Sesión Especial 26

Red de Geometría Algebraica y Singularidades

Organizadores

- Maria Alberich-Carramiñana (Universitat Politècnica de Catalunya)
- Francisco J. Castro Jiménez (Universidad de Sevilla)
- Félix Delgado de la Mata (Universidad de Valladolid)
- Daniel Hernández Ruipérez (Universidad de Salamanca)

Descripción

En esta sesión se presentan los recientes avances en el ámbito de la Geometría Algebraica y las Singularidades, dentro del marco de la Red de Geometría Algebraica y Singularidades (`http://www.mat.ucm.es/~rgas/index.php.html`).

Programa

Martes, 5 de febrero (tarde)

17:00 - 17:30	Víctor González Alonso (Universidad de Hannover) *Secciones "constantes" en variaciones de estructuras de Hodge*
17:30 - 18:00	Ignacio Ojeda Martínez de Castilla (Universidad de Extremadura) *Uniqueness of Limit Cycles for Quadratic Vector Fields*
18:00 - 18:30	Guillem Blanco (Universitat Politècnica de Catalunya) *Poles of the complex zeta function of a plane curve*
18:30 - 19:00	Raúl Oset Sinha (Universidad de Valencia) *Liftable vector fields, unfoldings and augmentations*

Jueves, 7 de febrero (mañana)

11:30 - 12:00	Roberto Giménez Conejero (Universidad de Valencia) *A weak version of Mond's Conjecture for corank 1 maps and applications.*
12:00 - 12:30	María Cruz Fernández Fernández (Universidad de Sevilla) *On the Gevrey expansion of some hypergeometric integrals*
12:30 -13:00	Pedro González Pérez (Universidad Complutense de Madrid) *Ultrametric properties of spaces of branches on normal surface singularities*

13:00 - 13:30 Beatriz Pascual Escudero (Universidad Autónoma Madrid)
Espacios de arcos y Resolución Constructiva de Singularidades

Jueves, 7 de febrero (tarde)

15:30 - 16:00 Pablo Simon Isaza (Universidad Complutense de Madrid)
CW Decompositions of Algebraic Curves within the Affine Space

16:00 - 16:30 Carlos Jesús Moreno Ávila (Universidad Jaume I de Castellón)
Conditions for the finite polyhedrality of the cone of curves of rational surfaces

16:30 - 17:00 Ana Belén de Felipe Paramio (Universidad de Barcelona)
Extension of valuations to the henselization

17:30 - 18:00 Marta Pérez Rodríguez (Universidad de Vigo)
Frobeniuserías formales y cohomología de variedades singulares.

18:00 - 18:30 Martí Lahoz Vilalta (Universidad de Barcelona)
Stability Conditions, Cubic Fourfolds and Hyperkäler manifolds

Viernes, 8 de febrero (mañana)

9:00 - 9:30 Ana Cristina López Martín (Universidad de Salamanca)
Categorías derivadas y curvas de Kodaira

9:30 - 10:00 Laura Brustenga (Universidad Autónoma de Barcelona)
Relative clusters for smooth families.

10:00 - 10:30 Angel Muñoz Castañeda (Universidad de León)
On the compactification of the universal moduli space of principal G-bundles

10:30 -11:00 Rubén Blasco-García (Universidad de Zaragoza)
Quasi-projective Artin groups

11:30: - 12:00 Miguel Ángel Marco Buzunáriz (Universidad de Zaragoza)
Heegaard splittings of graph manifolds

12:00 - 12:30 Adolfo Quirós Gracián (Universidad Autónoma Madrid)
q-correspondencia de Simpson: una aplicación aritmética de los operadores diferenciales "torcidos"

12:30 -13:00 Francisco Monserrat Delpalillo (Universidad Politécnica de Valencia)
Minimal valuations and Newton-Okounkov bodies

Poles of the complex zeta function of a plane curve

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Abstract. Given a plane curve singularity $f : (\mathbb{C}^2, \mathbf{0}) \to (\mathbb{C}, 0)$, we will study the poles and residues of the complex zeta function f^s of f. We will prove that most non-rupture divisors do not contribute to poles of f^s or roots of the Bernstein-Sato polynomial $b_f(s)$ of f. For plane branches we can give an optimal set of candidates for the poles of f^s from the rupture divisors and the characteristic sequence of f. Furthermore, we will prove the existence of a generic plane branch f_{gen} in the equisingularity class of f such that all the candidates are poles of f^s_{gen}. As a consequence, we prove Yano's conjecture for any number of characteristic exponents assuming that the eigenvalues of the monodromy of f are pairwise different.

Quasi-projectivity of Artin groups

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Abstract. A quasi-projective group is a group that can be realized as the fundamental group of a quasi-projective variety. The problem of knowing if a certain group is quasi-projective or not is known as Serre's problem. This problem had been solved for certain families of Artin groups: spherical Artin groups, affine Artin groups and right-angled Artin groups (RAAGs).
In this talk I will speak about this problem and explain a result that characterizes the family of quasi-projective even Artin groups. Moreover, we will state a stronger problem that we will call "Quasi-projective $K(\pi, 1)$ Conjecture"that is also satisfied by this family of even Artin groups.

Joint work with José Ignacio Cogolludo

Relative clusters for smooth families

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Abstract. In the talk we will discuss a generalisation of clusters of points to the relative setting. When the family is smooth, we are able to show that relative clusters form a representable functor. We will recall the construction of Kleiman's iterated blow-ups, which are the representing schemes for the absolute case.
Thereafter we will focus on and work out an explicit example of length two relative clusters. The example is geometric and interesting in its own, but hopefully, it will also share some insight about the general situation.

Joint work with J. Roé
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Extension of valuations to the henselization

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Abstract.
I will present a generalization to all local domains of a result of [HOST]. It concerns the uniqueness of the extension of a valuation ν dominating a local excellent domain R to a valuation of a quotient of the henselization of R by a minimal prime, and the fact that it has the same value group. This is related to the problem of local uniformization and finds applications in the study of the space of valuations centered at a point of an algebraic variety [de Felipe-1].
Our method assumes neither that R is noetherian nor that it is integrally closed. We reduce the problem to the extension of ν to a quotient of a standard étale local R-algebra. In that setting we draw valuative consequences from the observation that the Newton–Hensel algorithm for constructing roots of polynomials produces sequences that are always pseudo–convergent in the sense of Ostrowski.

Referencias

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[HOST] F. J. Herrera, M. A. Olalla, M. Spivakovsky, B. Teissier. *Extending a valuation centered in a local domain to the formal completion*, Proc. London Math. Soc. **105** (2012), no. 3, 571–621.

Joint work with B. Teissier.

On the Gevrey expansion of some hypergeometric integrals

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Abstract. Let $A \in \mathbb{Z}^{d\times n}$ be a rank d matrix and $\beta \in \mathbb{C}^d$ a parameter vector. Gelfand, Graev, Kapranov, Zelevinsky and, later, Adolphson introduced and studied the so called A-hypergeometric or GKZ system $M_A(\beta)$. It is a system of linear partial differential equations on $\mathbb{C}^n$ that vastly generalize the classical hypergeometric equations in one variable. Adolphson introduced hypergeometric integrals representations of such solutions. These type of integrals, but along certain explicit cycles, were also considered by Gelfand and Graev for the study of GG-systems and their relation to A-hypergeometric systems. We study hypergeometric integrals along a slightly modified version of the above mentioned cycles. Under certain conditions on (A, β), we find a set of integrals so that their Gevrey asymptotic expansions form a basis of the space of Gevrey solutions of $M_A(\beta)$ along a coordinate hyperplane. Finally, we also prove that they are equal to integrals with the same integrand but along rapid decay cycles in the sense of Hien. Our result generalizes a previous result by my coauthors, Castro and Granger in the case when $d = 1$.

Joint work with Francisco-Jesús Castro-Jiménez and Michel Granger.
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A weak version of Mond's Conjecture for corank 1 maps and applications.

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Abstract. In this work we have proved that, being $f : (\mathbb{C}^n, S) \to (\mathbb{C}^{n+1}, 0)$ of corank 1 and finitely $\mathcal{A}$-determined, $\mu_I(f) = 0$ if, and only if, f is a stable germ. This is a weak version of Mond's Conjecture, $\mu_I(f) \geq codim_{\mathcal{A}_e}(f)$, with our hypotheses.
We also develop some interesting results, for example the upper semicontinuity of $\mu_I(f_t)$, to prove a Houston's conjecture on excellent unfoldings in Gaffney's sense. The formal statement of this conjecture is that μ_I constant implies f_t excellent, for corank 1 germs.

Joint work with Juan J. Nuño Ballesteros
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Ultrametric spaces of branches on normal surface singularities

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Abstract. Let L be a fixed *branch* – that is, an irreducible germ of curve – on a normal surface singularity X. If A, B are two other branches, define

$$u_L(A, B) := \frac{(L \cdot A)\,(L \cdot B)}{A \cdot B},$$

where $A \cdot B$ denotes Munford's intersection number of A and B. If X is smooth a reformulation of a theorem of Płoski states that the function $u_L(A, B)$ is an ultrametric distance on the set of branches (different from L). Our aim is to study extensions of this result to normal surface singularities. The singularity X is *arborescent* if the dual graph of any good resolution is a tree. We prove that u_L is an ultrametric distance on the set of branches of X, different from a fixed branch L, if and only if X is arborescent. More generally, we describe arbitrarily large sets of branches of X, characterized in terms of their embedded resolution, in restriction to which the function u_L is an ultrametric. These results extend to certain subsets of semivaluation spaces. Joint work with Evelia García Barroso, Patrick Popescu-Pampu and Matteo Ruggiero.

Sobre el "rango de Higgs" de familias de curvas

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Resumen. Dada una familia de curvas proyectivas (complejas, lisas) $f\colon \mathcal{C} \to B$, una sección del fibrado de Hodge asociado $E_f = f_*\Omega^1_{\mathcal{C}/B}$ define una 1-forma diferencial en cada fibra. Las secciones "constantes", obtenidas como restricción de una única 1-forma en $\mathcal{C}$, generan un subfibrado plano $\mathcal{U} \subseteq E_f$. Acotar el rango de $\mathcal{U}$ tiene aplicaciones por ejemplo en la geografía de superficies fibradas o en la conjetura de Coleman-Oort sobre la (no) existencia de variedades de Shimura en el "Torelli locus". En un trabajo anterior (con L. Stoppino y S. Torelli) estudiamos el rango de $\mathcal{U}$ acotando el rango de otro subfibrado *a priori* más grande: el núcleo $\mathcal{K}$ del campo de Higgs asociado a la familia, cuyas secciones definen 1-formas en las fibras que admiten extensiones en primer orden. Es por tanto natural estudiar si la inclusión $\mathcal{U} \subseteq \mathcal{K}$ puede ser estricta y hasta qué punto, lo que podría mejorar las cotas para el rango de $\mathcal{U}$.
En esta charla presentaré técnicas que permiten estimar ambos rangos, así como construir familias de curvas donde $\mathcal{K}$ tiene rango arbitrario y diferente de $\mathcal{U}$, es decir, donde 1-formas que extienden a primer orden alrededor de todas las fibras, no extienden en ningún entorno abierto.

Trabajo en colaboración con Sara Torelli (Pavia)

CW Decompositions of Algebraic Curves within the Affine Space.

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Resumen. We construct a CW decomposition of a polydisk, having a simple algebraic curve as a subcomplex, and use it to construct a CW decomposition of the Milnor fiber for quasi-ordinary singularities with a single Puiseux pair. By using this decomposition we calculate the homology of the fiber and the action of the monodromy. With this as a motivation we provide a method for constructing a CW decomposition of the pair of an algebraic curve and the bidimensional affine space. Based on this method we made a program that calculates this decomposition explicitly from the braid monodromy of the curve.

Stability Conditions, Cubic Fourfolds and Hyperkähler Manifolds

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Abstract. The derived category of coherent sheaves on a smooth cubic fourfold has a subcategory, recently studied by Kuznetsov, Addington-Thomas and Huybrechts among others, that can be thought as the derived category of a non-commutative K3 surface.
In this talk, I will present this category and joint work in progress together with Bayer, Macrì, Nuer, Perry and Stellari about the construction of hyperkähler manifolds as moduli spaces of objects in it. The starting point is a method to induce Bridgeland stability conditions on semiorthogonal decompositions [1]. I will also explain how this result allows us to reinterpret previous work of the speaker concerning cubic threefolds and fourfolds [2, 3, 4].

Referencias

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Joint work with A. Bayer, E. Macrì, H. Nuer, A. Perry and P. Stellari.
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Categorías derivadas y curvas de Kodaira

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Resumen. Dos esquemas X e Y se dicen D-equivalentes si sus categorías derivadas de complejos acotados de haces coherentes son equivalentes como categorías trianguladas. En esta charla, abordaremos el problema de la D-equivalencia para las curvas de Kodaira (degeneraciones de curvas elípticas). Daremos condiciones necesarias para que dos curvas de Kodaira (incluyendo aquellas que tienen nilpotentes o que son curvas múltiples) sean D-equivalentes. En el caso de las curvas de Kodaira que son reducidas, clasificaremos completamente las asociadas de Fourier-Mukai y calcularemos cuándo la categoría derivas de singularidades es idempotentemente completa.

Heegaard splittings of graph manifolds

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Abstract. It is well known that the boundary of a regular neighbourhood of a complex surface singularity has the structure of a graph manifold. One possible way to represent 3-manifolds is in terms of Heegaard splittings. Osvath and Szabo defined a homology theory for 3-manifolds in terms of these splittings that can be useful to understand certain properties of singularities. Moreover, Sarkar and Wang gave a method to compute this homology from the corresponding Heegaard diagram
In this talk, we present a explicit way to construct a Heegaard splitting, and the corresponding diagram, from the decorated graph. The construction follows the construction of the graph, starting from the vertices and then joining the pieces according to the edges.

Joint work with E. Artal and S. Isaza-Peñaloza
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Minimal valuations and Newton-Okounkov bodies

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Abstract.
We consider the value $\hat{\mu}(\nu) = \lim_{m\to\infty} m^{-1}a(mL)$, where $a(mL)$ is the last value of the vanishing sequence of $H^0(mL)$ along a divisorial or irrational valuation ν centered at $\mathcal{O}_{\mathbb{P}^2,p}$, L (respectively, p) being a line (respectively, a point) of the projective plane $\mathbb{P}^2$ over an algebraically closed field. This value contains, for valuations, similar information as that given by Seshadri constants for points. It is always true that $\hat{\mu}(\nu) \geq \sqrt{1/\mathrm{vol}(\nu)}$ and minimal valuations are those satisfying the equality. We extend a result of [1] to arbitrary divisorial and irrational plane valuations (centered at a point of p of $\mathbb{P}^2$) proving that the Greuel-Lossen-Shustin Conjecture implies a variation of the Nagata Conjecture involving minimal valuations (which also implies the original one). We also provide infinitely many families of very general minimal valuations with an arbitrary number of Puiseux exponents, and an asymptotic result that can be considered as an evidence in the direction of the mentioned conjecture. Also we give an explicit description of the Newton-Okounkov body of the flag associated with an infinitely singular plane valuation (centered at p) showing that it is either a triangle or a quadrilateral (and characterizing each case).

Referencias

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The talk is based on joint works with C. Galindo, J. J. Moyano and M. Nickel.
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Conditions for the finite polyhedrality of the cone of curves of rational surfaces.

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Abstract. There is no characterization of finite generation of the cone of curves of a surface. However, C. Galindo and F. Monserrat have given equivalent conditions for the regularity of the cone of curves of surfaces given by divisorial valuations of the fraction field of $\mathcal{O}_{\mathbb{P}^2,p}$ centered at $\mathcal{O}_{\mathbb{P}^2,p}$, where $\mathbb{P}^2$ is the projective plane and $p \in \mathbb{P}^2$ is a closed point. As the rational surfaces can be obtained by blowing-up configurations of infinitely near points of the projective plane or a Hirzebruch surface, it is interesting to consider surfaces Z obtained by a finite simple sequence of point blowing-ups at a Hirzebruch surface. In this talk, we will give valuative conditions which will be equivalent to the finite polyhedrality of the cones of curves of surfaces Z as above.

Joint work with C. Galindo and F. Monserrat.
Partially supported by the Spanish Government Ministerio de Economía, Industria y Competitividad (MINECO), grant MTM2015-65764-C3-2-P

On the compactication of the universal moduli space of principal G-bundles

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Abstract.
Let G be a complex reductive group. The moduli space of semistable principal G-bundles over a smooth projective curve of genus $g \geq 2$ is well understood. In case $G = \mathrm{GL}_n$, its compactification when the curve is allowed to have nodal points as singularities, as well as the compactification of the universal moduli space over $\overline{M}_g$, is also known. However, this is no longer true for more general groups, even in the case $G = \mathrm{SL}_n$.
In this talk, I will discuss the construction of the moduli space of semistable principal G-bundles on a smooth projective curve given by A. Schmitt, and how thsese ideas lead to a compactification of the universal moduli space of semistable principal G-bundles over $\overline{M}_g$ ([1, 2]).

Referencias

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[2] Munõz Castanẽda, A. L., A compactification of the universal moduli space of principal G-bundles, arXiv:1806.06300v2 [math.AG] (2018).

Uniqueness of Limit Cycles for Quadratic Vector Fields

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Abstract. This talks deals with the study of the number of limit cycles surrounding a critical point of a quadratic planar vector field, which, in normal form, can be written as $x' = a_1x - y - a_3x^2 + (2a_2 + a_5)xy + a_6y^2$, $y' = x + a_1y + a_2x^2 + (2a_3 + a_4)xy - a_2y^2$. In particular, we study the semi-varieties defined in terms of the parameters $a_1, a_2, \ldots, a_6$ where some classical criteria for the associated Abel equation apply. The proofs combine classical ideas with tools from computational algebraic geometry.

Joint work with J.L. Bravo, M. Fernández, I. Ojeda, F. Sánchez

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Liftable vector fields, unfoldings and augmentations

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Abstract. We study liftable vector fields of smooth map-germs. Liftable vector fields have been a key tool to classify singularities since Arnol'd introduced them in the 80's. We show how to obtain the module of liftable vector fields of any map-germ of finite singularity type from the module of liftable vector fields of a stable unfolding of it. As an application, we obtain the liftable vector fields for the family H_k in Mond's list. We then show the relation between the liftable vector fields of a stable germ and its augmentations.

Joint work with J. J. Nuño-Ballesteros

Singularidades a través de los arcos y la sucesión de multiplicidades de Nash

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Resumen. Los espacios de arcos se han demostrado útiles en el estudio de numerosos aspectos de las variedades algebraicas: propiedades geométricas, algebraicas o topológicas, por ejemplo. En particular, es interesante cómo los arcos detectan las singularidades de una variedad y proporcionan algunos invariantes muy ilustrativos, y que permiten además conectar distintas líneas de investigación en este campo.

Expondremos algunos resultados en este sentido, tomando como guía la pregunta de qué pueden decirnos los arcos según el contacto que muestran con un cierto cerrado dentro de una variedad singular.

Trabajo en colaboración con Ana Bravo Zarza y Santiago Encinas Carrión

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Frobeniuserías formales y cohomología de variedades singulares

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Resumen. Para una cierta clase de variedades proyectivas singulares sobre un cuerpo perfecto de característica p, se establecen un teorema de degeneración de la sucesión espectral de Hogde-De Rham y un teorema de anulación del tipo Kodaira-Akizuki-Nakano. Los resultados utilizan de forma esencial el morfismo de Frobenius sobre esquemas formales lisos con esquema subyacente singular.

Trabajo en colaboración con Leovigildo Alonso Tarrío y Ana Jeremías López
Financiado por el Ministerio de Economía, Industria y Competitividad y por el Fondo Europeo de Desarrollo Regional, MTM2017-89830-P

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q-correspondencia de Simpson: una aplicación aritmética de los operadores diferenciales «torcidos»

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Resumen. Estudiamos desde un punto de vista algebraico la noción de operador diferenciales torcidos (*twisted* en inglés) [3] que, además de los operadores diferenciales usuales, incluye los operadores en q-diferencias. Queremos poder trabajar en q-característica positiva, es decir, cuando q es una raíz p-ésima primitiva de la unidad.
En esta situación, igual que en característica positiva, es necesario usar potencias dividas, ahora torcidas. A partir de ellas podemos construir versiones torcidas del algebra de Weyl y de la p-curvatura, así como un morfismo de Frobenius dividido, y demostrar [2] un q-análogo de la correspondencia de Simpson entre módulos con conexión integrable y fibrados de Higgs [6], o más exactamente, de la versión local de esta correspondencia que Ogus y Vologodsky establecieron en característica positiva [4].
Cuando el anillo base es de p^N -torsion, con p-primo, nuestra correspondencia se puede ver como una q-deformacion, en el sentido de [5], de la de Ogus-Vologossky, y el objetivo final es entender la correspondencia de Simpson p-ádica [1] como confluencia de q-correspondencias.
En la charla se presentarán las herramientas básicas de esta teoría y se esbozarán algunas de sus aplicaciones.

Referencias

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Trabajo en colaboración con M. Gros y B. L Stum (U. de Rennes, Francia)
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