International Conference on: Network Games, Tropical Geometry, and Quantum Communication

June 3-7, 2019 at ZIB

Xavier Allamigeon (Ecole Polytechnique)

Tropical geometry meets optimization.

Elisabeth Baldwin (Oxford U)

TBA.

Albert-László Barabási (Northeastern U)

Taming Complexity: From Network Science to Network Control. Our biological existence, our ability to communicate, to exchange goods and values, are guaranteed by numerous invisible networks, from the protein and genetic networks in our cells to the world wide web, Internet and financial and trade networks. I will show that the amazingly complex topology of these highly interconnected networks are the result of self-organizing processes governed by simple but generic laws. The ultimate proof of our understanding these complex systems is reflected in our ability to control them. I will therefore explore the controllability of an arbitrary complex network, identifying the set of driver nodes whose time-dependent control can guide the system's entire dynamics. By applying these tools to real networks, helps us unveil how the network topology determines controllability. Finally, I will discuss how network control informs our ability to predict neurons involved in specific processes in the brain, offering an avenue to experimentally test the predictions of network control.

Hans J. Briegel (Innsbruck and Konstanz)

Reinforcement learning and AI for quantum experiment.

Jose R. Correa (Universidad de Chile)

Recent progress on equilibria for flows over time.

Jan Draisma (U Bern)

Matroids: algebraicity, duality, and valuations. A matroid is a downward-closed set family such that for all cost functions on the ground set the greedy algorithm produces a minimal-cost maximal member of the family. Each matroid has a dual matroid, a notion closely related to duality in optimisation. Well-understood sources of matroids are graphs and linear spaces. Much less understood are *algebraic* matroids, which come from algebraic varieties. I will describe some tropical geometry of algebraic matroids that arise naturally in applications, and then discuss recent progress on the long-standing question whether the dual of an algebraic matroid is again algebraic. While we still do not know the answer to that question, I will show that slightly richer structures associated to algebraic varieties, namely the Lindström valuations on their matroids, are *not* closed under duality. The last part of the talk is based on joint work with Guus Bollen, Dustin Cartwright, and Rudi Pendavingh.

Dima Grigoriev (CNRS, INSMI-Lille)

Tropical Recurrent Sequences. Tropical recurrent sequences are introduced satisfying a given vector (being a tropical counterpart of classical linear recurrent sequences). We consider the case when Newton polygon of the vector has a single (bounded) edge. In this case there are periodic tropical recurrent sequences which are similar to classical linear recurrent sequences. A question is studied when there exists a non-periodic tropical recurrent sequence satisfying a given vector, and partial answers are provided to this question. Also an algorithm is designed which tests existence of non-periodic tropical recurrent sequences satisfying a given vector with integer coordinates. Finally, we introduce a tropical entropy of a vector, provide some bounds on it and extend this concept to tropical multivariable recurrent sequences.

Tobias Harks (U Augsburg)

Dynamic Flows with Adaptive Route Choice. We study dynamic network flows and introduce a notion of instantaneous dynamic equilibrium (IDE) requiring that for any positive inflow into an edge, this edge must lie on a currently shortest path towards the respective sink. We measure current shortest path length by current waiting times in queues plus physical travel times. As our main results, we show (1) existence of IDE flows, (2) finite termination of IDE flows for multi-source single sink networks assuming bounded and finitely lasting inflow rates, and, (3) the existence of a complex multi-commodity instance in which any IDE flow is caught in cycles and flow remains forever in the network. This is joint work with Lukas Graf and Leon Sering.

Rod van Meter (Keio)

Designing the quantum internet. The coming Quantum Internet will bring us new capabilities: advanced cryptographic functions, high-precision sensor networks for uses such as high-resolution astronomy, and secure distributed quantum computing. Experimental progress on the components for quantum repeaters is moving at a dizzying rate, and theorists have proposed various approaches to managing errors to create high-fidelity quantum entanglement. Building quantum networks presents different challenges from building quantum links. I will give an overview of these issues, then discuss the even more daunting challenge of creating a network of networks – an internetwork – and show how our simulations are guiding the design of a true quantum Internet.

Sang-il Oum (Institute for Basic Science and KAIST)

Survey on vertex minors.

Renato Renner (ETH)

Advantage Distillation in Quantum Communication.

Tim Roughgarden (Columbia)

TBA.

Kristin Shaw (U Oslo)

Patchworking of real algebraic curves: a tropical point of view. The study of the topology of real algebraic curves goes back over a 150 years, and the case of curves in the plane is one of Hilbert's famous problems at the turn of the 20th century. Viro's patchworking technique developed in the 1980's offers a powerful (and often combinatorial) method for constructing topological types of real algebraic curves in the plane, and it also applies to varieties of higher dimension. A contemporary view of Viro's patchworking formulates the construction using tropical geometry. This tropical point of view on patchworking has recently led to bounds on the Betti numbers of patchworked real algebraic varieties in terms of Hodge numbers of their complexifications (this is joint work with Arthur Renaudineau). In this talk, I will restrict only to the case of curves. I will survey Viro's original patchworking construction, Haas' tropical formulation and maximality conditions, and the work of Brugallé, Bertrand, and Renaudineau for the non-planar case. Finally I will present how using the joint work with Arthur Renaudineau, we can now further relate the combinatorics of graphs (tropical curves) to the topology of the real algebraic curves in the plane constructed via the patchworking procedure.

Bernd Sturmfels (UC Berkeley und MPI-MIS Leipzig)

Welcome to Tropical Geometry. This lecture is a gentle introduction to tropical geometry, aimed at those who have never seen this kind of mathematics before. We will start with arithmetic, discuss the quadratic formula and plane curves, and end up with phylogenetic trees.

Ngoc Mai Tran (U Texas, Austin)

Solve open problems in economics with tropical geometry. Tropical geometry has emerged as the variational approach to network flow problems, with a growing number of applications in numerous fields. In this talk, I will review the background and progress on three classes of problems in economics particularly suitable for tropical geometry: the quadratic pricing for combinatorial auctions, the matroid-based valuation conjecture, and characterizations of multiplayer mechanisms.

Marc Uetz (U Twente)

Shortest Paths, Mechanism Design, and Revenue Equivalence. Mechanism design is concerned with the problem of computing desired solutions in situations where data is distributed among selfish agents. Auctions are a prime example of this. We discuss some of the most fundamental questions in the design of mechanisms, and derive simple answers by interpreting these questions in graph theoretic terms. Doing that, several bits of mechanism design are reformulated as shortest path problems, among other things, leading to simple(r) proofs for some classical results. The talk is based on (but goes beyond) a joint paper with Heydenreich, Müller and Vohra. No prior knowledge of mechanism design is required.

László Végh (London School of Economics)

Strongly polynomial algorithms for market equilibrium computation. Most known strongly polynomial algorithms are for special classes of linear programs, and only few examples are known in nonlinear optimization. The talk will give an overview of two such results. The first result gives a strongly polynomial algorithm for some instances of flows with separable convex objectives, including separable convex quadratic objectives, as well as market equilibrium in linear Fisher markets. The second, more recent result provides the first strongly polynomial algorithm for exchange markets with linear utilities. These results can be obtained by extending the classical technique of variable fixing from linear programs to the convex settings. The main progress in both algorithms is gradually identifying edges in the support of the optimal solutions. This is based on joint work with Jugal Garg.

Stephanie Wehner (Delft)

TBA.