List of abstracts

Marian Aprodu

IMAR & University of Bucharest, Romania

Ulrich bundles on projective surfaces

An Ulrich bundle on a projective variety is a vector bundle that admits a completely linear resolution as a sheaf on the projective space. Ulrich bundles are semi-stable and the restrictions to any hyperplane section remain semi-stable. This notion originates in classical algebraic geometry, being related to the problem of finding, whenever possible, linear determinantal or linear pfaffian descriptions of hypersurfaces in a complex projective space. Generally, the existence of an Ulrich bundle has nice consequences on the equations of the given variety, specifically, the Cayley-Chow form is the determinant of a matrix of linear forms in the Pluecker coordinates. We discuss recent results on the existence of rank-two Ulrich bundles on surfaces. The talk is mainly based on joint works with G. Farkas, A. Ortega, and with L. Costa, R. M. Miro-Roig.

Vasile Brînzănescu

IMAR, Romania

Moduli spaces of vector bundles on ruled surfaces

Different moduli spaces of vector bundles over ruled surfaces will be recalled: moduli spaces defined by numerical invariants, moduli spaces of stable vector bundles and moduli spaces of Higgs bundles. Some recent results on co-Higgs vector bundles over ruled surfaces will be presented.

Marc Chardin

Institut Mathématique de Jussieu, France

The ubiquity of Koszul homology

The Koszul homology plays an important role in a number of situations. It is useful for studying residual intersections, as already remarked long ago by Craig Huneke, or for understanding images and fibers of rational maps. Another example is the understanding of syzygies of rings of invariants, or of Veronese rings. In some applications, duality results on Koszul homology are important. They extend the one of Jürgen Herzog in his Habilitationsschrift and could deserve further investigation.

Aldo Conca

Universita degli Studi di Genova, Italy

Lovász-Saks-Schrijver ideals and coordinate sections of determinantal varieties

The goal of the talk is to present results concerning Lovász-Saks-Schrijver ideals and their connection with the study of coordinate sections of determinantal ideals. This is a joint work with Volkmar Welker.

Sorin Dăscălescu

Universitatea din Bucureşti, Romania

Gradings on matrix algebras and generalized flags

We discuss group gradings on the full matrix algebra $M_n(k)$ over a field k, and on certain subalgebras of $M_n(k)$. These subalgebras are related to some algebraic-combinatorial objects, called generalized flags. A special class of such gradings arises from generalized flags equipped with a grading; these can be classified as orbits of a certain action.

Viviana Ene

Universitatea Ovidius, Romania

Ideals of 2–minors associated with pairs of graphs

In this talk we survey various properties of binomial edge ideals defined on generic $m \times n$–matrices whose generators are indexed by pairs of graphs. This class of ideals generalizes in a natural way the classical binomial edge ideals and the ideals generated by adjacent minors. We mainly focus on the results obtained in joint papers with H. Baskoroputro, C. Ion, J. Herzog, T. Hibi, A. Qureshi.

Florian Enescu

Georgia State University, USA

On certain aspects of the Frobenius homomorphism

In this talk, we will present various applications of Frobenius related concepts to finite fields and local rings of positive characteristic.

Mihai Fulger

Princeton University, USA

Seshadri constants for curve classes

Seshadri constants are a classical concept for studying local positivity for ample line bundles around points of a projective variety. Taking the case of surfaces as inspiration, we find a different generalization to arbitrary dimension. We define and study Seshadri constants for movable curve classes at points of projective varieties. We find analogues for curve classes of several results that are classical for divisor classes. Among them we find a Seshadri ampleness criterion, and a Seshadri characterization of the augmented base locus and one for jet separation.

Herwig Hauser

Universität Wien, Austria

The mystery of algebraic power series

A formal or convergent power series in several variables is called "algebraic" if it satisfies a polynomial equation with polynomial coefficients. Despite the simple definition, there is no complete theory - the many individual theorems are scattered over analysis, algebra and combinatorics. They often do not relate to each other. As a matter of illustration we survey some of these results, and will then pick up some more specific aspects to be discussed in detail.

Example: The series $h(x)$ in one variable all whose coefficients are 0 except those in front of x^{2^k}, for k in $\mathbb{N}$, which are taken equal to 1, is algebraic over a field of characteristic 2 and transcendental otherwise.

The talk addresses a general audience.

Jürgen Herzog

Universität Duisburg-Essen, Campus Essen, Germany

Ordinary and symbolic powers and the Golod property

Let R be a standard graded K-algebra with graded maximal ideal $\mathfrak{m}$. The formal power series $P_R(t) = \sum_{i\geq 0} \dim_K \operatorname{Tor}_i(R/\mathfrak{m}, R/\mathfrak{m})t^i$ is called the Poincaré series of R. In general, $P_R(t)$ is not a rational series. However, Serre showed that $P_R(t)$ is coefficientwise bounded above by the rational series

$$\frac{(1+t)^n}{1 - t\sum_{i\geq 1} \dim_K H_i(\mathbf{x}; R)t^i},$$

where $\mathbf{x} = x_1, \ldots, x_n$ is a minimal system of generators of $\mathfrak{m}$ and where $H_i(\mathbf{x}; R)$ denotes the ith Koszul homology of the sequence $\mathbf{x}$.

The ring R is called Golod, if $P_R(t)$ coincides with this upper bound given by Serre. Obviously the residue field of a Golod ring has a rational Poincaré series.

Suppose $R = S/I^k$, where $S = K[x_1, \ldots, x_n]$ is the polynomial ring over a field K and I is a graded ideal. In this lecture we report on a joint result with Craig Huneke, in which we show that if the characteristic of K is zero, then R is Golod for all $k \geq 2$. The same holds true for the symbolic and saturated powers of I. However the corresponding result in positive characteristic is still open. Only recently, in a joint paper with Maleki, we showed that S/I^k is Golod in all characteristics if I is a monomial ideal. A local version of the theorem is also missing.

The method to derive the above mentioned results is based on an explicit description of the Koszul cycles representing the homology classes of $H_i(\mathbf{x}; R)$. This description is given in terms of the data provided by the minimal free S-resolution of $R = S/I$.

References

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Radu Laza

Stony Brook University, USA

Some remarks on degenerations of Hyper-Kaehler Manifolds

The key tool for understanding degenerations of K3 surfaces is the Kulikov-Persson-Pinkham theorem (a semi-stable degeneration of K3 surfaces can be modified to have trivial canonical bundle). Recent advances in MMP (with essential further contributions from Fujino) give an analogous result on higher dimensional HK manifolds. In this talk, I will explore some geometric consequences of this result (e.g. a simplification of some proofs of deformation type for certain HK constructions, and some results on the dual complex of a semi-stable degeneration of HKs). This is a report on joint work with J. Kollr, G. Sacca, and C. Voisin.

Mircea Mustaţă

University of Michigan, USA

A vanishing theorem for rational singularities

Given a variety Z with rational singularities, and a log resolution Y of Z, with exceptional divisor E, we conjecture the vanishing of the (n-1)th higher direct image of the sheaf of differential forms on Y, with log poles along E. I will discuss a proof in the case of isolated singularities. This is joint work with Sebastian Olano and Mihnea Popa.

Ştefan Papadima

IMAR, Romania

Moduli spaces and finiteness issues in deformation theory

Finiteness properties are crucial in understanding the structure of moduli spaces, both global and local. I will illustrate this point on highly natural examples, coming from algebraic geometry and topology. I will explain a couple of deep consequences of the relevant finiteness properties, and I will discuss recent obstructions related to these properties. This is joint work with Alex Suciu (Northeastern University).

Gerhard Pfister

Universität Kaiserslautern, Germany

On Modular Computations of Problems over $\mathbb{Q}$

A standard method for finding a rational number from its values modulo a collection of primes is to determine its value modulo the product of the primes via Chinese remaindering, and then use Farey sequences for rational reconstruction. Successively enlarging the set of primes if needed, this method is guaranteed to work if we restrict ourselves to good primes. Depending on the particular application, however, there may be no efficient way of identifying good primes. In the algebraic and geometric applications we have in mind, the final result consists of an a priori unknown ideal (or module) which is found via a construction yielding the (reduced) Groebner basis of the ideal. In this context, we discuss a general setup for modular and, thus, potentially parallel algorithms which can handle “bad” primes. A key new ingredient is an error tolerant algorithm for rational reconstruction via Gaussian reduction.

Claudiu Raicu

University of Notre Dame, USA

Regularity of determinantal thickenings

Consider the ring $S = \mathbb{C}[x_{ij}]$ of polynomial functions on the vector space $\mathbb{C}^{(m\times n)}$ of complex $m \times n$ matrices. The action of the group $\mathrm{GL} = \mathrm{GL}_m \times \mathrm{GL}_n$ via row and column operations on $\mathbb{C}^{(m\times n)}$ induces an action on S. I will explain how to calculate, for every GL-invariant ideal I in S and every $j \geq 0$, the modules $\mathrm{Ext}^j_S(S/I, S)$ as well as the kernels and cokernels of the maps $\mathrm{Ext}^j_S(S/I, S) \to \mathrm{Ext}^j_S(S/J, S)$ induced by inclusions of such ideals. As a consequence, I will give a formula for the regularity of the powers and symbolic powers of generic determinantal ideals, and in particular characterize which powers have a linear minimal free resolution.

Marko Roczen

Humboldt-Universität zu Berlin, Germany

Some Semi-Quasihomogeneous Singularities with given Saito-Invariant

Let k be an algebraically closed field of any characteristic, $f \in k[\mathbf{X}]$ a polynomial in the indeterminates $\mathbf{X}$ which is *quasihomogeneous of weight* $\mathbf{w}$ and such that it defines an isolated singularity at the origin. The number $s = s(\mathbf{w})$ denotes the combinatorial expression of an invariant introduced by Kyoji Saito for quasi-homogeneous islolated singularities of complex hypersurfaces. Apparently, it gives rise to some aspects of the classification of semi-quasihomogeneous isolated singularities, i.e. of singularities with *quasihomogeneous principal part*: For $s < 1$ the corresponding singularities are the ADE-singularities (contact simple singularities) in any characteristic. The general case – over the field of complex numbers has gained interest in theoretical physics. From the explicit description of ADE-singularities follows that $s = 1$ is the smallest accumulation point of possible values for $s(\mathbf{w})$. The present talk is devoted mainly to the case $s \geq 1$ up to the next accumulation point. We conclude formulating a conjecture on the existence of a general Saito-invariant.

Guillaume Rond

Institut de Mathématiques de Marseille, France

Topological algebraicity of analytic set or function germs

(joint work with M. Bilski and A. Parusinski) T. Mostowski proved that every analytic set germ is homeomorphic to the germ of an algebraic set. Using similar ideas we show that every analytic function germ is topologically equivalent to a polynomial function germ. The main tools are the nested approximation theorem due to D. Popescu and Zariski equisingularity.

Alexandra Seceleanu

University of Nebraska, USA

Symbolic powers and line arrangements

The problem of describing the set of polynomials vanishing to a prescribed order at every point of a given variety leads to challenging questions. Algebraically, these questions can be formulated in terms of symbolic powers of homogeneous ideals. A fundamental formula connecting the symbolic powers and the ordinary powers of ideals in regular rings was given by Ein, Lazarsfeld, and Smith in 2001 and extended by Hochster and Huneke in 2002. For most (but not all) ideals defining points in the plane, it was proven by Bocci and Harbourne that symbolic powers behave better than predicted by these results. In this talk, we take a closer look at some counterexamples to an improved containment formula obtained from singular loci of line arrangements and highlight various techniques that can be employed to study them.

Peter Symonds

University of Manchester, United Kingdom

The Asymptotic Behavior of Frobenius Direct Images of Rings of Invariants

We define the Frobenius limit of a module over a ring of prime characteristic to be the limit of the normalized Frobenius direct images in a certain normed Grothendieck group. If this exists then the coefficient of the free module of rank 1 is the usual F-signature. When a finite group acts on a polynomial ring, we calculate this limit for all the modules over the twisted group algebra that are free over the polynomial ring; we also calculate the Frobenius limit for the restriction of these to the ring of invariants.