PRIMER ENCUENTRO DE LA RED DE POLINOMIOS ORTOGONALES Y TEORÍA DE APROXIMACIÓN

ORTHONET 2013

LOGROÑO, 22 Y 23 DE FEBRERO DE 2013

Reunidos el 25 de mayo de 2012, en la Universidad Carlos III de Madrid, los investigadores principales de proyectos de investigación financiados por el Plan Nacional de I+D+I (u otras instancias universitarias y autonómicas) dentro del Área de Polinomios Ortogonales, Funciones Especiales y Aplicaciones, a saber

- Dolores Barrios Rolanía (Universidad Politécnica de Madrid)
- Óscar Ciaurri Ramírez (Universidad de La Rioja)
- Antonio Durán Guardeño (Universidad de Sevilla)
- Eduardo Godoy Malvar (Universidad de Vigo)
- Pablo González Vera (Universidad de La Laguna)
- José Luis López García (Universidad Pública de Navarra)
- Francisco Marcellán Español (Universidad Carlos III de Madrid)
- Andrei Martínez Finkelshtein (Universidad de Almería)
- Miguel Piñar González (Universidad de Granada)
- Jesús Sánchez Dehesa Moreno-Cid (Universidad de Granada)
- Javier Segura Sala (Universidad de Cantabria)
- Emilio Torrano Giménez (Universidad Politécnica de Madrid)

acordaron constituir una Red Temática denominada ORTHONET. Cada uno de ellos actuaría como representante de sus distintos grupos de investigación.

Poco más tarde se adhirió al acuerdo Alicia Cachafeiro López (Universidad de Vigo). Y, tras la triste desaparición de Pablo, fue sustituido por Ramón Orive Rodríguez (Universidad de La Laguna).

El primer Encuentro de la Red, ORTHONET 2013, tiene lugar en Logroño los días 22 y 23 de febrero de 2013, en las instalaciones del Complejo Científico-Tecnológico de la Universidad de La Rioja. En el plano adjunto, es el edificio marcado con un «9».

Comité organizador

El comité organizador de ORTHONET 2013 está formado por las siguientes personas, todos profesores del Departamento de Matemáticas y Computación de la Universidad de La Rioja:

- Manuel Bello Hernández
- Óscar Ciaurri Ramírez
- Judit Mínguez Ceniceros
- Francisco Javier Pérez Lázaro
- Luz Roncal Gómez
- Juan Luis Varona Malumbres

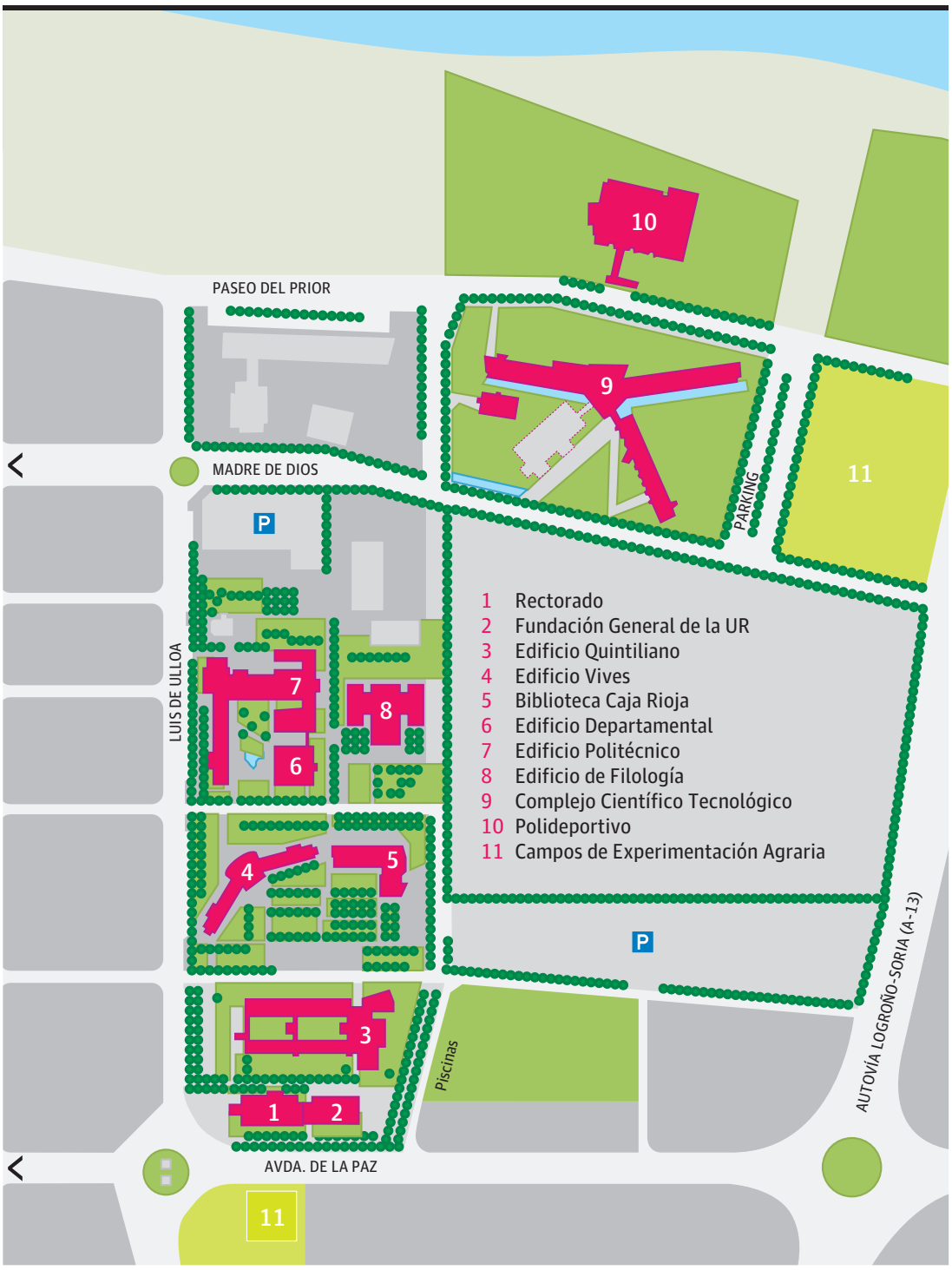
Comité científico

Actúa como comité científico de ORTHONET 2013 la comisión científica de la Red, formada por:

- Antonio Durán Guardeño (Universidad de Sevilla, presidente)
- Óscar Ciaurri Ramírez (Universidad de La Rioja)

UNIVERSIDAD DE LA RIOJA

Plano del campus



El Primer Encuentro de la Red de Polinomios Ortogonales y Teoría de Aproximación (ORTHONET 2013) tendrá lugar en el Complejo Científico-Tecnológico de la Universidad de La Rioja (Edificio «9»).

- Guillermo López Lagomasino (Universidad Carlos III de Madrid)
- Jesús Sánchez Dehesa (Universidad de Granada)

Programa científico

	Viernes 22	Sábado 23
9:00 a 9:30	Recepción	
9:30 a 10:30	Conferencia Plenaria «Luis Vigil» Christian Berg	Sesión de Problemas
10:30 a 11:15	Primera conferencia sénior Javier Segura	
11:15 a 11:45	Pausa café	Pausa café
11:45 a 12:30	Segunda conferencia sénior Manuel Bello Hernández	Reunión de IPs
12:30 a 13:00	Primera conferencia júnior Ruymán Cruz Barroso	
13:00 a 13:30	Segunda conferencia júnior Alfredo Deaño	Reunión plenaria
13:30 a 15:30	Pausa comida	Pausa comida
15:30 a 16:30	Tarde libre disposición	Conferencia Plenaria Aplicada Alberto Grünbaum
16:30 a 17:15		Tercera conferencia sénior Luis Velázquez
17:15 a 17:45		Pausa café
17:45 a 18:30		Cuarta conferencia sénior José Luis Torrea
18:30 a 19:00		Tercera conferencia júnior Pablo Sánchez
19:00 a 19:30		Cuarta conferencia júnior Manuel Domínguez

Resúmenes de las Conferencias

Conferencia Plenaria «Luis Vigil»: Cristian Berg, *On the order of indeterminate moment problems based on the recurrence coefficients.*

For an indeterminate moment problem we denote the orthonormal polynomials by P_n. We study the relation between the growth of the function $P(z) = \sum_{n=0}^{\infty} |P_n(z)|^2$ and summability properties of the sequence $(P_n(z))$. The order of the function P is called the order of the moment problem. It is shown that under suitable conditions on the recurrence coefficients in the three term recurrence relation

$$zP_n(z) = b_n P_{n+1}(z) + a_n P_n(z) + b_{n-1} P_{n-1}(z),$$

then the order of the moment problem is equal to the exponent of convergence of the sequence (b_n). Similar results are obtained for logarithmic order and for more general types of slow growth.

Under the same conditions it is also shown that the order of the moment problem is equal to the order of the entire functions

$$L(z) = \sum_{n=0}^{\infty} \frac{z^n}{\sqrt{s_{2n}}}, \qquad H(z) = \sum_{n=0}^{\infty} k_n z^n,$$

where (s_n) are the moments and $k_n > 0$ is the leading coefficient of P_n.

The talk is based on a joint manuscript with Ryszard Szwarc, Wrocław.

Primera conferencia sénior: Javier Segura, *Recent developments in the computation of special functions.*

We give an overview of methods for computing special functions and of current activities and future plans of our research group. In particular, we discuss in detail two current lines of investigation. Firstly, we describe methods for the computation and inversion of central and non-central chi-squared cumulative distributions (also called incomplete gamma and Marcum Q functions respectively). Secondly, we describe global fourth order methods for computing complex zeros of special functions, and we provide explicit examples (Bessel functions and Bessel polynomials) demonstrating the efficiency and reliability of the method.

Segunda conferencia sénior: Manuel Bello Hernández, *Interpolation and meromorphic continuation.*

In this talk we present some results of meromorphic continuation through interpolation process. We characterize the region of meromorphic continuation of an analytic function f in terms of the geometric rate of convergence on a compact set of sequences of multi-point rational interpolants of f. The rational approximants have a bounded number of poles and the distribution of interpolation points is arbitrary.

The talk is based on a joint paper with Bernardo de la Calle.

Primera conferencia júnior: Ruymán Cruz Barroso, *On positive rational interpolatory quadrature formulas on the unit circle with prescribed nodes.*

Let $\mathring{\mu}$ be a positive measure on the unit circle $\mathbb{T} := \{z \in \mathbb{C} : |z| = 1\}$. In this talk we consider positive (with positive weights) rational interpolatory quadrature formulas on the unit circle (see [1]–[3]) that approximate integrals of the form $I_{\mathring{\mu}}(f) = \int_{\mathbb{T}} f(z)\, d\mu(z)$. These rules, that are exact in spaces of rational functions, may have some of the nodes fixed in advance. The existence and some of its computational aspects will be discussed along with a connection with positive rational interpolatory quadrature formulas with prescribed nodes on the interval, that approximate integrals of the form $I_\mu(g) = \int_{-1}^{1} g(x)\, d\mu(x)$, where the measures μ and $\mathring{\mu}$ are related by the Joukowsky transformation.

References

[1] **A. Bultheel, R. Cruz-Barroso, K. Deckers and F. Perdomo-Pío**, Positive rational interpolatory quadrature formulas on the unit circle and the interval, *Appl. Numer. Math.* **60** (2010), 1286–1299.

[2] **A. Bultheel, P. González-Vera, E. Hendriksen and O. Njåstad**, Computation of rational Szegő-Lobatto quadrature formulas, *Appl. Numer. Math.* **60** (2010), no. 12, 1251–1263.

[3] **A. Bultheel, P. González-Vera, E. Hendriksen and O. Njåstad**, Rational quadrature formulas on the unit circle with prescribed nodes and maximal domain of validity, *IMA J. Numer. Anal.* **30** (2010), 940–963.

Segunda conferencia júnior: Alfredo Deaño, *Complex orthogonal polynomials and Gaussian quadrature.*

The application of the method of steepest descent to oscillatory integrals defined on the real axis leads to integration over contours in the complex plane. These integrals can be discretized using complex Gaussian quadrature rules, that are constructed from families of non-standard orthogonal polynomials defined in $\mathbb{C}$. The zero distribution of the roots of these OPs can be analyzed using logarithmic potential theory, and asymptotic information can usually be obtained via Riemann-Hilbert techniques. We present several cases that have been considered recently or that are under study, and we point out possible open problems in this area.

This is joint and ongoing work with A. Asheim, D. Huybrechs, A. B. J. Kuijlaars (KU Leuven, Belgium) and P. Román (Universidad Nacional de Córdoba, Argentina).

Conferencia Plenaria Aplicada: Alberto Grünbaum, *Two mathematical success stories: X-ray crystallography and medical imaging.*

The relation between mathematics and the areas alluded to in the title has a rich history. I will review some of my favorite highlights. I hope to be able to indicate that this is very much a two way street.

Tercera conferencia sénior: Luis Velázquez, *Quantum recurrence and matrix Schur functions.*

A relation between the theory of Schur functions and a notion for recurrence in quantum systems has been recently discovered. This is the origin of a rich interplay between spectral theory, complex analysis, orthogonal polynomials theory and the issue of quantum recurrence. The above connection not only provides new analytical techniques for quantum mechanical problems, but also reveals an unexpected geometrical and a topological meaning of some recurrence properties of quantum systems. We will review some of these results and their surprising physical consequences.

The results that will be reviewed are the fruit of joint works with Albert Werner and Reinhard Werner (Leibniz Universität Hannover), Jean Bourgain (IAS Princeton), Alberto Grünbaum and Jon Wilkening (UC Berkeley).

Cuarta conferencia sénior: José Luis Torrea, *Orthogonal systems and semigroups.*

We shall explain how to interpret some results in classical Harmonic Analysis and Complex Analysis from a semigroups theory point of view. This interpretation will allow us to define, in a unified way, the parallel objects for different systems of orthogonal functions, including the classical orthogonal polynomials.

Tercera conferencia júnior: Pablo Sánchez, *Uncertainty relations.*

The celebrated Heisenberg formulation of the uncertainty principle is expressed as an inequality involving the variance of the densities in the position and momentum spaces of a quantum system. The amplitude functions of these densities are related through a Fourier transform. In this talk several position-momentum uncertainty-like inequalities based on various information-theoretic measures are given, either for general D-dimensional quantum systems or for those in arbitrary spherically symmetric potentials. These inequalities are generalizations and improvements of the mentioned Heisenberg uncertainty principle.

Cuarta conferencia júnior: Manuel Domínguez, *Integral equations and representations of some Hermite-type families of orthogonal matrix polynomials.*

We study two examples of Hermite-type matrix orthogonal polynomials which are simultaneously eigenfunctions of a second-order differential operator of Schrödinger type with matrix-valued quadratic potential and a Fourier-type integral operator. We also show integral representations of these families. We find double integral representations of the corresponding Christoffel-Darboux kernels and the relation with non-commutative Painlevé IV differential equations.

Lista de asistentes

- Pilar Alfaro García (Universidad de Zaragoza)
- Renato Álvarez Nodarse (Universidad de Sevilla)
- Dolores Barrios Rolanía (Universidad Politécnica de Madrid)
- Manuel Bello Hernández (Universidad de La Rioja)
- Christian Berg (Københavns Universitet)
- Jorge Alberto Borrego Morell (Universidad Carlos III de Madrid)
- María-José Cantero Medina (Universidad de Zaragoza)
- Mirta Castro Smirnova (Universidad de Sevilla)
- Roberto Costas Santos (Universidad de Alcalá)
- Óscar Ciaurri Ramírez (Universidad de La Rioja)
- Ruymán Cruz Barroso (Universidad de La Laguna),
- Alfredo Deaño Cabrera (Universidad Carlos III de Madrid / KU Leuven)
- Antonia Delgado Amaro (Universidad de Granada)
- Carlos Díaz Mendoza (Universidad de La Laguna)
- Manuel Domínguez de la Iglesia (Universidad de Sevilla)
- Antonio Durán Guardeño (Universidad de Sevilla)
- Carmen Escribano Iglesias (Universidad Politécnica de Madrid)
- Enrique Fernández Cara (Universidad de Sevilla)
- Lidia Fernández Rodríguez (Universidad de Granada)
- Chelo Ferreira González (Universidad de Zaragoza)
- Ulises Fidalgo Prieto (Universidad Carlos III de Madrid)
- Alberto Grünbaum (University of California Berkeley)
- András Kroó (Universidad Carlos III de Madrid)
- José Luis López García (Universidad Pública de Navarra)
- Guillermo López Lagomasino (Universidad Carlos III de Madrid)
- Francisco Marcellán Español (Universidad Carlos III de Madrid)
- Andrei Martínez Finkelshtein (Universidad de Almería)
- Ana Martínez de los Ríos (Universidad de Sevilla)
- Sergio Medina Peralta (Universidad Carlos III de Madrid)

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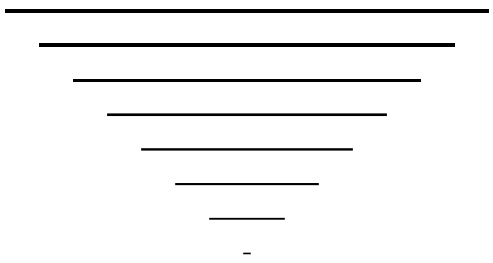
- Emilio Torrano Giménez (Universidad Politécnica de Madrid)
- José Luis Torrea Hernández (Universidad Autónoma de Madrid)
- Juan Luis Varona Malumbres (Universidad de La Rioja)
- Luis Velázquez Campoy (Universidad de Zaragoza)
- Alejandro Zarzo Altarejos (Universidad Politécnica de Madrid)



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