SEAM 40 Abstracts

Eigen functions of 2d-dimensional canonical systems

Keshav Acharya
Embry-Riddle Aeronautical University

In this talk we discuss the solutions of 2d-dimensional canonical systems. First, we present some basic theory including proving the existence of solution of any canonical system and establish some properties of its fundamental solution. Then we consider the systems on a bounded interval as a boundary-value problem and show that the eigen-functions of the system form an orthonormal basis for a Hilbert space.

Dynamic Mode Decomposition with Weighted Composition Operators

Chukwuebuka Amagwula
University Of South Florida

Dynamic Mode Decomposition DMD is a data-driven technique used to model dynamical systems using time series data in which each data point is called a snapshot. These snapshots are important because they represent the state of the given system at a particular time, which helps us develop a pattern to aid in the the development of a model for the system. DMD is usually related to the Koopman Operator, and this has led to many advances in DMD as new extensions are being discovered.

However, in my talk, we explore an application of weighted composition operators to learning a non-linear discrete time system from data over a Reproducing Kernel Hilbert Space (RKHS). In particular, we will see that adjoint relationships between weighted composition operators and kernel functions provides an avenue for producing a finite rank approximation of a weighted composition operator corresponding to an unknown system.

Weighted composition operators have been demonstrated to be compact for a wide variety of RKHS. This fact together with the generated finite rank approximations, give credence to our approximation method, and provides benefits over the use of Koopman operators which are often not compact nor bounded for most symbols.

An Optimal Approximation Problem for Noncommutative Polynomials and Rational Functions

Palak Arora
Williams College

For this talk, we will first consider the following classical problem: if f is a polynomial with no zeros in the unit disk, what is the optimal way to approximate $1/f$ by polynomials? Motivated by this optimal approximation by polynomials in the unit disk, we consider the following noncommutative (nc) approximation problem: for a polynomial f in d noncommuting arguments, find an nc polynomial p_n, of degree at most n, to minimize

$$c_n := \|p_n f - 1\|^2.$$

We show that $c_n \to 0$ if and only if f is nonsingular in a certain nc domain (the *row ball*). As an application, we will generalize this result to nc rational functions.

Constructing New Classes of Analytic Functions from Operator Realizations

Meric Augat
Bucknell University

Realizations of functions have a long and storied history in Analysis and Operator Theory stretching back at least five decades. A realization of a function is a representation in terms of $(I - Az)^{-1}$ for some explicit operator A. Many properties of the represented function are witnessed by the chosen operator A, e.g. if A is a nilpotent matrix, then the function it represents is a polynomial.

In this talk we present a theory of realizations for noncommutative analytic functions on some neighborhood of 0 – all these results readily apply to the single variable commutative case. We show that every entire function has a (minimal) compact and quasinilpotent realization. Moreover, we show that any class of operators with a few reasonable closure properties corresponds with an algebra of analytic functions that naturally embeds in a (skew) field.

This project is joint work with Robert Martin and Eli Shamovich.

Frames via Unilateral Iterations of Bounded Operators

Victor Bailey
University of Oklahoma

Dynamical Sampling is, in a sense, a hypernym classifying the set of inverse problems arising from considering samples of a signal and its future states under the action of a bounded linear operator. Recent works in this area consider questions such as when can a given frame for a separable Hilbert Space, $\{f_k\}_{k\in I} \subset H$, be represented by iterations of an operator on a single vector and what are necessary and sufficient conditions for a system, $\{T^n\varphi\}_{n=0}^{\infty} \subset H$, to be a frame? In this talk, we will discuss the connection between frames given by iterations of a bounded operator and the theory of model spaces in the Hardy-Hilbert Space as well as necessary and sufficient conditions for a system generated by the orbit of a pair of commuting bounded operators to be a frame. This is joint work with Carlos Cabrelli.

Donoghue classes and c-entropy of L-systems

Sergey Belyi
Troy University

Given a symmetric operator $\dot{A}$ with deficiency indices $(1,1)$ and its self-adjoint extension A in a Hilbert space $\mathcal{H}$, we construct a (unique) L-system with the main operator in $\mathcal{H}$ such that its impedance mapping coincides with the Weyl-Titchmarsh function $M_{(\dot{A},A)}(z)$ or its linear-fractional transformation $M_{(\dot{A},A_\alpha)}(z)$ of the Donoghue class. Similar L-system constructions are provided for the generalized Donoghue classes function $aM_{(\dot{A},A)}(z)$ (with $a > 0$). We also evaluate c-entropy and the main operator dissipation coefficient for the obtained L-systems.

The talk is based on joint work with E. Tsekanovskii and K.A. Makarov.

Clark Measures for Rational Inner Functions on the Polydisk

Kelly Bickel
Bucknell University

Clark measures associated with one-variable inner functions are closely connected to a number of topics in classical operator theory and complex function theory on the unit disk. In this talk, we'll use an analogous definition to introduce Clark measures on the polydisk associated to d-variable rational inner functions. For the two-variable setting, we'll give exact formulas for these Clark measures, characterize when associated Clark embeddings are unitary, and time permitting, connect the vanishing of the Clark measure weights to the behavior of the rational inner function at a particular singularity. This is joint work with John Anderson, Joseph Cima, Linus Bergqvist, and Alan Sola.

Near- Riesz bases

Deborpita Biswas
Clemson University

James R. Holub, in one of his papers in 1994, introduced the influential concept of near-Riesz bases as frames which become Riesz bases after removal of finitely many terms. We recently extended his definition of near- Riesz basis to sequences which are not frames. In this talk I will present a characterization of our extended near-Riesz bases in terms of the Fredholmness of their associated synthesis operator. I will also present some perturbation results for our near-Riesz bases.

A Weyl Law for a Class of Toeplitz Operators

Trevor Camper
Clemson University

In this talk, a class of radial Toeplitz operators will be introduced. For this class, a general Weyl law will be presented which is similar to the classical setting. Additional results concerning spectral asymptotics for this class will be derived.

Paley-Wiener Theorem for Probabilistic Frames

Dongwei Chen
Clemson Univresity

Paley-Wiener theorem is a classical result about the stability of basis in a Banach space, which claims that if a sequence in a Banach Space is "close" to a basis in some sense, this sequence is also a basis. Paley-Wiener theorem is also generalized to frames in Hilbert space. In this talk, we generalize the Paley-Wiener theorem to probabilistic frames for R^d. Probabilistic frame is a probability measure on R^d with finite second moment and the support spanning R^d. We claim that if a probability measure is "close" to a probabilistic frame in some sense, then this probability measure is also a probabilistic frame.

System Identification for Fluid Model in Porous Media

Haowei(Alice) Chen
University of South Florida

A three-dimensional relaxation fractional order model for viscoelastic fluid is built. The model based on the exact solution in Laplace space for some unsteady flow-Maxwell flow in an infinite reservoir is obtained by Laplace transform and Fourier transform. System Identification using DMD-Kernel-Liouville Operator was introduced for comparission.

Measurement of non-compactness of Sobolev embedding into variable Lorentz space

Chian Yeong Chuah
Ohio State University

The study of Sobolev embedding into the Lebesgue spaces and Lorentz spaces plays a fundamental role in the field of PDE and approximation theory. In the classical setting, the Rellich–Kondrachov theorem provides condition on which the Sobolev embedding is compact. In the case where the embedding is non-compact, there are various levels to which one can measure the quality of non-compactness. In this talk, we discuss the compactness of Sobolev embedding into the variable Lorentz space where the behavior of non-compactness is concentrated around a single point. The quality of non-compactness is also discussed in this case.

Barron Space for Graph Convolution Neural Networks

Seok-Young Chung and Qiyu Sun
University of Central Florida

Graph convolutional neural network (GCNN) operates on graph domain and it has achieved a superior performance to accomplish a wide range of tasks. In this talk, we introduce a Barron space of functions on a compact domain of graph signals, discuss its various properties, such as reproducing kernel Banach space property and universal approximation property. We will also discuss well approximation property of functions in the Barron space by outputs of some GCNNs, and learnability of functions in the Barron space from their random samples.

On Generators of the Hardy and Bergman Space

Joseph A. Cima
The University of North Carolina at Chapel Hill

A function φ which is analytic and bounded in the unit disk $\mathbb{D}$ is called a generator for the Hardy space $H^2(\mathbb{D})$ or the Bergman space $A^2(\mathbb{D})$ if polynomials in φ are dense in the corresponding space. We characterize generators in terms of $\varphi-$invariant subspaces which are also $z-$invariant and study wandering properties of such subspaces. Density of bounded analytic functions in the $\varphi-$invariant subspaces is also investigated. This is a joint work with Valentin V. Andreev (Lamar University) and Miron B. Bekker (The University of Pittsburgh at Johnstown).

Garsia norm and boundedness of Hankel Operators in Weighted Hardy spaces

Ana Čolović
Washington University in St. Louis

We discuss the boundedness of Hankel operators between a weighted Hardy space and a weighted L^2 space, with two different Muckenhoupt weights. In the Lebesgue measure setting, Hankel operator with a symbol f is bounded if and only if its symbol has a bounded Garsia norm, or equivalently, a bounded BMO norm. We generalize this result to the case of two weights, with the appropriate generalization of the Carleson embedding theorem.

Weighted norm inequalities for multiplier weak-type inequalities

David Cruz-Uribe, OFS
The University of Alabama

In this talk we will consider a version of weak-type inequalities we refer to as *multiplier weak-type inequalities.* Given a weight w and $1 \leq p < \infty$, the (p, p) multiplier weak-type inequality for an operator T is of the form

$$|\{x \in \mathbb{R}^n : |w^{\frac{1}{p}}(x)T(w^{-\frac{1}{p}}f)(x)| > t\}| \leq \frac{C}{t^p}\int_{\mathbb{R}^n} |f(x)|^p\, dx.$$

These inequalities follow from the a strong (p, p) inequality of the form

$$\int_{\mathbb{R}^n} |Tf(x)|^p w(x)\, dx \leq C \int_{\mathbb{R}^n} |f(x)|^p w(x)\, dx$$

by mapping $f \mapsto w^{-\frac{1}{p}}f$ and applying Chebyshev's inequality. These inequalities were first considered by Muckenhoupt and Wheeden (1977) for the maximal operator and the Hilbert transform on the real line. They showed that such inequalities hold if w is a Muckenhoupt A_p weight, but gave examples to show that the class of weights is strictly larger for these operators. Their A_p results were extended to all dimensions and all Calderón-Zygmund integral operators by myself, Martell, and Pérez (2005). They have attracted renewed attention since they were shown to be the right way of generalizing weak-type inequalities to the setting of matrix weights (DCU, Isralowitz, Moen, Pott, Rivera-Ríos, 2020).

In this talk, we will consider the problem of quantitative estimates, in terms of the A_p characteristic, for maximal operators and singular integrals with both scalar and matrix weights. As an application, we give a new proof of strong (p, p) inequalities with matrix weights for singular integrals.

If there is time, we will also discuss analogous results for the fractional integral/Riesz potential in both the scalar and matrix weighted cases. These results are completely new, as even qualitative results for fractional integrals in the scalar case were not known.

This talk is joint work with my student, Michael Penrod, and my postdoc, Brandon Sweeting.

On a problem of von Renteln

Arthur Danielyan
University of South Florida

We present the solution of a harmonic analysis problem proposed by M. von Renteln in 1980.

Quantum harmonic analysis on the Bergman space

Vishwa Dewage
Clemson University

It was shown recently by Fulsche that techniques from Werner's quantum harmonic analysis (QHA) have some fascinating applications in the theory of Toeplitz operators on the Bargmann-Fock space.

Applying QHA techniques to the Bergman space turned out to be significantly more difficult due to the non-commutativity of the group acting on the unit ball. We overcome these difficulties and develop QHA on the Bergman space. As the most striking application, by modifying slightly the notion of alpha Berezin transform $B_\alpha(S)$ of Suarez we were able to prove that each operator S in the Toeplitz algebra can be approximated by Toeplitz operators with symbols $B_\alpha(S)$. This way we answer positively a long-standing open question of Suarez and provide a constructive proof of the well-known theorem of Xia that Toeplitz operators are dense in the Toeplitz algebra over the Bergman space.

This is a joint work with Matthew Dawson, Mishko Mitkovski, and Gestur Olafsson.

Projections in combinations of finite order operators

Priyadarshi Dey
Kenyon College

An interesting problem in Banach space theory is to study the projections that are in the convex hull of surjective isometries. The study was initiated by Fernanda Botelho for the space of all continuous functions with values in a strictly convex space and it was shown that for a strictly convex Banach space X, a projection which is in the convex hull of 2 surjective isometries is a generalized bicircular projection. The study was further generalized to three projections and for projections which lie in the convex hull of n-surjective isometries. This problem has also been studied in several settings. In this talk, I will give a classification result of projections which belong to the combination of powers of finite order operators. I will mention results for the case of operators of order 4 and beyond. Some open problems and unsolved cases will also be mentioned. This is a joint work with Fernanda Botelho & Zachary Easley.

The α-z-Bures Wasserstein divergence and quantum α-z-fidelity

Trung Hoa Dinh
Troy University

In this talk, we introduce the α-z-Bures Wasserstein divergence and quantum α-z-fidelity. We study the least squares problem and the Data Processing Inequality with respect to the new quantum divergence.

On Compactness of Toeplitz and Hankel Operators on the Bergman Spaces of Convex Reinhardt Domains in $\mathbb{C}^2$.

Nazlı Doğan
Fatih Sultan Mehmet Vakıf University

Hankel and Toeplitz operators form significant classes of operators on Bergman spaces. The investigation of the compactness of these operators has been the subject of many studies. One of the most important studies on this subject was given by Axler-Zheng by using the Berezin transform. Generalizations of the result of Axler-Zheng for various domains is an important problem explored by several mathematicians. In this talk, we present some results on the compactness of Toeplitz and Hankel operators on Bergman spaces of convex Reinhardt domains of $\mathbb{C}^2$ by using Berezin transform. This is joint work with Sönmez Şahutoğlu from University of Toledo.

A progress report on OPAs in H^p

Christopher Felder
Indiana University, Bloomington

Take a point in a vector space. Now fix a closed subspace in that vector space. A naturally-arising question is, “Which point in the subspace is nearest to the given point?”

If the vector space is a Hilbert space, elementary analysis tells us that the ‘nearest point’ is the (orthogonal) projection of the given point onto the subspace.

If the vector space is not a Hilbert space, but rather a (uniformly convex) Banach space, this problem becomes much more difficult: the nearest point uniquely exists but is, a priori, not computable with linear methods. This is due to the fact that the nearest point in this setting is characterized by an analogue of the orthogonal projection, known as the metric projection, which is *non-linear*.

We will discuss the Banach space problem for certain points and subspaces in the Hardy spaces of the unit disk. The given point is the unit constant function and the subspaces are ones which are generated by polynomial multiples of some function in H^p; the nearest point in this situation corresponds to what is known as an *optimal polynomial approximant* (OPA).

We will present the state-of-the-art in tackling this problem, which includes an interesting way to move from Banach space to Hilbert space, and gain surprising traction there.

This talk is based on joint work with various subsets of the following set of people: C. Bénéteau, R. Centner, R. Cheng, D. Khavinson, M. Manolaki, and K. Maronikolakis.

Good Lambda Inequalities and Variable Orlicz Hardy Spaces

Tim Ferguson
University of Alabama

We prove a general theorem showing that local good-λ inequalities imply bounds in certain variable Orlicz spaces (also called Musielak-Orlicz spaces). We use this to prove results about variable Orlicz Hardy spaces in the unit disc.

Non-Local Games and Operator Algebras

Priyanga Ganesan
University of California, San Diego

In recent years, nonlocal games have received significant attention in operator algebras and resulted in highly fruitful interactions, including the recent resolution of the Connes Embedding Problem. A nonlocal game involves two non-communicating players who cooperatively play to win against a referee. In this talk, I will provide an introduction to the theory of non-local games and quantum correlation classes. We will discuss the role of C*-algebras and operator systems in the study of their perfect strategies. It will be shown that mathematical structures arising from entanglement-assisted strategies for nonlocal games can be naturally interpreted and studied using tools from operator algebras. I will then present a general framework of non local games involving quantum inputs and classical outputs and use them to discuss an isometry game for quantum metric spaces.

Tracial joint spectral measures

Otte Heinävaara
Princeton University

Given two Hermitian matrices, A and B, we introduce a new type of spectral measure, a *tracial joint spectral measure* $\mu_{A,B}$ on the plane. Existence of this measure implies that any two-dimensional subspace of the Schatten-p class is isometric to a subspace of L_p. We discuss some applications and limitations of this result.

Relating Convolution and Cross-correlation to Applications

Austin Jacobs
University of Florida

While many applications exist for convolution and cross-correlation, we will focus solely on how these integral operators function as the core underlying calculation for certain motion tracking methods. We provide a proof of validity of method and then use this proof of validity to give some estimates for error in the presence of noise.

Solving Quantum Max Cut via Swap Operators

Igor Klep
University of Ljubljana, Slovenia

The Quantum Max Cut (QMC) problem has emerged as a test-problem for designing approximation algorithms for local Hamiltonian problems in quantum physics. In this talk we attack this problem using the algebraic structure of QMC; we will explore the relationship between QMC and the representation theory of the symmetric group.

The first major contribution is an extension of noncommutative Sum of Squares optimization techniques championed by Helton and McCullough to give a new hierarchy of relaxations to Quantum Max Cut. The hierarchy we present is based on polynomials in the swap operators. To prove completeness of this hierarchy, we give a finite presentation of the algebra generated by the swap operators. We find that level-2 of this new hierarchy is exact (up to tolerance 10^{-7}) on all QMC instances with uniform edge weights on small graphs.

The second major contribution of this talk is a polynomial-time algorithm that exactly computes the maximum eigenvalue of the QMC Hamiltonian for certain graphs, including graphs that can be "decomposed" as a signed combination of cliques. A special case of the latter are complete bipartite graphs with uniform edge-weights, for which exact solutions are known from the work of Lieb and Mattis (1962).

The talk is based on joint work `https://arxiv.org/abs/2307.15661` with Adam Bene Watts, Anirban Chowdhury, Aidan Epperly, and J. William Helton, and a paper in progress with Tea Štrekelj and Jurij Volčič.

Polynomial Lemniscates and Torsional Rigidity

Adam Kraus
Baylor University

In 2015, D. Khavinson and M. Fleeman characterized the projection of z-bar to the Bergman space of a bounded region in terms of a boundary condition. This allows one to find examples of regions where one can calculate this projection explicitly and then use known results to calculate the torsional rigidity of the region. The main difficulty in applying these results is determining if the region in question is bounded. We will consider families of polynomial lemniscates and determine necessary conditions in which they include a bounded connected component.

Aleksandrov-Clark Theory and its generalizations

Constanze Liaw
University of Delaware

We will begin by recalling the origination of Aleksandrov-Clark Theory: First note that Beurling's Theorem says that any shift-invariant subspace of the Hardy space $H^2(\mathbb{D})$ is of the form $\theta H^2(\mathbb{D})$ for an inner function θ. Now, for a fixed inner θ, we form the model space, that is, the orthogonal complement of the corresponding shift-invariant subspace in the Hardy space. Consider the compressed shift, which is the application of the shift to functions from the model space followed by the projection to the model space. Clark observed that all rank one perturbations of the compressed shift that are also unitary have a particular, simple form. Following this discovery, a rich theory was developed connecting the spectral properties of those unitary rank one perturbations with properties of functions from the model space, more precisely, with their non-tangential boundary values. Some intriguing perturbation results were obtained via complex function theory. Generalizations, some of which we will consider, include the following. Model spaces can be defined but turn out considerably more complicated when θ is not inner. Finite rank perturbations were investigated. A generalization to the non-commutative setting has been formulated.

A Constructive Definition of the Riemann Integral on a Separable Banach Space

Timothy Myers
Howard University

The goal of this talk is to construct a Riemann integral on a separable Banach space which possesses all of the fundamental properties of the Riemann integral on $\mathbb{R}^n$. Let $\mathcal{B}$ represent a separable Banach space. The paper [GM] presents a proof that $\mathcal{B}$ has an isomorphic, isometric embedding in $\mathbb{R}^\infty$. In this work we will use this embedding to define a Riemann integral on special subsets of $\mathcal{B}$, which makes the derivations of most of its properties virtually identical to those of its finite-dimensional analogue. Similar to the Lebesgue integral on $\mathcal{B}$, this Riemann integral has the advantage of equaling a limit of Riemann integrals on $\mathbb{R}^n$ as $n \to \infty$.

We will use this convergence to study some probability density functions on $\mathcal{B}$.

Keywords : Riemann integral, Lebesgue integral, separable Banach space.

[GM] T.L. Gill, T. Myers, *Constructive Analysis on Banach Spaces,* Real Analysis Exchange, **44** (2019) 1-36.

Invariant subspaces associated with near-isometries

Sushant Pokhriyal
University of South Florida

This is a joint work with Dr. Sneh Lata and Prof. Dinesh Singh. The main purpose of this talk is to describe the invariant subspaces of a few distinct classes of operators on Hilbert space. The presentation is devoted to generalizing the famous Beurling's Invariant subspace Theorem for the shift operator to the case of the tuple of operators, where the operators assumed are weaker than isometries, we will be referring to this weaker condition of operators as near-isometries. To begin with, we first derive a generalization of Slocinski's well-known Wold-type decomposition of a pair of doubly commuting isometries to the case of an n-tuple of doubly commuting operators near-isometries. Then, with the help of Wold decomposition for the n-tuple of doubly commuting near-isometries, we will represent in concrete fashion those Hilbert spaces that are vector subspaces of the Hardy spaces $H^p(\mathbb{D}^n)(1 \leq p \leq \infty)$ that remain invariant under the action of coordinate wise multiplication by an n-tuple $(T_{B_1}, ..., T_{B_n})$ of operators where for each $1 \leq i \leq n$, B_i is a finite Blaschke factor on the open unit disc. The critical point to be noted is that these T_{B_i} are assumed to be near-isometries.

On Rhaly Operators

Gabriel T Prăjitură
SUNY Brockport

Rhaly operators are an abstractization and one possible generalization of the Cesaro operator. We will discuss some fundamental questions about these operators: boundedness, compactness, normality, spectrum. We will present some complete characterizations of these properties and some partial answers.

This talk is based on joint work with Petros Galanopoulos, Aristotle University of Thessaloniki, Greece; Daniel Girela, Universidad de Malaga, Spain; George Popescu, Polytechnic University of Craiova, Romania; Ileana Gabriela Sebe, Polytechnic University of Bucharest Gheorghe Mihoc-Caius Iacob Institute of Mathematical Statistics and Applied Mathematics of the Romanian Academy, Bucharest, Romania.

On compactness of products of Toeplitz operators

Tomas Miguel Rodriguez
University of Toledo

We study compactness of product of Toeplitz operators with symbols continuous on the closure of the polydisc in terms of behavior of the symbols on the boundary. For certain classes of symbols f and g, we show that T_fT_g is compact if and only if fg vanishes on the boundary. We provide examples to show that for more general symbols, the vanishing of fg on the whole polydisc might not imply the compactness of T_fT_g. On the other hand, the reverse direction is closely related to the zero product problem for Toeplitz operators on the unit disc, which is still open.

This is joint work with Trieu Le and Sönmez Şahutoğlu.

Moments of Multivariate Trace Polynomials

George Roman
University of Florida

We examine moments of multivariate trace polynomials over the unitary group, generalizing the work of Diaconis and Shahshahani (1994). In the process, we extend the notion of certain symmetric polynomials and show an interesting connection between random matrix theory and the Drury-Arveson kernel.

Resolving Inverse Problems through Function Theoretic Operators over Reproducing Kernel Hilbert Spaces

Joel Rosenfeld

University of South Florida

Inverse problems arise in a variety of applications, including medical and computational imaging, data driven methods in dynamical systems, and function approximation, to name a few. The resolution of these inverse problems is a major area of mathematics, and often relies on posing inverse problems as minimization problems together with a variety of regularization strategies.

In this talk, I will present an alternative strategy for a subset of inverse problems, where an unknown function is embedded into a function theoretic operator, and the action of this operator on a particular function in the function space will return the unknown function. The strategy is then to find finite rank approximations of this operator to achieve our approximation.

We will give several examples of this framework in action in the setting of function approximation and dynamical systems. This will utilize weighted composition operators, Liouville operators, and reproducing kernel Hilbert spaces.

Function theoretic properties associated to higher spin Laplacians

John Ryan

University of Arkansas

A higher spin Laplacian is also known as a Bosonic Laplacian. This is because these operators are direct analogues in Euclidean space of standard operators arising in mathematical physics over Minkowski space.

A higher spin Laplacian is a second order, homogeneous differential operator acting on smooth functions defined over a domain in Euclidean space and taking values in the space of harmonic polynomials homogeneous of degree k. When $k = 0$ we retrieve the usual Laplacian. Each of these operators is conformally invariant. We show that some of the properties of these operators are similar to those for the usual Laplacian, including boundary value problems.

Exposed points of matrix convex sets

Tea Štrekelj

University of Ljubljana

In this talk we investigate the notions of exposed points and (exposed) faces in the matrix convex setting. Matrix exposed points in finite dimensions were first defined by Kriel in 2019, but we extend this notion to matrix convex sets in infinite-dimensional vector spaces. Then a connection between matrix exposed points and matrix extreme points is established: a matrix extreme point is ordinary exposed if and only if it is matrix exposed. This leads to a Krein-Milman type result for matrix exposed points that is due to Straszewicz-Klee in classical convexity: a compact matrix convex set is the closed matrix convex hull of its matrix exposed points.

This talk is based on joint work with Igor Klep.

Denjoy-Wolff points on the bidisc

George Tsikalas
Washington University in St. Louis

Let f denote a holomorphic self-map of the unit disc $\mathbb{D}$ without any interior fixed points. A classical 1926 theorem of Denjoy and Wolff asserts that the sequence of iterates

$$f^{[n]} := f \circ f \circ \cdots \circ f$$

converges locally uniformly to a boundary fixed point of f, termed the *Denjoy-Wolff point*. The situation changes dramatically when one considers holomorphic fixed-point-free self-maps F of the bidisc $\mathbb{D}^2$; the presence of large "flat" boundary components in $\partial\mathbb{D}^2$ will, in general, prevent the iterates from converging. The cluster set of the sequence of iterates in this setting was described in a 1954 paper of Hervé.

In this talk, we will discuss extensions of the notion of a Denjoy-Wolff point to $\mathbb{D}^2$. Further, we will describe how imposing additional regularity assumptions on the behavior of the function F at such points can lead to much greater control over the behavior of the iterates. Certain refinements of Hervé's results will thus be obtained. This is joint work with Michael Jury.

Rational Inner Functions and Graphs: an example of Pascoe

Ryan Tully-Doyle
Cal Poly, San Luis Obispo

In a 2017 paper on the Julia-Carathéodory theorem for Pick functions of two variables, J. E. Pascoe pointed out that adjacency matrices of simple undirected graphs can be used to produce an interesting class of representing rational inner functions with guaranteed boundary singularities via a so-called Nevanlinna representation, an operator analogue of the Cauchy transform. This talk will discuss the original motivation for the example in the context of boundary regularity, as well as the surprising amount of follow-up that has featured applications of Pascoe's idea, including work on rational inner functions by Bickel, Pascoe, and Sola, work on iteration of low degree rational inner functions in two variables, and recent efforts to understand the connection between graphs and functions first explored by Bickel and Hong.

Investigating CT Image Reconstruction using Reproducing Kernel Hilbert Spaces

Hongliang Wang
University of South Florida

Over 80 million CT scans are performed annually in the United States, and are one of the most important diagnostic tools developed in the 20th century. Numerical Methods for CT scanners initially required the resolution of very large algebraic equations which were resolved with iterative solvers. However, limitations of computing power led to the use of Fourier based methods, such as filtered back projection up until 2009. Since then iterative methods and sparsity promoting methods have begun to replace filtered back projection because of the requirement of substantially less x-ray exposure to a patient.

In this talk we are going to explore alternative frameworks for image reconstruction; iterative reconstruction methods, filtered back projection, and a regression approach utilizing reproducing kernel Hilbert spaces and occupation kernels.

Collapsing Ricci Limit Spaces with No Manifold Structure

Kai-Hsiang Wang
Northwestern University

It is known in the literature that a non-collapsing Ricci limit space admits a manifold structure on an open dense subset (J. Cheeger and T. H. Colding, '97). It has been an open question about how regular can a collapsing Ricci limit space be. In our joint work with Erik Hupp and Aaron Naber, we provide an example of collapsing Ricci limits that admit no manifold structure (nowhere Euclidean).

A compactness criterion for localized operators with applications to pseudodifferential operators

Cody Waters
Clemson University

In this talk we discuss a compactness criterion for localized operators on a framed Hilbert space where the frame is assumed to have some additional algebraic structure. We also give a sufficient condition for the localization of an operator which is based on invariance under conjugation by other operators that are closely related to the frame. As an application, we characterize the L^2-compactness of pseudodifferential operators when the symbol σ satisfies $\|\partial_x^\alpha \partial_\xi^\beta \sigma\|_{L^\infty} < \infty$ for $|\alpha|, |\beta| \leq 2\,([n/2]+1)$. This talk is based on joint work with Cody Stockdale.

Uncertainty Principle via Short-time Fourier Transform

Pu-Ting Yu
Georgia Institute of Technology

The classical uncertainty principle in Gabor analysis studied the following type of questions: "If a Gabor system forms a Riesz basis or a frame,..etc, then how simultaneously well-concentrated can the atom and its Fourier transform be?" By using short-time Fourier transform, we ask a similar question as follows. "If a Gabor system forms a Riesz basis or a frame,..etc, then how simultaneously well-concentrated the atom and its short-time Fourier transform can be?" It was proposed by Heil whether the atom of a Gabor frame must be in the modulation spae M^p for some $1 \leq p < 2$. In this talk, we will answer this question negatively by explicitly constructing a counterexample.

Fredholm and frame preserving weighted composition operators

Ruhan Zhao
SUNY Brockport

We characterize Fredholm and frame-preserving weighted composition operators on some general Hilbert spaces of holomorphic functions in bounded domains in C^n. This is a joint work with Jasbir Singh Manhas.

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