

## DRESDEN LEIPZIG SEMINAR ALGEBRA AND GEOEMTRY

**Clemens Brüser:** Determinantal Representations of Nonnegative Polynomials  
(joint work with Mario Kummer)

In this talk, I will present our work on the study of determinantal representations of globally nonnegative polynomials. We ask whether for a given polynomial  $p$  that is globally nonnegative, there exists a symmetric matrix  $M$ , the entries of which are quadratic forms of degree 2 such that

- $p$  is the determinant of  $M$
- $M$  is positive semidefinite upon evaluation in any given point.

For suitable polynomials  $p$  in three variables, we can answer this question in a hands-on fashion: Assuming that such a determinantal representation  $M$  exists, it defines a morphism of sheaves. The cokernel of this map can be explicitly described using methods of cohomology. This allows for verification whether  $M$  in the assumed form exists and - provided the answer is positive - a reconstruction of  $M$ .

We employ these tools to first reprove a (negative) result of Quarez 2015. We then apply them to the Robinson polynomial and prove that it does not admit such a determinantal representation either. This answers a question posed by Buckley and Sivic 2020.

**Joan Claramunt:** A graph-theoretic characterization of homeomorphisms on the Cantor set

We will explain a graph-theoretic model for dynamical systems given by a *homeomorphism* on the Cantor set. In order to make the dynamics appear explicitly in the graph, we use two-colored Bratteli separated graphs. This construction can be generalized to dynamical systems given by *surjective local homeomorphisms* on the Cantor set. We use this construction in order to write the Steinberg algebra associated with the dynamical system as a colimit of the graph algebras associated with the different levels of the corresponding graph. This enables us to compute several invariants of the dynamical system purely in terms of the graph.

This talk will be split into three parts. In the first part I will provide background necessary definitions, and recall the construction of the *Leavitt path algebra* associated with a separated graph. In the second part I will explain, with an example, how to construct a separated graph out of a dynamical system of our kind. In fact, this construction gives a *bijective* correspondence between dynamical systems of our kind and a (well-identified) subclass of separated graphs. Finally, in the last part of the talk, I will comment on the relation between the Steinberg algebra, defined purely in terms of the dynamical system, and the Leavitt path algebras of the different levels of the separated graph.

This is joint work with Pere Ara (Universitat Autònoma de Barcelona (UAB), Barcelona).

**Marco Lotz:** Reflection length at infinity in hyperbolic reflection groups

In a discrete group generated by hyperplane reflections in the  $n$ -dimensional hyperbolic space, the reflection length of an element is the minimal number of hyperplane reflections in the group that suffices to factor the element. For a Coxeter

group that arises in this way and does not split into a direct product of spherical and affine reflection groups, the reflection length is unbounded. The action of the Coxeter group induces a tessellation of the hyperbolic space. After fixing a fundamental domain, there exists a bijection between the tiles and the group elements. We describe certain points in the visual boundary of the  $n$ -dimensional hyperbolic space for which every neighbourhood contains tiles of every reflection length. To prove this, we show that two disjoint hyperplanes in the  $n$ -dimensional hyperbolic space without common boundary points have a unique common perpendicular.

**Lisa Seccia:** F-singularities of ideals of minors

This is meant to be an introductory talk on ideals of minors and their singularities in prime characteristic. These singularities are defined in terms of the Frobenius map, and they have gained significant attention in recent years due to their connection with “classical” singularities in birational geometry in characteristic zero. This talk will provide a concise overview on F-singularity theory. In particular, we will discuss the case of ideals generated by minors of a matrix of indeterminates.

**Simon Telen:** Hilbert functions in computational algebraic geometry

The problem of finding the smallest degree from which the Hilbert function equals the Hilbert polynomial is central in solving polynomial equations. In this talk, I will justify this claim and illustrate it for symmetric tensor decomposition, and for solving equations on Grassmannians and del Pezzo surfaces. This is joint work with Barbara Betti, Fulvio Gesmundo, Leonie Kayser and Marta Panizzut.

**Olga Varghese:** Automatic continuity-prominent examples in geometric group theory

Given two topological groups  $L$  and  $G$  and an algebraic morphism  $\varphi: L \rightarrow G$ , can we find conditions on the groups  $L$ ,  $G$  and the morphism  $\varphi$  ensuring that  $\varphi$  is continuous? In particular, we show that every algebraic epimorphism from a locally compact Hausdorff group into  $F_n$  or  $Aut(F_n)$  is continuous.