

CORE Seminar:

From conic programming to real algebraic geometry and back

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Abstract. In this talk, we will present interactions between conic programming, a branch of optimization, and real algebraic geometry, the algebraic and geometric study of real polynomial systems. This has led to a number of beautiful mathematical theorems, both improving our understanding of the geometric picture as well as sharpening our tools for applications.

On the optimization side, we will take a look at hyperbolic programs, an instance of conic programs first studied in the 1990s that comprises linear programs as well as semidefinite programs. On the algebraic side, it is based on the theory of hyperbolic respectively real stable polynomials, which show up in many parts of mathematics, ranging from control theory to combinatorics. In many ways, hyperbolic polynomials behave like determinants of families of symmetric matrices. We will compare these two paradigms, one based in matrix calculus, the other purely in algebraic geometry, through a series of examples, pictures, theorems, and conjectures.

Daniel Plaumann has been an associate professor at TU Dortmund, Germany, since 2016. His research interests are real and classical algebraic geometry, positive polynomials, matrix inequalities, and applications to optimization and functional analysis. He received his PhD in 2008 from the University of Konstanz. In 2010, he was a Feodor Lynen Fellow of the Alexander von Humboldt Foundation at UC Berkeley and in 2014 Research Fellow at the Nanyang Technological University in Singapore. He is currently a long-term visitor at the Simons Institute for the Theory of Computing in Berkeley.

Rainer Sinn has been an assistant professor for discrete geometry at Freie Universität Berlin, Germany, since 2017. His research interests are discrete, convex, and real algebraic geometry. He graduated from the University of Konstanz in 2014 with a fellowship of the German National Academic Foundation. In 2014, before moving to the Georgia Institute of Technology for a postdoc position with Greg Blekherman, he was a visiting researcher at the National Institute of Mathematical Sciences in Daejeon, Korea, during a Thematic Program on Applied Algebraic Geometry. In 2017, he was at the Max Planck Institute for Mathematics in the Sciences in Leipzig as a member of the Nonlinear Algebra group led by Bernd Sturmfels. He is currently a research fellow at the Simons Institute for the Theory of Computing in Berkeley.
