SEAM 2015 – The 31st Southeast Analysis Meeting

March 8-10, 2015

Abstracts for Contributed Talks

Scott Atkinson
University of Virginia

Convex Sets Associated to C^*-Algebras

Abstract

Given a separable C^*-algebra A, we can associate to it an invariant taking the form of a convex set. This invariant is closely related (and sometimes isomorphic) to the trace space of A, but it is in general a finer invariant than the trace space. In addition to discussing its basic properties, we will also discuss some interesting questions rising from studying this new invariant. This is an ongoing project based off of a 2011 paper by Nate Brown.

Angshuman Bhattacharya
University of Georgia

Relative weak injectivity of operator systems

Abstract

In the recent past tensor product of operator systems has gained a very systematic framework which generalize several well known C^*-algebraic tensor product concepts to the operator system category. In this talk we shall review a few of those and introduce the concept of relative weak injectivity in the category of operator systems.

Job Bonyo
Mississippi State University

Cesàro-like operators on Hardy and Bergman spaces of the half plane

Abstract

We construct integral operators associated with strongly continuous groups of invertible isometries on the Hardy spaces and the weighted Bergman spaces of the upper half plane. Specifically, we obtain the spectrum and point spectrum of the generator and represent the resolvents as integral operators related to the Cesàro operator

$$\mathcal{C}_1 f(z) := \frac{1}{z} \int_0^z f(\zeta)\, d\zeta$$

investigated by Siskakis and Arvanitidis on the Hardy Spaces $H^p(\mathbb{U})$, $p > 1$, where $\mathbb{U}$ is the upper half plane.

Cheng Chu
Washington University in St. Louis
Asymptotic Bohr Radius for Polynomials

Abstract

Given a polynomial P on the unit disk, form the polynomial $\widetilde{P}$ by replacing the coefficients of P with their absolute values. There is a maximal radius R, so that the supremum of $\widetilde{P}$ on the disk of radius R is bounded by the supremum of P on the whole unit disk, for every choice of P. Bohrs famous theorem shows that $R = 1/3$, and this radius is called the Bohr radius. In this talk, we consider a similar Bohr radius $R(n)$ for the class of polynomials of degree at most n. I will give an asymptotic formula for $R(n)$, which was conjectured by R. Fournier in 2008.

Joseph Cima
University of North Carolina, Chapel Hill
Some comments on weak H^1

Abstract

We define the (real) Weak Hardy one space. We discuss a characterization given by R.Fefferman and Soria. We discuss an interesting subspace and exhibit some bounded linear functionals on the dual of this subspace.

Amalia Culiuc
Brown University
Bounds for Calderon-Zygmund operators with matrix A_2 weights

Abstract

In this talk we will present some recent results on the boundedness of Calderon-Zygmund operators on weighted spaces with matrix A_2 weights. Following the techniques developed by Bickel, Petermichl, and Wick for the Hilbert transform, we study the norm bounds for the Riesz and Ahlfors-Beurling operators. Joint work with Brett Wick

Arthur Danielyan
University of South Florida
On the zero-free polynomial approximation problem

Abstract

Abstract: Let E be a compact set in $\mathbb{C}$ with connected complement, and let $A(E)$ be the class of all complex continuous function on E that are analytic in the interior E^0 of E. Let $f \in A(E)$ be zero free on E^0 . By Mergelyans theorem f can be uniformly approximated on E by polynomials, but is it possible to realize such approximation by polynomials that are zero-free on E? This natural question has been proposed by J. Andersson and P. Gauthier. So far it has been settled for some particular sets E. In this talk we describes classes of functions for which zero free approximation is possible on an arbitrary E.

Nathan Feldman
Washington and Lee University
A Convex Stone-Weierstrass Theorem and Convex Dynamics

Abstract

A convex-polynomial is one that is in the convex-hull of the set of monomials, so its coefficients must be non-negative and sum to one. We will discuss when the convex-polynomials are dense within various real function spaces on the real line. A bounded linear operator on a Banach space is said to be convex-cyclic if there is a vector such that the convex hull of its orbit under the operator is dense in the Banach space. As a corollary of our approximation theorems we can give a characterization of which real self-adjoint operators on real Hilbert spaces are convex-cyclic and say when certain multiplication operators on various spaces of real functions are convex-cyclic.

Tim Ferguson
University of Alabama
Extremal Problems in Bergman Spaces and an Extension of Ryabykh's Hardy Space Regularity Theorem For $1 < p < \infty$

Abstract

We discuss the extremal problem of maximizing linear functionals on Bergman spaces. Given a functional on the dual space of the Bergman space A^p with representing kernel $k \in A^q$, where $1/p+1/q = 1$, we show that if $q \leq q_1 < \infty$ and $k \in H^{q_1}$, then the extremal function $F \in H^{(p-1)q_1}$. We also discuss related results. These results were previously known only in the case where p is an even integer.

Jordan Greenblatt
University of California, Los Angeles
Asymptotic Maximal Bounds for Cartesian Powers of Finite Graphs

Abstract

Much in the spirit of Stein's Euclidean spherical maximal bounds, Harrow, Kolla, and Schulman (2013) proved a dimension-independent L^2 bound for the spherical maximal operator on the hypercube. Later, Krause applied Stein's analytic interpolation methods to attain dimension-independent L^p bounds for all $p > 1$ and subsequently, in conjunction with Kolla, he and I generalized the bounds to include arbitrary finite cliques. I will the discuss dimension-independence proofs for clique powers/hypercubes, focusing mainly on the spectral methods used to bound discrete Littlewood-Paley square functions. Finally, if time permits, I will demonstrate examples of graphs whose Cartesian powers' maximal bounds behave poorly and present the current state and future directions of the project of identifying analogous asymptotics from a graph's basic structure.

Lauren Huckaba
University of Georgia
Pinned $(k-1)$-point configurations in $\mathbb{R}^k$

Abstract

In 1986, Bourgain proved that if A is a measurable subset of $\mathbb{R}^k$ with positive upper density and $V \subset \mathbb{R}^k$ is a set of k points spanning a $(k-1)$-dimensional hyperplane (a "k-point configuration"), then there exists a $\lambda_0 > 0$ such that A contains an isometric copy of $\lambda \cdot V$ for any $\lambda > \lambda_0$. In this talk, we discuss a "pinned" version of the result where we find such copies of some $(k-1)$-point configuration in $\mathbb{R}^k$ from some point $x \in A$. Joint work with Neil Lyall and Akos Magyar.

Joshua Isralowitz
University at Albany
Matrix weighted Poincare and Sobolev inequalities

Abstract

With an eye towards proving new regularity results for degenerate systems of elliptic PDEs, we prove natural matrix weighted Poincare and Sobolev inequalities that are closely related to the classical Fabes/Kenig/Serapioni scalar weighted Poincare and Sobolev inequalities. Furthermore, we prove natural matrix weighted norm inequalities for both the classical fractional integral operators and fractional maximal operators. This is joint work with Kabe Moen.

Ishwari Kunwar
Georgia Institute of Technology
Multilinear Paraproduct Operators

Abstract

In this talk, we will present a decomposition of point-wise product

$$f_1 f_2 \dots f_m,\ m \geq 2,$$

that generalizes the paraproduct decomposition:

$$f_1 f_2 = \sum_{I \in \mathcal{D}} \widehat{f_1}(I) \langle f_2 \rangle_I h_I + \sum_{I \in \mathcal{D}} \langle f_1 \rangle_I \widehat{f_2}(I) h_I + \sum_{I \in \mathcal{D}} \widehat{f_1}(I) \widehat{f_2}(I) h_I^2.$$

We then discuss the boundedness properties of corresponding multilinear paraproducts arising from the decomposition. We also define multilinear Haar multipliers and discuss boundedness properties of those operators and their commutator with the multiplication operator M_b for $b \in BMO^d$.

Vasile Lauric
Florida A&M University
A Fuglede-Putnam theorem for almost normal operators S with finite $q_2(S)$ modulo Hilbert-Schmidt class

Abstract

The Fuglede-Putnam theorem for normal operators modulo Hilbert-Schmidt (HS) class says if N is a normal operator and X is an arbitrary operator such that $NX - XN =: R$ is a HS operator, then $N * X - XN* =: Q$ is also a HS operator and both R and Q have equal HS norm. We will discuss an extension of such a theorem for almost normal operators (i.e. operators with trace-class self-commutator) that have finite HS modulus of triangularity ($q_2(\cdot)$), and some consequences. We forward the "gues" that perhaps such a result might be valid without the hypothesis of HS triangularity since it is a straightforward consequence of Voiculescu's Conjecture 4.

Phi Le
University of Missouri, Columbia
Carleson measure estimate and the Dirichlet problem for degenerate elliptic equations

Abstract

In this project, we were interested in Carleson measure estimates and the Dirichlet problem for degenerate elliptic equations of the form $Lu = \mathrm{div} A\nabla u$. More precisely, we proved some related results of Kato problem in weighted L^p levels. Then we used the above results to show that a bounded solution of $Lu = 0$ satisfies the corresponding Carleson measure estimate and finally we showed that the harmonic measure belongs Muckenhoupt A_∞ class with respect to surface measure and also solvability of the Dirichlet problem with weighted L^p data. Joint work with Steve Hofmann and Andrew Morris.

Peter Luthy
Washington University in St. Louis
A Characterization of Continuous One-Parameter Dilation Groups Which Admit Continuous Wavelets on $\mathbb{R}^2$

Abstract

A continuous wavelet on $\mathbb{R}^2$ comes from the action of a group of dilations together with the action of $\mathbb{R}^2$ as translations (for standard "discrete" wavelets, the translations come from $\mathbb{Z}^2$). There is a genuine sense in which the continuous wavelet is a more natural analytic object than the discrete wavelet is. In this talk, we will discuss continuous wavelets, compare them to discrete wavelets, and develop a simple (and somewhat surprising) characterization of the one-parameter matrix groups whose actions as dilation groups admit continuous wavelets on $\mathbb{R}^2$.

Kabe Moen
University of Alabama
Regularity results for weak solutions of elliptic PDE below the natural exponent

Abstract

We will discuss regularity results for weak solutions to the Dirichlet problem for a divergence form elliptic operator. We give L^p estimates for the second derivative when $p < 2$. Our work generalizes results due to Miranda.

Yumeng Ou
Brown University
Upper bound for iterated commutators of general singular integrals

Abstract

We show that the product BMO space can be characterized by iterated commutators of a large class of Calderón-Zygmund operators. This result follows from a proof of boundedness of iterated commutators of arbitrary Calderón-Zygmund operators in terms of the BMO norm of their symbol functions, using Hytönen's representation theorem of Calderón-Zygmund operators as averages of dyadic shifts. As a key element of the proof, we introduce some new dyadic paraproducts which have BMO estimates. And the main idea of the proof is to show that commutator of any dyadic shift operators can be represented as a finite linear combination of those paraproducts. Some very recent development of this type of results will also be introduced.

Alex Rice
University of Rochester
Difference Sets and Polynomials

Abstract

In a series of papers in the 1970s, Sárközy proved that any set of integers of positive upper density necessarily contains two distinct elements which differ by a perfect square, as well as two elements which differ by one less than a prime number, confirming conjectures of Lovàsz and Erdős, respectively. In this talk, we provide a brief survey of the extensive literature that has developed on improvements and extensions of these results, culminating in a brand new "super theorem" which expands to sums of polynomials, improves certain quantitative bounds, and includes most previous results as special cases. This is joint work with Neil Lyall.

Trevor Richards
Washington and Lee University
Conformal equivalence of functions and the fingerprint of a shape

Abstract

We will discuss recent results involving the problem of conformal equivalence of analytic functions of a complex variable (say f and g are conformally equivalent if there is a conformal map ϕ from the domain of f to the domain of g which satisfies $f = g \circ \phi$) and shape analysis via the fingerprint of a shape C on the unit circle T.

Joel Rosenfeld
University of Florida
A look at the Polylogarithmic Hardy Space

Abstract

The Polylogarithm has been studied by many mathematicians going back to Euler, who was the first to study the Dilogarithm. Since then the Polylogarithm has appeared as solutions to integral equations, it is used as a tool for computation in statistical mechanics, and particular slices of this function are well known special functions. In this talk we will investigate a Reproducing Kernel Hilbert Space of two variables that is generated by kernel functions arising from the Polylogarithm, the so called Polylogarithmic Hardy Space. This space has a natural isometry with the Hardy space through the Melin transform. We will also talk about operators on the Polylogarithmic Hardy Space.

Benjamin Russo
University of Florida
The Equivalence of Lifting and Factorization for Tuples of 3-Isometries

Abstract

An operator T is called a 3-isometry if there exists a $B_1(T^*, T)$ and $B_2(T^*, T)$ such that

$$Q(n) = T^{*n}T^n = 1 + nB_1(T^*, T) + n^2 B_2(T^*, T)$$

for all natural numbers n. These operators are related to the 3-symmetric operators introduced by Helton, which have a connection to disconjugacy theory from the theory of Sturm-Liouville equations. Of particular importance in the study of 3-isometries is the associated operator polynomial $Q(s)$ where s is a real number. We call an operator J a Jordan operator of order 2 if $J = U + N$ where U is unitary, N is nilpotent order 2, and U and N commute. Jordan operators are a canonical example of 3-isometries. By use of the theory of completely positive maps, it can be shown that a class of 3-isometries satisfying a particular positivity condition on the operator pencil $Q(s)$ can be lifted to Jordan operators. In the multi-variable setting we can define an analogous class for tuples of commuting 3-isometries. It is a natural question to ask whether tuples of commuting 3-isometries satisfying an analogous positivity condition always lift to tuples of commuting Jordan operators. In this talk, we will discuss our exploration into the equivalence of lifting to the factorization of the associated operator polynomial $Q(s)$. We will also show that this factorization is not always possible by modifying an example of Choi.

Livinus Uko
Georgia Gwinnett College
A modified Kantorovich Theorems on the solvability of mildly non-smooth Nonlinear Equations

Abstract

We prove a modified Kantorovich Theorem on the existence of a unique zero of the sum of a differentiable function and a Lipchitz continuous function on a Banach space. It is shown that generalized equations and variational inequalities can be reformulated as problems of this kind.

The result contains, as a corollary, a modified Kantorovich theorem on the existence of a unique zero of a differentiable function. This result is obtained using only center-Lipschitz conditions, and is therefore weaker than the classical Kantorovich Theorem on the solvability of smooth nonlinear equations and the extensions of it that were obtained by Uko and Argyros using combination of Lipschitz and center-Lipschitz conditions.

An illustrative example is given in the paper.

Kazuo Yamazaki
Washington State University
Logarithmically extended global regularity result of Lans-alpha MHD system in two dimension

Abstract

We study the two-dimensional generalized Lans alpha magnetohydrodynamics (MHD) system. We show that the solution pairs of velocity and magnetic fields to this system preserve their initial regularity in two cases: dissipation logarithmically weaker than a full Laplacian and zero diffusion, zero dissipation and diffusion logarithmically weaker than a full Laplacian. They represent logarithmic improvement of previous results.

If time remains, we also discuss recent results on related models such as the Navier-Stokes equations, Boussinesq system, micro-polar and magneto-micropolar fluid systems in both deterministic and stochastic settings.