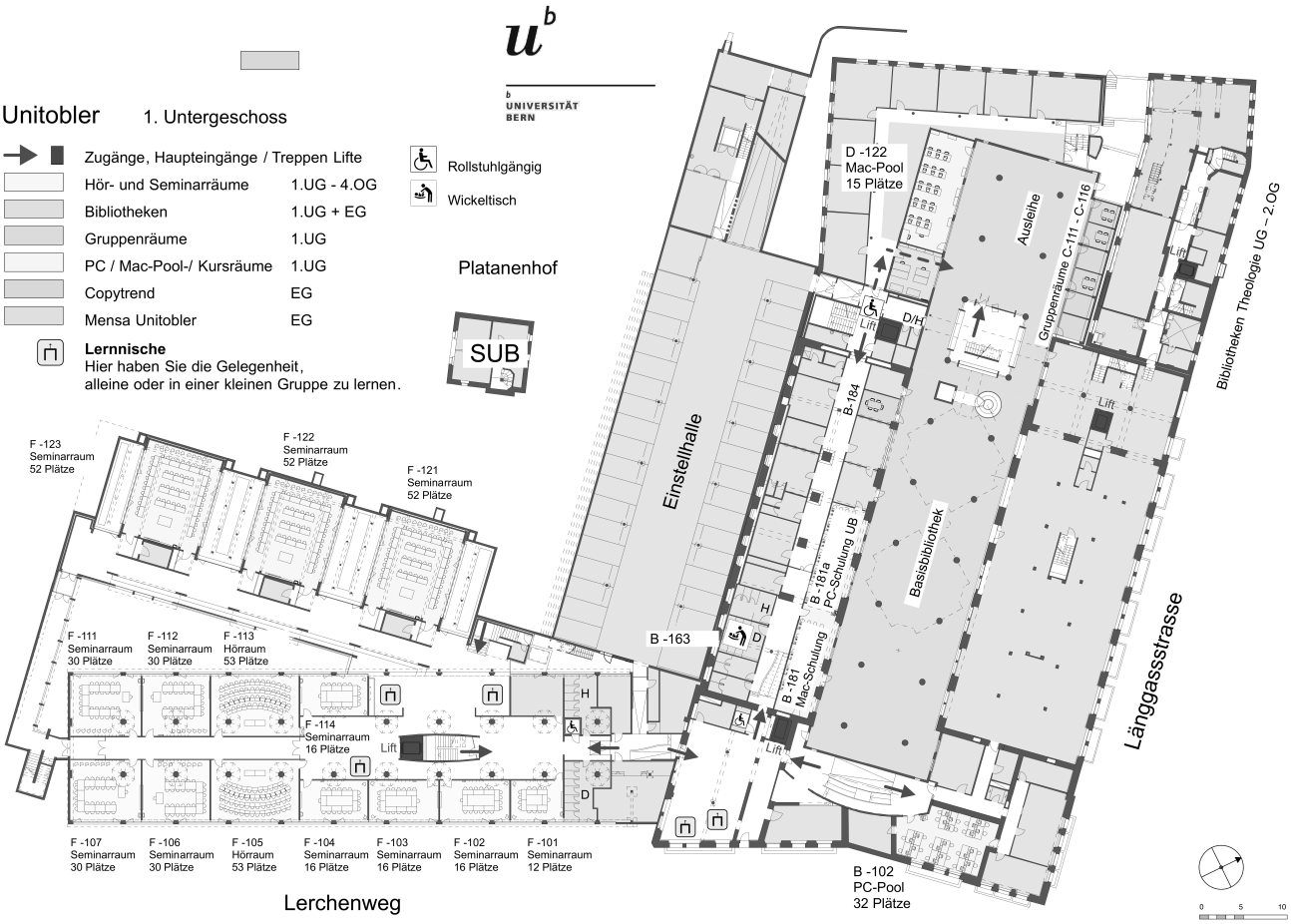
Map of the Unitobler area



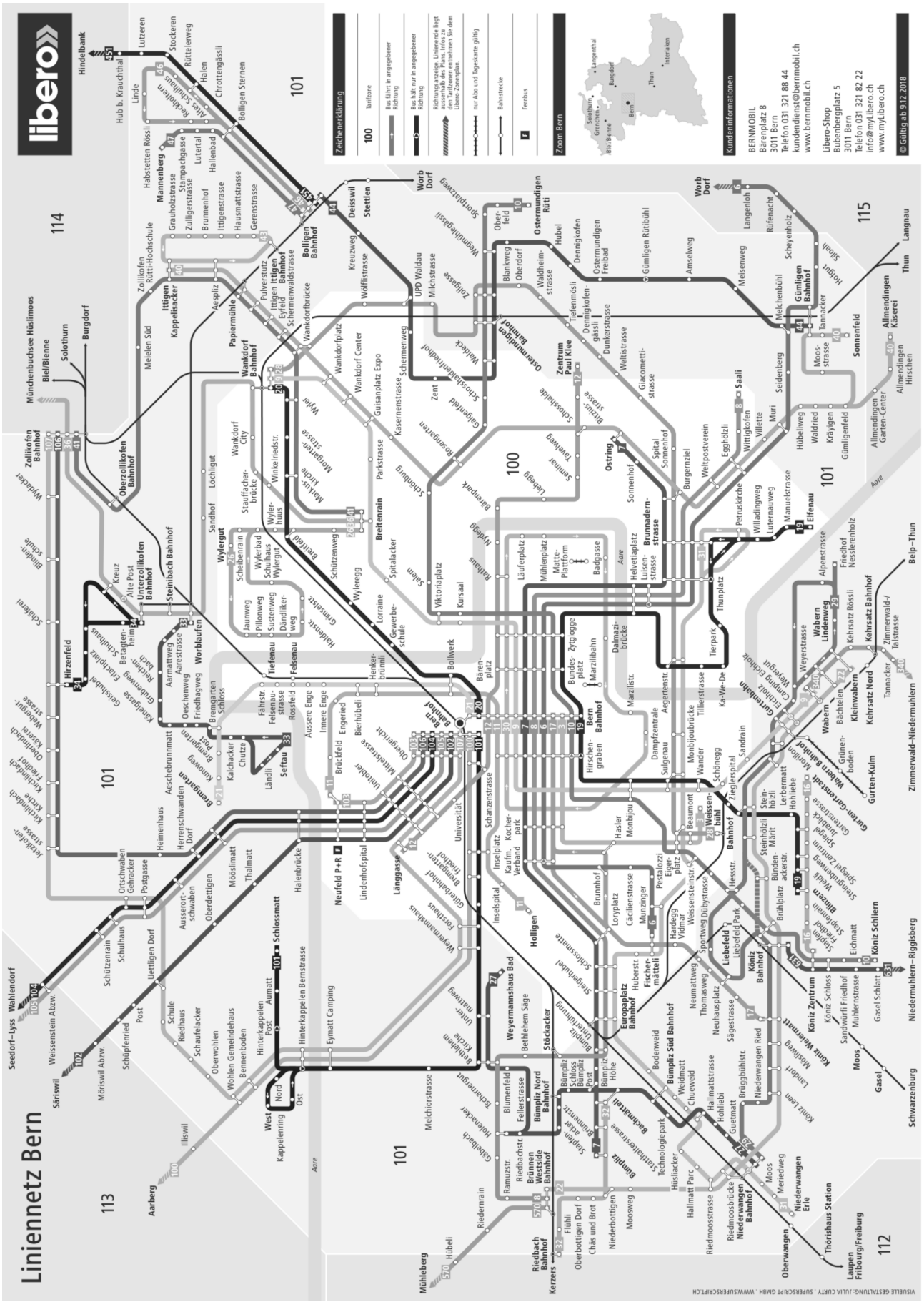
Unitobler, rooms starting with F0



Unitobler basement, rooms starting with F-1



Public transport map



Food options in Länggasse

1 Mensa vonRoll
2 Indian food, Tulsi
3 Mensa Unitobler
4 Supermarket Coop
5 Open air pizza/Kebab
6 Migros supermarket with restaurant
7 Icecream, Gelateria di Berna
8 Ehiopian food, Injera
9 Korean/Sushi, Jinny's Sushi
10 Lebanese, Pittaria
11 Café, Parterre
12 Pizza and Kebab
13 Mensa faculty of science
14 Mexican food, bigote verde
15 Mensa SBB Grosse Schanze
16 Train station, fast food

Budget SIAM AG 19

The amounts below are in CHF, multiply by approximately 1 to get USD. The budget is based on an estimated participation of 650, 11 plenary speakers (10 invited, plus 1 Early Career Prize winner), 2 conference co-chairs, and 15 committee members (local + programme).

Expenses

Item	Description	Amount
Plenary speakers and co-chairs reimbursement	Travel and accommodation	32,000.00
Program book	Design + Printing	7,000.00
Website and poster design	Poster	750.00
	Conftool	2,300.00
	KAS services website	1,300.00
	Creditcard charges	3,120.00
	VAT	7,000.00
Material	Name tags	975.00
	Paper blocks	780.00
	Paper bags	325.00
	Pens	1,950.00
	Tshirts for staff	500.00
Staff cost	18 student assistents for 1.5 weeks	27,000.00
	2 student assistant for 6 months, 3.5 hours a week	4,800.00
	secretarial support	3,000.00
Food and Beverage	Coffee breaks	51,000.00
	Reception during poster session	30,000.00
	Personnel + guarantee for Mensa to open on Saturday	4,000.00
Equipment rental	Offered by University of Bern	0.00
Meeting room rental	Offered by University of Bern	0.00
AV technical support	1 person present during week	1,000.00
Advertising	Online and via mailing lists	0.00
Travel grants	Students and early career researchers	35,350.00
Miscellaneous	10 percent of above	17,880.00
Total		**200,030.00**

Revenue

Item	Description	Amount
NWO contribution Draisma		32,000.00
SNF contribution Scientific Events	for invited speakers	19,700.00
SNF contribution Delucchi	for travel grants	10,000.00
Start-up funds Draisma	(University of Bern)	30,000.00
SIAM contribution to invited speakers	(2* 2500)	5,000.00
Registration fees	Master's and Ph.D. students	22,000.00
	SIAG/AG members	40,000.00
	SIAM members	9,250.00
	Non-SIAM speaker or minisymposium organiser	21,000.00
	Others	11,750.00
Total		**200,700.00**

Speaker Index

Organiser and Co-Author Index