Algebraic groups and related topics
Groupes algébriques et sujets connexes

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FRANCOIS BERGERON, Université du Québec à Montréal

Structural Properties of Modules of Rectangular Multivariate Harmonic polynomials

Modules of rectangular $k \times n$-variate diagonal harmonic polynomials (for the symmetric group) afford two commuting actions, one for the general linear group GL_k, and one for the symmetric group S_n. These modules are a broad generalization of similar modules considered in the seminal work of Garsia and Haiman in relation to S_n-diagonal coinvariant spaces. These recent extensions make apparent deep ties between many areas of research such as: Rectangular Catalan Combinatorics, Homology of (m, n)-Torus Knots, Algebraic Geometry (Hilbert Scheme of points in the plane), and Theoretical Physics. We will describe many structural properties of the aforementioned $k \times n$-variate modules, which characterize their decomposition into irreducibles for both actions. If time allows, we will also describe intriguing links with operators that occur in the "Delta conjecture" of Haglund et al.

YIN CHEN, Northeast Normal University, Changchun, China

On vector modular invariant fields

Let G be one of the three groups $GL(n, \mathbf{F}_q), SL(n, \mathbf{F}_q)$ or $U(n, \mathbf{F}_q)$ and let W be the standard n-dimensional representation of G. For non-negative integers m and d we let $mW \oplus dW^*$ denote the representation of G given by the direct sum of m vectors and d covectors. Let $\mathbf{F}_q(mW \oplus dW^*)^G$ be the vector invariant field. In this talk, we give a collection of homogenous invariant polynomials $\{\ell_1, \ell_2, \ldots, \ell_{(m+d)n}\} \subset \mathbf{F}_q[mW \oplus dW^*]^G$ such that $\mathbf{F}_q(mW \oplus dW^*)^G = \mathbf{F}_q(\ell_1, \ell_2, \ldots, \ell_{(m+d)n})$ for all cases except when $md = 0$ and $G = GL(n, \mathbf{F}_q)$ or $SL(n, \mathbf{F}_q)$. This is a joint work with David L. Wehlau.

JIANJUN CHUAI, University of New Brunswick

On the polynomial property of invariant rings of p-groups

Let V be a finite-dimensional vector space over a field F of characteristic $p > 0$ and let $G \subset GL(V)$ be a finite p-group. Assume $F[V]^G$ is polynomial. In this talk, we develop conditions that guarantee that $F[V]^H$ is also polynomial, where H is a maximal subgroup of G.

This is joint work with Eddy Campbell.

EMILIE DUFRESNE, University of Nottingham

Mapping toric varieties into small dimensional spaces

A smooth d-dimensional projective variety X can always be embedded into $2d + 1$-dimensional space. In contrast, a singular variety may require an arbitrary large ambient space. If we relax our requirement and ask only that the map is injective, then any d-dimensional projective (resp. affine) variety can be mapped injectively to $2d + 1$-dimensional projective space (resp. affine). Focusing on the affine case, a natural question then arises: what is the minimal m such that an affine variety can be mapped injectively to m-dimensional affine space? In this talk I discuss this question for the afffine cones over normal toric varieties, with the most complete results being for the affine cones over Segre-Veronese varieties.

(joint work with Jack Jeffries)

ALEX DUNCAN, University of South Carolina

Automorphism groups of cubic surfaces in arbitrary characteristic

I discuss the possible automorphism groups of a smooth cubic surface over an algebraically closed field of arbitrary characteristic. While the classifications are wildly different in bad characteristics, it turns out that the differences can all be explained by a few small geometric observations. We will also completely characterize which surfaces and automorphism groups in positive characteristic can be lifted to characteristic 0.

CHRISTOPHE HOHLWEG, LaCIM, UQAM
Low elements and Shi arrangements

Low elements form a special finite subset of a given Coxeter group. They appeared in relation with the study of the word problem for Artin-Tits groups via Garside theory. In this talk, I will explain that, in the case of an affine Coxeter group, they share an intimate link with the corresponding Shi arrangements. Shi arrangements were introduced by Shi in the 80's to study Kazhdan-Lusztig cells in affine types. Finally, I will discuss some results and conjectures on how to generalize the affine framework to any infinite Coxeter group. (joint work with Nathan Chapelier (UQAM))

GREGOR KEMPER, Technical University of Munich
Quotients of connected solvable groups

Geometric invariant theory is concerned with constructing quotients of a variety X by an action of an algebraic group G. This talk deals with the case that G is connected and solvable, and presents an algorithm for producing a nonempty open subset $U \subseteq X$ and a universal geometric quotient of U. The algorithm does not require any Gröbner basis computations, and the quotient is in fact even better than only being universally geometric.

JOCHEN KUTTLER, University of Alberta
Derivations and differentials of Lie algebras

Derivations of Lie algebras play an important role in the construction of for example Extended Affine Lie Algebras. I will present an overview over the theory of differentials of Lie algebras which then allows a functorial approach to derviations, leading to the construction of algebraic Lie algebroids associated to forms of simple Lie algebras over a commutative ring. Similarly, in the spirit of Atiyah, one can associate a Lie algebroid to any simple group scheme over a ring.

This is joint work with Arturo Pianzola and Federico Quallbrunn.

NICOLE LEMIRE, University of Western Ontario
Birational Properties of Algebraic Tori

We discuss the rationality and birational linearisation problems for families of 4 and 5 dimensional algebraic tori. This is partly joint work with Armin Jamshidpey.

DAVID MUNDELIUS, Technical University of Munich
Arithmetic invariants of finite pseudoreflection groups

The famous Chevalley-Shephard-Todd theorem states that the ring of invariants of a finite pseudoreflection group over a field in which the group order is invertible is always isomorphic to a polynomial ring. Smith's proof of this theorem is based on the fact that a finitely generated graded algebra over a field is isomorphic to a polynomial ring if and only if it is regular. We generalize this idea to invariants with coefficients in a ring, more precisely in a Dedekind domain. If the group order of a pseudoreflection group is invertible we can show that also in this situation the ring of invariants is regular. Moreover, we prove regularity for such rings of invariants in some cases where the group order is not invertible. Finally, we characterize finitely generated regular graded algebras over Dedekind domains.

JIM SHANK, University of Kent
Modular Representations and Invariants of p-Groups

Invariant Theory seeks to construct polynomial functions with specified symmetry. I will discuss some current research in the modular case, i.e., when the characteristic of the field of coefficients is a prime number p which divides the order of the symmetry group.

ANNE SHEPLER, University of North Texas
Classical invariant theory

The classical invariant theory of reflection groups was motivated in part by connections with Lie group cohomology. The field attracted growing attention in its own right as results highlighted an appealing pattern: When a real or complex reflection group acts on a set, the collection of invariant objects often exhibits the same algebraic structure as the original set. The Shephard-Todd-Chevalley Theorem is a first example of this phenomenon, but invariant differential forms and derivations provide more examples. Indeed, Louis Solomon realized the space of invariant differential forms as an exterior algebra in its own right in 1963. We extend Solomon's Theorem to mixed differential forms using techniques of Gutkin and Opdam on characters. These results resolve some combinatorial conjectures on Hilbert series motivated by W-Catalan combinatorics. It also connects with conjectures on Lie groups and work of Bazlov, Broer, Joseph, Reeder, and Stembridge, as well as more recent work of Deconcini, Papi, and Procesi. Joint with Vic Reiner.

WILLIAM SLOFSTRA, University of Waterloo
The isomorphism type of Schubert varieties

Suppose X and Y are Schubert varieties in two (possibly different) full flag varieties of Kac-Moody type. I will give a combinatorial criterion for X and Y to be isomorphic.

NANCY WALLACE, UQAM
Explicit formulas for the Multiplicities of Some Irreducible Components of $(GL_\infty) - \mathbb{S}_n$-Modules of Coinvariants.

For François Bergeron's multivariate generalization of Garcia and Haiman's $\mathbb{S}_n$-diagonal coinvariant space is a $(GL_\infty) - \mathbb{S}_n$-Modules, I found explicit combinatorial formulas for some of the components of the characters of these modules. This relates to recent work of Gorsky, Negut and Rasmussen on the Euler characteristic of some sheaves on the flag Hilbert scheme, as well as the work of Hogancamp on the Hilbert-Poincaré series of the Khovanov-Rosansky homology of torus links.