First Congress of Greek Mathematicians
Special Session in Analysis
June 25-29, 2018

Organizers

Nikos Frantzikinakis – Apostolos Giannopoulos – Vassilis Kanellopoulos
Mihalis Kolountzakis – Aristos Siskakis

Time Schedule of Talks

	Monday, June 25		**Tuesday, June 26**		**Wednesday, June 27**
		09:00	Tsirivas	09:00	Kyriazis
		09:30	Manolaki	09:30	Georgiadis
		10:00	*break*	10:00	*break*
		10:30	Marias	10:30	Pattakos
16:00	Malikiosis	16:00	Mourgoglou	16:00	Paouris
16:40	Nestoridi	16:40	Parissis	16:40	Saroglou
17:10	*break*	17:20	*break*	17:20	*break*
17:30	Koutsogiannis	17:30	Vellis	17:30	Vritsiou
18:00	Eskenazis	18:00	Chatzakos	18:00	Brazitikos
18:30	*end*	18:30	*end*	18:30	*end*

	Thursday, June 28		**Friday, June 29**
09:00	Vidras	09:00	Nikolidakis
09:30	Tryfonos	09:40	Petridis
10:00	*break*	10:20	*break*
10:30	Pouliasis	10:30	Iliopoulou
16:00	Tyros	16:00	Kakariadis
16:40	Todorov	16:40	Sakellaris
17:20	*break*	17:10	Labropoulos
17:30	Djolovic	17:40	*end*
18:00	Drivaliaris		
18:30	*end*		

Speakers

Silouanos Brazitikos (National and Kapodistrian University of Athens)
Uniform cover inequalities for the volume of coordinate sections and projections of convex bodies

The classical Loomis-Whitney inequality and the uniform cover inequality of Bollobás and Thomason provide upper bounds for the volume of a compact set in terms of its lower dimensional coordinate projections. We provide further extensions of these inequalities in the setting of convex bodies. We also establish the corresponding dual inequalities for coordinate sections; these uniform cover inequalities for sections may be viewed as extensions of Meyer's dual Loomis-Whitney inequality.

Dimitris Chatzakos (CEMPI, Lille and Universite Lille 1 – Sciences et Technologies)

Spectral theory of automorphic forms on the 3*-dimensional hyperbolic space*

Automorphic forms are one of the central topics of modern analytic number theory. In the 2-dimensional case, there is a rich spectral theory (also called the Selberg theory) of automorphic forms acting on the hyperbolic plane. The use of trace formulas, such as the Selberg trace formula and the Bruggeman-Kuznetsov formula, has been a powerful tool in the study of counting problems, L-functions and Quantum ergodicity problems.

In this talk we discuss the spectral theory of automorphic forms on 3-dimensional manifolds. We will focus on applications to the Prime Geodesic Theorem and Quantum ergodicity. In particular, we present our recent work on the Prime Geodesic Theorem for the Picard manifold. Time permitting, we will briefly discuss the Quantum variance problem on 3-manifolds.

Ivana Djolovic (University of Belgrade, Technical Faculty in Bor)

A note on some Cesàro sequence spaces

Many sequence spaces arise from the concept of summability. A very important summability method is defined by the Cesàro matrix of order 1. We can consider Cesàro sequence spaces, obtained from this concept, in the sense of strong or ordinary boundedness and summability. Further, the spaces can be "extended" to weighted sequence spaces. Here, we will consider some of them related to ℓ_p spaces ($1 \leq p < \infty$) and appropriate matrix and linear operators. A new approach will be presented.

Dimosthenis Drivaliaris (University of the Aegean)

The angle of an operator and range - kernel complementarity

In my talk I will discuss the relation between the angle of an operator $A : X \to X$ on a complex Banach space X and its range and kernel being complementary. I will show that if the angle of A is less than π, and A has closed range and its range and kernel have closed sum, then its range and kernel are complementary. If X is a Hilbert space, then I will show that in the previous result we don't need to assume that the range and the kernel of A have closed sum. I will also show that if X is a strictly convex, finite dimensional Banach space and $A : X \to X$, then the range and the kernel of A are complementary if and only if there exists $0 \neq t \in \mathbb{C}$ such that the angle of tA is less than π. The talk is based on joint work with N. Yannakakis.

Alexandros Eskenazis (Princeton University)

Polynomial inequalities on the Hamming cube

Every function f on the n-dimensional discrete cube $\{-1, 1\}^n$ admits a unique representation as a multilinear polynomial of total degree at most n, called the Walsh expansion of f. We will review the basics of Fourier analysis on the discrete cube and explain a duality argument (inspired by classical work of Figiel) which leads to approximation theoretic estimates for functions whose Walsh expansion has total degree significantly smaller than n. These include Bernstein-Markov inequalities and moment comparison for vector-valued Rademacher chaos of low degree. The talk is based on joint work in progress with Paata Ivanisvili.

Athanasios Georgiadis (Aalborg University)

Analysis on metric spaces associated with operators

Consider the very broad setting of doubling spaces associated with proper operators. Without any algebraic or differential structure we establish distributions, polynomials, convolution-type actions, function spaces and more.

Marina Iliopoulou (University of California,Berkeley)

Near extremisers for the Riesz-Sobolev inequality on compact connected abelian groups

This talk is about finding arithmetic structure in sets. In particular, consider three sets A, B, C in a compact connected abelian group (for instance, in the circle). The Riesz-Sobolev inequality essentially states that, given the sizes of the three sets, the set $(A + B) \cap C$ (i.e., the part of the sumset of A and B that lives inside C) cannot be too large. The question is: what do the sets A, B and C look like, if $(A + B) \cap C$ is almost as large as possible? We will discuss the answer to this question; this is joint work with Michael Christ.

Evgenios Kakariadis (University of Newcastle)

Using entropy to parametrize KMS-states of Pimsner algebras

We revisit the Laca-Neshveyev classification of KMS-states at positive inverse temperature for Pimsner algebras of finite rank. The finite rank entails an entropy notion that shapes the KMS simplices and allows to parametrize the finite and the infinite parts by tracial states on the diagonal. In particular the tracial entropies dictate the lowest critical temperature below which there are no KMS-states and the strong entropy is the maximum above which there are no infinite KMS-states. As an application we recover previous results for graph C^*-algebras and generalized C^*-crossed products.

Andreas Koutsogiannis (Ohio State University)

Multiple ergodic averages and applications

Via the study of multiple ergodic averages of the form

$$\frac{1}{N}\sum_{n=1}^{N} T^n f_1 \cdot T^{2n} f_2 \cdot \ldots \cdot T^{kn} f_k,$$

where $k \in \mathbb{N}$, T is a measure preserving transformation and f_i's are bounded, Furstenberg, in 1977, was able to provide an ergodic theoretical proof of Szemeredi's theorem, i.e., every subset of natural numbers of positive upper density contains arbitrarily long arithmetic progressions. We will present some recent developments in the area for more general averages, e.g., for multiple commuting T_i's with iterates along specific classes of integer valued sequences. If time permits, we will also talk about the corresponding averages along prime numbers.

George Kyriazis (University of Cyprus)

Measuring Smoothness in Function Spaces

We discuss some basic elements of Littlewood-Paley Theory on $\mathbb{R}^d$ and then we extend it, by means of the Spectral Decomposition Theory, to the Homogeneous Besov and Triebel-Lizorkin spaces in the presence of a non-negative self-adjoint operator whose heat kernel has Gaussian localization and the Markov property.

Nikos Labropoulos (University of Patras)

Analytical approach of the symmetry: Sharp supercritical Hardy-Sobolev inequalities and applications

We consider the optimal Hardy-Sobolev inequality on smooth bounded symmetric domains of the Euclidean space without any assumption concerning the "shape" of the boundary (i.e. some convexity) confirming that the symmetry of a domain is an intrinsic property characterizing both the domain itself and its boundary. Our model domain is

the solid torus because of its particular interest in terms both of the geometry and of the analysis. We apply the results of the above study to solve the supercritical problem

$$\text{(P)} \quad \Delta_p u + a(x)u^{p-1} = f(x)\frac{u^{p^*(s)-1}}{|x|^s},\ u>0 \ \text{ on } T,\ \ u=0 \ \text{ on } \ \partial T,$$

$$1<p<2,\ \ 0\le s\le p \ \text{ and } \ p^*(s)=\frac{p(2-s)}{2-p}.$$

and some variants of it. Joint work with Athanase Cotsiolis.

Romanos-Diogenes Malikiosis (Technical University of Berlin)

Fuglede's spectral set conjecture on cyclic groups

Fuglede's conjecture (1974) states that a bounded measurable subset in $\mathbb{R}^d$ accepts an orthogonal basis of exponential functions (i.e. it is spectral) if and only if it tiles the space with a discrete set of translations. This conjecture turned out to be false by Tao's counterexample in 2003. Using Tao's ideas, counterexamples in finite Abelian groups such as $\mathbb{Z}_N^d$ can be lifted to counterexamples in $\mathbb{R}^d$, thus shifting the interest on this conjecture to this setting in recent years. This has been successful for $d \geq 3$, but the conjecture is still open for $d = 1, 2$.

Some recent results in the cyclic group setting will be presented in this talk, which are connected to the work of Coven-Meyerowitz and Laba on tiling subsets of $\mathbb{Z}$, as well as the structure of vanishing sums of roots of unity. This is joint work with Mihalis Kolountzakis, and recent work in progress by the speaker.

Myrto Manolaki (University of South Florida)

Optimal polynomial approximantson the unit circle

The notion of optimal polynomial approximants was introduced for investigating the phenomenon of cyclicity in certain weighted Hardy spaces. Given a function f in such a space, a polynomial p_n is called an optimal polynomial approximant of degree n to $1/f$ if p_n minimizes the norm $\|pf - 1\|$ over all polynomials p of degree at most n. It is known that, for each cyclic function f, the sequence (p_n) converges to $1/f$ on the unit disc. In this talk, we will discuss when this property remains true on the unit circle and we will present some recent results about the optimal polynomial approximants to reciprocals of polynomials with simple roots. Joint work with Catherine Beneteau and Daniel Seco.

Michail Marias (Aristotle University of Thessaloniki)

Analysis on locally symmetric spaces

We shall present two classical problems of Harmonic Analysis:

1. Fourier multipliers, and
2. Strichartz estimates for the Schrödinger operator,

in the geometric framework of locally symmetric spaces.

Mihalis Mourgoglou (University of the Basque Country (UPV/EHU) and Ikerbasque)

Harmonic measure and quantitative rectifiability

The past few years there has been a renaissance of new results of harmonic measure in domains in the Euclidean space in connection with the (uniform) rectifiability of the boundary of the domain. The connection between boundedness of Riesz transform and quantitative rectifiability due to the celebrated result of Nazarov, Tolsa and Volberg, the theory of Calderon-Zygmund operators for non-homogeneous measures, as well as techniques that are used in free boundary problems, have played a significant role in the flourishing of this field. In the present talk we will present some recent advances in

"quantitative" one-phase and two-phase free boundary problems for harmonic measure, and time permitting, some PDE characterizations of quantitative rectifiability.

Evita Nestoridi (Princeton University)

On the mixing time of the Diaconis-Gangolli random walk on contingency tables over $\mathbb{Z}/2\mathbb{Z}$

A contingency table over $\mathbb{Z}/2\mathbb{Z}$ is an $n \times n$ matrix with fixed row sums $(r_1, \ldots, r_n)$ and column sums $(c_1, \ldots, c_n)$. The Diaconis-Gangolli random walk on $n \times n$ contingency tables over $\mathbb{Z}/2\mathbb{Z}$ suggests to start with a contingency table $(a_{i,j})$, pick coordinates $a_{i,j}, a_{i,k}, a_{m,j}, a_{m,k}$ and add ones to them. In joint work with Oanh Nguyen, we use Fourier Analysis arguments to prove that the random walk exhibits cutoff at $\frac{n^2}{8} \log n$ with window $n^2 \log \log n$. The only previous results on the mixing time of this random walk, was for contingency tables with finite rows and integer entries.

Eleftherios Nikolidakis (University of Ioannina)

Dyadic weights on $\mathbb{R}^n$ *and reverse Hölder inequalities*

We study nonnegative functions (weights), defined on the unit cube of $\mathbb{R}^n$, $Q_0 = [0,1]^n$, that satisfy a reverse Hölder inequality on every dyadic subcube of Q_0, for a fixed exponent $p > 1$ and constant $c \geq 1$. We prove that there exists $p_0 > p$, which depends on p, c, n for which every such function has the property that it belongs to $L^q(Q_0)$, for every $q \in [p, p_0)$. Additionally we shall study the class of weights that satisfy the dyadic or regular A_1 condition and investigate analogous best possible results.

Grigoris Paouris (Texas A&M University)

Recent developments on Dvoretzky's theorem

Dvoretzky's famous theorem asserts that for any n sufficiently large and for any $\varepsilon \in (0,1)$, there exists a $k = k(n, \varepsilon)$ with the following property: every n-dimensional normed space contains a k-dimensional subspace which is $(1+\varepsilon)$-Euclidean. While the asymptotic behavior of the function $k(n, \varepsilon)$ is completely understood, the dependence on ε is still unclear. We will review the obstacles that arise in the almost isometric study, as opposed to the isomorphic, and we will discuss a recent approach which employs tools from topology, combinatorics and modern probability theory to establish the best known -up-to-date- estimate on the problem. Based on joint work(s) with P. Valettas.

Ioannis Parissis (Ikerbasque fellow - University of the Basque Country)

Directional singular integrals and maximal averages in two and higher dimensions

I will give a brief overview of the area of directional singular integrals and maximal averages on $\mathbb{R}^n$. More precisely I will give an account of the problem of bounding the maximal function along sets of directions, starting from the natural two-dimensional point of view. I will discuss the important special cases of lacunary sets of directions, and equispaced (uniform) directions. I then move to the discussion of the companion directional Hilbert transform where, even in two dimensions, the boundedness properties are not fully understood.

In higher dimensions our understanding of this problem is much more rudimentary. I will sketch some proofs of new results in three dimensions obtained recently in collaboration with Francesco Di Plinio (University of Virginia). Our focus is on lacunary sets of directions in $\mathbb{R}^3$ for the Hilbert transform, and equispaced directions for the directional maximal averages.

Nikolaos Pattakos (Karlsruhe Institute of Technology)

Nonlinear Schrödinger equation with initial data in a modulation space

In this talk we present some recent results on global and local wellposedness of the cubic nonlinear Schrödinger equation with initial data in a modulation space. For the global result we use the splitting method of Bourgain and for the local wellposedness result the differentiation by parts technique plays the central role.

Giorgis Petridis (University of Georgia)

Additive combinatorics and multilinear exponential sums

Given subsets $A_1, A_2, \dots, A_n$ of the prime order finite field $\mathbb{Z}/p\mathbb{Z}$ one is often interested in bounding the modulus of the multilinear exponential sum

$$\sum_{a_1 \in A_1, \dots, a_n \in A_n} \exp\left(\frac{2\pi i a_1 \dots a_n}{p}\right).$$

There are natural connections between this question and the so-called sum-product phenomenon over finite fields. This expository talk will flesh out this relationship and survey relatively speaking recent results.

Stamatis Pouliasis (Texas Tech University)

Condenser capacity and holomorphic functions

First we shall present some basic facts about condenser capacity, the Green function and their relation with holomorphic functions. Then we will discuss an inequality for the capacity of a condenser via a holomorphic function, which takes into account the valency of the holomorphic function on the positive plate of the condenser. Also, we will present an equality statement and some related results. Finally, we will examine the asymptotic behavior of the capacity of the inverse image of a condenser under Blaschke products and universal covering maps.

Georgios Sakellaris (Universitat Autònoma de Barcelona)

Green's function for second order elliptic equations with singular lower order coefficients and applications

We will discuss joint work with Seick Kim, in which we construct Green's function for second order elliptic operators of the form $\mathcal{L}u = -\mathrm{div}(A\nabla u + bu) + c\nabla u + du$. Under specific regularity assumptions, we will describe that Green's function and its derivative are members of certain weak-L^p spaces.

In the subcritical case, the weak-L^p bounds will lead to the classical estimate $G(x,y) \leq C|x-y|^{2-n}$, where $n \geq 3$ is the underlying dimension. Moreover, we will show the pointwise bound $|\nabla G(x,y)| \leq C|x-y|^{1-n}$, if A satisfies a mild smoothness assumption. However, in the critical case, we will show that the first pointwise estimate could fail, even for small perturbations of the Laplacian.

We will also explain more recent applications of the previous constructions in the Dirichlet and Regularity boundary value problems in Lipschitz domains Ω, with boundary values $f \in L^2(\partial\Omega)$ and $f \in W^{1,2}(\partial\Omega)$, respectively, for equations with lower order coefficients. Using the method of layer potentials, we will deduce solvability by showing that the single layer potential $\mathcal{S} : L^2(\partial\Omega) \to W^{1,2}(\partial\Omega)$ is invertible.

Christos Saroglou (Kent State University)

Wulff shapes and a characterization of simplices via a Bezout type inequality

Inspired by a fundamental theorem of Bernstein, Kushnirenko, and Khovanskii we study the following Bezout type inequality for mixed volumes

$$V(L_1,\dots,L_n)V_n(K) \leq V(L_1,K[n-1])V(L_2,\dots,L_n,K).$$

We show that the above inequality characterizes simplices, i.e. if K is a convex body satisfying the inequality for all convex bodies $L_1,\dots,L_n \subset \mathbb{R}^n$, then K must be an n-dimensional simplex. The main idea of the proof is to study perturbations given by Wulff shapes. In particular, we prove a new theorem on differentiability of the support function of the Wulff shape, which is of independent interest. In addition, we study the Bezout inequality for mixed volumes introduced previously by Soprunov and Zvavitch. We introduce the class of weakly decomposable convex bodies which is strictly larger than the set of all polytopes that are non-simplices. We show that this Bezout inequality characterizes weakly indecomposable convex bodies, extending our previous result.

Ivan Todorov (Queen's University Belfast)

Operator systems and non-signalling games

In the past few years, there has been a new wave of interactions between operator algebra theory and quantum physics, one of whose manifestations has been through the study of non-signalling correlations and non-local games. In particular, it has been shown that operator systems play a crucial role in the description of correlations, perfect strategies for non-signalling games have been expressed in C^*-algebraic terms, and graph theoretic concepts have been lifted to a non-commutative setting. This talk will be a survey of some of the latest developments, with emphasis on the newly introduced class of imitation games and the role of operator system tensor products in the study of non-signalling correlations.

Christiana Tryfonos (University of Cyprus)

Weighted Koppelman integral representation formulas on smooth compact toric varieties

We derive a weighted Koppelman integral representation formula on smooth compact toric varieties for $(0,q)$ smooth forms taking values in specific line bundles. This is achieved by reducing our construction to the fact that the singular sets of the kernels involved are along the "exceptional set" of the specific varieties. As an application of the above representation formula we obtain the vanishing of the Dolbeault cohomology groups of $(0,q)$ forms over smooth compact toric varieties with values in various lines bundles. Even though these results are already known, the novelty here lies on the fact that our method gives an explicit solution to the $\overline{\partial}$-equation on the varieties in question.

Nikos Tsirivas (University of Ioannina)

Universal Taylor series for non-simply connected domains

It is known that, for any simply connected proper subdomain Ω of the complex plane and any point j in Ω, there are holomorphic functions on Ω that have universal Taylor series expansions about j; that is, partial sums of the Taylor series approximate arbitrary polynomials on arbitrary compacta in $\mathbb{C} \setminus \Omega$ that have connected complement. This talk show that this phenomenon can break down for non-simply connected domains Ω, even when $\mathbb{C} \setminus \Omega$ is compact. This answers a question of Melas and disproves a conjecture of Müller, Vlachou and Yaviran.

We note that this result is a very specific case of a result of Stephen Gardiner.

Konstantinos Tyros (National and Kapodistrian University of Athens)

Independence vs structurability for stochastic processes indexed by the discrete hypercube

We study stochastic processes of the form $(D_t)_{t\in A^n}$, where A is a finite set, n a positive integer, A^n the discrete n-dimensional hypercube (that is, the Cartesian product with n many copies of A) and each D_t a measurable event in some probability space. Under a mild "stationarity" condition, we obtain structural information assuming that $(D_t)_{t\in A^n}$ does not exhibit an independent behaviour. As a consequence, we have a new proof of the density Hales-Jewett theorem. We will also discuss several related problems. This is a joint work with Pandelis Dodos.

Vyron Vellis (University of Connecticut)

Fractional rectifiability

Given a bounded set $E \subset \mathbb{R}^n$ and a positive integer $m < n$, when is it possible to construct a nice map (Hölder, Lipschitz, quasisymmetric, bi-Lipschitz etc.) from the m-cube into $\mathbb{R}^n$ so that E is contained in its image? In this talk we approach this question from two different directions. Firstly, we discuss an extension of Peter Jones' traveling salesman construction, which provides a sufficient condition for E to be contained in a $(1/s)$-Hölder curve, $s \geq 1$. Secondly, we present sharp sufficient conditions in terms of the geometry of E and its metric (Assouad) dimension which ensure that E admits a Hölder, bi-Lipschitz or quasisymmetric parametrization by the m-cube. Then, building upon a series of papers by Martin and Mattila from 1988 to 2000, we apply this parametrization to investigate the influence that s-dimensional lower and upper Hausdorff s-densities have on the geometry of a Radon measure in $\mathbb{R}^n$ when s is a real number between 0 and n. This topic in geometric measure theory has been extensively studied when s is an integer. This talk is based on a joint work with Matthew Badger and an upcoming joint work with Matthew Badger and Lisa Naples.

Alekos Vidras (University of Cyprus)

Bergman-Weil expansions for holomorphic functions in Several Complex Variables

Using a modified Cauchy-Weil representation formula in a Weil polyhedron $\mathbf{D}_f \subset U \subset \mathbb{C}^n$, a generalized version of classic Lagrange interpolation formula (at any order) with respect to a discrete set defined by

$$S := \{f_1 = \cdots = f_m = 0\},\ m > n$$

is being proved. Note the set S, as described, fails to be complete intersection. We present our result as an averaged version of classic Lagrange interpolation formula in the case $m = n$, using Crofton's formula that leads us naturally to the construction of Bochner-Martinelli kernels. Joint work with A. Yger.

Beatrice-Helen Vritsiou (University of Alberta)

On the variance conjecture for the Schatten classes

The variance conjecture in Asymptotic Convex Geometry asks whether the Euclidean norm of a random vector uniformly distributed in a (properly normalised) high-dimensional convex body $K \subset \mathbb{R}^n$ satisfies a Poincaré-type inequality implying that its variance is much smaller than its expectation. In this talk we will discuss the conjecture in the case of unit balls of p-Schatten norms on spaces of square matrices and on their subspaces of self-adjoint matrices. Moreover, we will show how to settle the conjecture affirmatively when K is the unit ball of the operator norm in these spaces. The arguments rely on a combination of tools from Random Matrix Theory, the theory of special functions and algebraic combinatorics.