SEAM 27 ABSTRACTS

Jim Agler, UC San Diego

Waleed K. Al-Rawashdeh, Montana Tech

Hilbert-Schmidt Difference of Composition Operators on Hardy Space

An operator T on a separable Hilbert space $\mathcal{H}$ is said to be Hilbert-Schmidt if there exists an orthonormal basis $\{e_n\}$ of $\mathcal{H}$ such that the sum $\sum_{n=0}^{\infty} \|Te_n\|_{\mathcal{H}}$ is finite.

In particular, using the orthonormal basis $\{z^n\}$ of the Hardy space $H^2(\mathbb{D})$, the composition operator $C_\varphi : f \mapsto f \circ \varphi$ on $H^2(\mathbb{D})$ is Hilbert-Schmidt if and only if $\|C_\varphi\|_{HS}^2 = \int_{\partial\mathbb{D}} \frac{1}{1-|\varphi|^2} d\sigma < \infty$. The pseudo-hyperbolic distance in the unit disk $\mathbb{D}$ is defined as

$$\rho(z,w) = |\varphi_w(z)| \qquad \text{where} \qquad \varphi_w(z) = \frac{w-z}{1-\overline{w}z},$$

for $z, w \in \mathbb{D}$. We show that the pseudo-hyperbolic distance is a good measure for characterizing the Hilbert-Schmidt difference of two composition operators on $H^2(\mathbb{D})$. In addition, we use a boundary-data argument to find a sufficient condition for the difference of two composition operators to be Hilbert-Schmidt.

Austin Amaya, Virginia Tech

Zero-pole interpolation, Beurling-Lax representations for shift-invariant subspaces, and transfer function realizations: half-plane/continuous time versions

A generalized Beurling-Lax theorem due to Ball and Helton in 1984 gives a Beurling-Lax representation for a pair of subspaces $(\mathcal{M}, \mathcal{M}^\times)$, which forms a direct-sum decomposition of $L^2(\mathbb{T})$, such that $\mathcal{M}$ is forward shift-invariant and $\mathcal{M}^\times$ is backward shift-invariant. Additionally, work of Ball, Gohberg, and Rodman in 1990 demonstrates that such a pair of subspaces can be individually parameterized in terms of zero-pole data inside or outside of the unit disk, according to whether the subspace is, respectively, forward or backward shift-invariant, so long as the pair of spaces is a finite-dimensional perturbation of the model pair of Hardy spaces $(H^2(\mathbb{D}), H^2(\mathbb{D})^\perp)$. The subsequent work of Ball and Raney in 2007 removes the "finite-dimensional perturbation" requirement. In this talk, we shall see how both the Beurling-Lax representation and the zero-pole parameterization can be extended to the continuous time case wherein the disk is replaced by the right half-plane Π_+, $(\mathcal{M}, \mathcal{M}^\times)$ forms a direct-sum decomposition of $L^2(i\mathbb{R})$, and the pair $(\mathcal{M}, \mathcal{M}^\times)$ is allowed to be an infinite-dimensional perturbation of the model pair $(H^2(\Pi_+), H^2(\Pi_-))$. This generalization makes use of the formalism for well-posed infinite dimensional linear systems developed in the book by Staffans in 2005.

Nadya Askaripour, University of Toledo

Spaces of holomorphic, integrable k-differentials and Poincare series map

Let S be a hyperbolic Riemann surface, and L be a closed subset of S, and $k > 1$ is an integer. We study spaces of integrable, square integrable and bounded holomorphic k-differentials on $S - L$, which are Banach spaces, and for a special norm we will have Hilbert spaces. Also the main result will provide a description of the kernel of the Poincare series map, which is a surjective, linear map between two spaces of integrable holomorphic k-differentials.

Sheldon Axler, San Francisco State University

Symbolic manipulation of harmonic functions

This talk will demonstrate a software package for symbolic manipulation of harmonic functions. For example, the Dirichlet problem can be solved exactly for balls, ellipsoids, annular regions, and exteriors of balls in $\mathbf{R}^n$ if the boundary data is a polynomial. Among other features, this software can also compute orthogonal projections of polynomials onto the harmonic Bergman space of the unit ball.

Joseph Ball, Virginia Tech

The characteristic function as a unitary invariant for row contractions

It is well known that the characteristic function provides a complete unitary invariant for a completely nonunitary Hilbert-space contraction operator, and, moreover, one can construct a canonical functional model which recovers the contraction operator from the characteristic function up to unitary equivalence. Popescu and Bhattacharyya-Eschmeier-Sarkar obtained similar results for the class of completely non-coisometric row contractions and commutative completely non-coisometric row contractions, respectively. The speaker and Vinnikov identified an additional functional invariant which together with the Popescu characteristic function provides a complete unitary invariant as well as a two-component noncommutative Sz.-Nagy–Foias canonical model for the class of completely nonunitary row contractions. The talk will describe a multivariable de Branges-Rovnyak model which leads to a unitary-classification theory beyond the completely non-coisometric case for the class of commutative row contractions. This is joint work with Vladimir Bolotnikov of the College of William and Mary.

Hari Bercovici, Indiana University

On sums and products in a finite factor

We will discuss recent progress in the technology of proving eigenvalue inequalities in a finite factor. The techniques are quite satisfactory for sums of selfadjoint operators, but products of unitaries pose seemingly very difficult questions.

Kelly Bickel, Washington University

Differentiating Matrix Functions

Every real-valued function defined on the plane induces a matrix-valued function on the space of pairs of commuting self-adjoint matrices. We show that a C^1 function f always induces a matrix function that can be continuously differentiated along C^1 curves. With additional restrictions on the domain of f, this result extends to higher-order differentiation.

Robert Bridges, Purdue University

Solutions to Schroeder's Equation in $\mathbb{C}^N$

If ϕ is an analytic self-map of $\mathbb{B}^N$, there is an induced composition operator, C_ϕ, sending f to $f \circ \phi$ for any analytic function f (or more generally any complex-valued function) defined on $\mathbb{B}^N$. When $N = 1$ our underlying domain is the disk and Schroeder's equation is the eigenvalue equation for C_ϕ. Specifically, given a complex λ, does there exist an analytic f for which $C_\phi f = \lambda f$?

Carl Cowen and Barbara MacCluer have generalized Schroeder's equation to $\mathbb{C}^N$ for $N \geq 1$ as follows:

Given an analytic self map ϕ of $\mathbb{B}^N$ which fixes 0 and is not unitary on a slice, does there exist an analytic $F : \mathbb{B}^N \to \mathbb{C}^N$ such that both $C_\phi F = \phi'(0)F$ and F has full rank near 0?

This talk will give new results pertaining to finding solutions to Schroeder's equation in $\mathbb{C}^N$, including the suspected result that in the absence of resonance a solution must exist.

Xuwen Chen, University of Maryland

On the Uniqueness of Solutions to the Gross-Pitaevskii Hierarchy with A Quadratic Trap

In this talk, the speaker will present a simple proof of the uniqueness of solutions to the Gross-Pitaevskii hierarchy with a quadratic trap.

Joseph A. Cima, University of North Carolina

Comments on $g'(z) = Log\ \ h'(z)$

The space of Cauchy-Transforms (C.T.) on the unit circle is a Banach space. It is a subspace of all $H^p, p < 1$, and contains H^1. The primitives of functions in the H^p spaces are of some interest and in this note we consider the primitives of functions in the C.T. space. We show the integral operator on C.T. is compact. In addition work of Pommerenke yields a connection between the Bloch space and the primitives. This in turn allows us to partner functions (by a non-linear mapping) in the space C.T. with a subset of univalent functions. There are interesting qc properties obtained for the univalent functions so obtained.

Flavia Colonna, George Mason University

New criteria for boundedness and compactness of weighted composition operators mapping into the Bloch space

An interesting question in operator theory is: Given Banach spaces X and Y and a linear operator $T : X \to Y$, what is a minimal collection of functions in the range of T whose boundedness in norm in Y guarantees the boundedness of T?

In this talk, we study this problem in the case of the weighted composition operator $W_{\psi,\varphi}$ from the Hardy spaces H^p (with $1 \le p \le \infty$), the Bloch space $\mathcal{B}$, the Bergman spaces A^p_α (with $\alpha > -1$, $1 < p < \infty$) and the Dirichlet space $\mathcal{D}$, respectively, into $\mathcal{B}$.

Furthermore, we obtain new characterizations of the compactness of such operators in terms of the little "oh"-condition on the Bloch norm of suitable collections of functions. In the cases of the bounded weighted composition operators from H^p for $1 \le p < \infty$ or A^p_α for $1 < p < \infty$, we also obtain characterizations of compactness purely in terms of the symbols of the operator that, to the best of our knowledge, have not appeared in the literature, although for $p = 2$, they could be obtained as a special case of a theorem of Ohno and Stroethoff for weighted composition operators from reproducing kernel Hilbert spaces into the Bloch space.

Part of this research was motivated by the wish to generalize to weighted composition operators the following compactness criterion for composition operators on the Bloch space proved by Wulan, Zheng and Zhu: C_φ is compact on $\mathcal{B}$ if and only if $\lim_{n\to\infty} \|\varphi^n\|_\beta = 0$, where

$$\|f\|_\beta = \sup_{z\in\mathbb{D}} (1 - |z|^2)|f'(z)|.$$

Alberto Condori, Florida Gulf Coast University

Recent results on superoptimal approximation of matrix-valued functions by meromorphic matrix-valued functions with at most k poles

Let Φ be a continuous $n \times n$ matrix-valued function on the unit circle $\mathbb{T}$ such that the $(k-1)$th singular value of the Hankel operator with symbol Φ is greater than its kth singular value. In this case, it is well-known now that Φ has a unique superoptimal meromorphic approximant Q with at most k poles in the unit disc $\mathbb{D}$ (i.e. the McMillan degree of Q in $\mathbb{D}$ is at most k) and Q minimizes the essential suprema of singular values $s_j\left((\Phi - Q)(\zeta)\right)$, $j \ge 0$, with respect to the lexicographic ordering. In this talk, we present some recent results regarding the Toeplitz operator with symbol $\Phi - Q$ and discuss some applications, if time permits.

Carl C. Cowen, IUPUI

Hermitian Weighted Composition Operators and Bergman Extremal Functions

If ψ is an analytic function on the unit disk and ϕ is an analytic map of the disk into itself, the weighted composition operator $W_{\psi,\phi}$ on H, a Hilbert space of analytic functions, is the operator defined by

$$(W_{\psi,\phi}f)(z) = \psi(z)f(\phi(z))$$

for z in the disk and f in H. We begin by characterizing the Hermitian weighted composition operators on the weighted Hardy spaces H^2_κ, with $\kappa \geq 1$, for which the kernel functions are $(1 - \overline{w}z)^{-\kappa}$, including the standard weight Bergman spaces. For these spaces, their spectra and spectral decompositions are described.

If N is a subspace of H^2_κ that is invariant for the operator of multiplication by z such that there are functions f in N with $f(0) \neq 0$ and G is a function of N so that

$$\|G\| = 1 \quad \text{and} \quad G(0) = \sup\{\operatorname{Re} f(0) : f \in N \text{ and } \|f\| = 1\}$$

then we say G *solves the extremal problem for the invariant subspace* N. As a consequence of the spectral theory for some of the Hermitian weighted composition operators above, we compute the extremal functions for the subspaces associated with the usual atomic inner functions for these weighted Bergman spaces and get explicit formulas for the projections of the kernel functions on these subspaces.

This talk is based on joint work of Eung Il Ko, Gajath Gunatillake, and the speaker.

The presentation is in honor of John B. Conway in appreciation of his friendship and excellent advice over the course of many years.

Zeljko Cuckovic, University of Toledo

Toeplitz operators on Bergman spaces of polyanalytic functions

We study algebraic properties of Toeplitz operators on Bergman spaces of polyanalytic functions on the unit disk. We obtain results on finite-rank commutators and semi-commutators of Toeplitz operators with harmonic symbols. (Joint work with Trieu Le).

Raúl Curto, University of Iowa

Operators Cauchy Dual to 2-hyperexpansive Operators: The Multivariable Case

In joint work with Sameer Chavan, we introduce an abstract framework to study generating m-tuples, and use it to analyze hypercontractivity and hyperexpansivity in several variables. These two notions encompass (joint) hyponormality and subnormality, as well as the study of toral and spherical isometries; for instance, the Drury-Arveson 2-shift is a spherical complete hyperexpansion.

Our approach produces a unified theory that simultaneously covers toral and spherical hypercontractions (and hyperexpansions). As a byproduct, we arrive at a dilation theory for completely hypercontractive and completely hyperexpansive generating tuples. We can then analyze in detail the Cauchy duals of toral and spherical 2-hyperexpansive tuples. We also discuss various applications.

Yen Do, Georgia Tech

The lacunary Walsh-Fourier series and convergence near L^1

In this talk I will survey recent results about the convergence of lacunary Walsh-Fourier series. We show that if a function is $L(\log\log L)(\log\log\log L)$ integrable on the torus then the lacunary series convergence a.e., which is a triple log term away from Konyagin's conjecture. This is joint work with Michael Lacey.

Michael Dritshcel, University of Newcastle

Peter Duren, University of Michigan

Schwarzian norms and two-point distortion

The Schwarzian norm of a locally univalent analytic function in the unit disk $\mathbb{D}$ is defined by $\|Sf\| = \sup_{z\in\mathbb{D}}(1-|z|^2)^2|Sf(z)|$, where $Sf = (f''/f')' - \frac{1}{2}(f''/f')^2$ is the Schwarzian derivative. A bound $\|Sf\| \le 2(1+\delta^2)$ on the Schwarzian norm for any given $\delta > 0$ is shown to be equivalent to a certain weighted lower bound on the distance $|f(\alpha) - f(\beta)|$ for all $\alpha, \beta \in \mathbb{D}$ with hyperbolic separation $d(\alpha, \beta) \ge \pi/\delta$. Furthermore, the same bound on the Schwarzian norm is equivalent to a certain upper bound on the two-point distortion. Similar results apply to bounds of the form $\|Sf\| \le 2(1-\delta^2)$ for $0 < \delta < 1$, which imply that f is univalent in $\mathbb{D}$. (Joint work with Martin Chuaqui, William Ma, Diego Mejía, David Minda, and Brad Osgood.)

Nathan Feldman, Washington and Lee University

The Cyclic Behavior of Cosubnormal Operators

An open question that appeared in both of John Conway's books on subnormal operators asked whether or not every pure subnormal operator has a cyclic adjoint. Surprisingly, the answer is yes! This has been known for nearly 13 years now. Even more surprising is the fact that many pure cosubnormal operators satisfy stronger forms of cyclicity; such as hypercyclicity (having a dense orbit) or supercyclicity (scalar multiples of an orbit is dense). We will discuss various strong forms of cyclicity exhibited by cosubnormal operators, including some new ones. Several open problems will be given as well.

Raluca Felea, Rochester Institute of Technology

Fourier Integral Operators with singularities

We consider the generalized Radon transform that integrates over lines in R^3 with directions parallel to an arbitrary curve on the sphere which is used in tomography inverse problems. This is a Fourier integral operator F with fold and blow down singularities. When the adjoint operator F^* is applied, new singularities appear and the goal is to understand them and to decrease their strength.

Tim Ferguson, University of Michigan

Explicit Solutions of some Extremal Problems in Bergman Spaces

We discuss a technique which in some cases leads to explicit solutions of extremal problems in Bergman spaces. We will give some specific examples and explain an application to the study of canonical divisors.

Stephan Ramon Garcia, Pomona College

On a problem of Halmos — unitary equivalence of a matrix to its transpose

In one of his famous problem books, Halmos asked whether every square complex matrix is unitarily equivalent to its transpose (UET). As can be shown with ad hoc examples, the answer is no. In this talk, we give a complete characterization of matrices for which are UET. Surprisingly, the naive conjecture that a matrix is UET if and only if it is unitarily equivalent to a complex symmetric (i.e., self-transpose) matrix is true in dimensions $n \leq 7$ but false for $n \geq 8$. In particular, unexpected building blocks begin to appear in dimensions 6 and 8. This is joint work with James E. Tener (UC Berkeley).

Pratibha Ghatage, Cleveland State University

A survey of closed range composition operators

We discuss necessary and sufficient conditions for a composition operator on a Bloch or Bergman space to be bounded below in terms of inverse images of their symbol and relate them to Carleson measures.

Will Grilliette, University of Nebraska—Lincoln

A New View of Presentation Theory for C-algebras*

In this talk, I offer an alternative presentation theory for C*-algebras with applicability to various other normed structures. Specifically, the set of generators is equipped with a nonnegative-valued function which ensures existence of a C*-algebra for the presentation. This modification allows clear definitions of a "relation" for generators of a C*-algebra and utilization of classical algebraic tools, such as Tietze transformations.

As an example, I will discuss the universal C*-algebra of an invertible element, given by the presentation

$$\langle (x,t),(y,s) | xy = yx = 1 \rangle_{\mathbf{1C^*}},$$

where $t, s \geq 0$. The isomorphism classes which arise depend on a numeric condition on the product ts. If $ts = 1$, the algebra is $C(\mathbb{T})$. If $ts > 1$, the algebra is $C[0,1] *_{\mathbb{C}} C(\mathbb{T})$, the free product with amalgamation along the scalars.

Don Hadwin, University of New Hampshire

MF Traces and Topological Free Entropy Dimension

We discuss Dan Voiculescu's topological free entropy dimension. The domain of definition of this invariant is a tuple of operators that generates an MF-C*-algebra in the sense of Blackadar and Kirchberg. We are able to obtain many new results by introducing new concepts, including: MF trace, the MF ideal, and MF nuclearity. We are also able to extend results on free entropy of Junhao Shen and myself by identifying the "correct" C*-analogue of the notion of "diffuseness" in finite von Neumann algebras. (Joint with Qihui Li, Weihua Li, and Junhao Shen).

Katherine Heller, North Central College

Composition Operators on $S^2(\mathbb{D})$

Given $\varphi : \mathbb{D} \to \mathbb{D}$, an analytic map of the unit disc in $\mathbb{C}$, the composition operator C_φ is defined by $C_\varphi(f) = f \circ \varphi$ for f belonging to some Hilbert space of analytic functions on $\mathbb{D}$. In this talk, we will present a formula for the adjoint of a linear-fractionally induced composition operator on $S^2(\mathbb{D})$, the Hilbert space of functions whose derivative is in the Hardy space, $H^2(\mathbb{D})$. We will then use this formula to characterize compactness of the commutator $C_\varphi^* C_\psi - C_\psi C_\varphi^*$ on $S^2(\mathbb{D})$ for linear fractional self-maps of the disc φ and ψ.

J. William Helton, UC San Diego

*Free *-convexity*

Convexity is the most desired property of an optimization problem, since local minima (often easy to find numerically) are global. Within the subject of convex optimization the biggest advance in the last 20 years is semidefinite programing, which is the pursuit of linear matrix inequalities (LMIs). Many problems in many branches of science convert to LMIs, where in computational complexity and in linear systems engineering it has had a major impact.

Studying properties of LMIs presents an opportunity for operator theorists, since analyzing LMIs and finding their range of applicability involves a variety of operator techniques. Thanks to these there is getting to be a substantial theory of LMIs. This talk focuses on the branch of the subject where the unknowns are matrices (rather than scalars). It presents a range of theorems in free analysis which pertain to many classes of LMIs arising in linear systems.

Yun-Su Kim, University of Toledo

Algebraic Elements and Invariant Subspaces

We prove that if a completely non-unitary contraction T in $L(H)$ has a non- trivial algebraic element h, then T has a non-trivial invariant subspace.

Greg Knese, University of Alabama

A refined Agler decomposition and geometric applications

We prove a refined Agler decomposition for bounded analytic functions on the bidisk and show how it can be used to reprove an interesting result of Guo et al. related to extending holomorphic functions without increasing their norm. In addition, we give a new treatment of Heath and Suffridge's characterization of holomorphic retracts on the polydisk.

Eddy Kwessi, Auburn University

A note on multiplication operators in Lorentz spaces $L(p;r)$; $1 \leq r \leq p$

In this note, we first characterize all functions g such that the multiplication operator $T_g f = g \cdot f$ is bounded in the Lorentz Space $L(p;1)$ based on a new characterization of this space given by De Souza in 2010. Then using interpolation theorem for operators on $L(p;1)$, we find the characterization of the multiplication operators in $L(p;r)$; $1 < r \leq p$.

Trieu Le, University of Toledo

Some algebraic properties of Toeplitz operators on the Segal-Bargmann space

Let $\mathcal{H}$ be the Segal-Bargmann space, which consists of Gaussian square-integrable entire functions on $\mathbb{C}^n$. For a bounded function f on $\mathbb{C}^n$, T_f denotes the Toeplitz operator with symbol f acting on $\mathcal{H}$. Let f_1 and f_2 be two bounded radial functions, one of which is non-constant, we will discuss the necessary and sufficient conditions on a bounded function g for which $T_{f_1}T_g = T_gT_{f_2}$. We then use this result to study the commuting and zero-product problems for Toeplitz operators on $\mathcal{H}$. This is joint work with W. Bauer.

Junxia Li, University of Arkansas

Some Rarita-Schwinger operators

In this paper we study a generalization of the classical Rarita-Schwinger type operators and construct their fundamental solutions. We give some basic integral formulas related to these operators. We also establish that the projection operators appearing in the Rarita-Schwinger operators and the Rarita-Schwinger equations are conformally invariant. We further obtain the intertwining operators for other operators related to the Rarita-Schwinger operators under actions of the conformal group.

Constanze Liaw, Texas A&M

Regularizations of singular integral operators

In the theory of singular integral operators significant effort is often required to rigorously define such an operator. This is due to the fact that the kernels of such operators are not locally integrable on the diagonal, so the integral formally defining the operator or its bilinear form is not well defined (the integrand is not in L^1) even for nice functions. However, since the kernel only has singularities on the diagonal, the bilinear form is well defined say for bounded compactly supported functions with separated supports.

One of the standard ways to interpret the boundedness of a singular integral operators is to consider regularized kernels, where the cut-off function is zero in a neighborhood of the origin, so the corresponding regularized operators with kernel are well defined (at least on a dense set). Then one can ask about uniform boundedness of the regularized operators. For the standard regularizations one usually considers truncated operators.

The main result of the paper is that for a wide class of singular integral operators (including the classical Calderon–Zygmund operators in non-homogeneous two weight settings), the L^p boundedness of the bilinear form on the compactly supported functions with separated supports (the so-called restricted L^p boundedness) implies the uniform L^p-boundedness of regularized operators for any reasonable choice of a smooth cut-off of the kernel. If the kernel satisfies some additional assumptions (which are satisfied for classical singular integral operators like Hilbert Transform, Cauchy Transform, Ahlfors–Beurling Transform, Generalized Riesz Transforms), then the restricted L^p boundedness also implies the uniform L^p boundedness of the classical truncated operators.

This is joint work with S. Treil.

Erik Lundberg, University of South Florida

Algebraic Dirichlet problems

We consider the Dirichlet problem with polynomial (or real-entire) data posed on (a component of) the zero set of a polynomial. For any polynomial data posed on an ellipsoid the solution is again a polynomial. We discuss some partial results toward proving the Khavinson-Shapiro conjecture which states that this property characterizes ellipsoids. We also discuss some related investigations such as locating the singularities that can develop when the solution to an algebraically-posed Dirichlet problem is analytically continued outside its natural domain.

Paul McGuire, Bucknell University

Analytic tridiagonal reproducing kernels and subnormality

Assume $K = K(z,w)$ is an analytic reproducing kernel on $E \times E$ and that $H(K)$ denotes the associated Hilbert space with reproducing kernel K. A tridiagonal kernel has the form $K(z,w) = \sum_{i,j=0}^{\infty} f_n(z)f_n(w)$ where $f_n(z) = (a_n + b_n z)z^n$. By a suitable normalization we may assume the domain E is the unit disk $\mathbb{D}$. The operator of multiplication by z on $H(K)$ is a subnormal operator if there is a measure μ on $\mathbb{D}$ such that $H(K) = P^2(\mu)$. Are there any subnormal operators associated with tridiagonal kernels and, if so, what are they? Some examples of subnormal operators on tridiagonal kernel spaces will be introduced as well as some related questions having to do with sums of reproducing kernels. This is joint work with Gregory Adams and Nathan Feldman.

Len Miller, Mississippi State University

Spectral properties of operators associated with the Cesàro operator on weighted Bergman spaces

For $\nu > 0$ and f analytic on the unit disc, define

$$C_\nu f(z) = z^{-\nu} \int_0^z \frac{f(\omega)}{1-\omega}\omega^{\nu-1}\, d\omega, \quad (|z| < 1).$$

The classical Cesàro operator is then C_1. We discuss spectral properties of $C_\nu \in \mathcal{L}(L^p_a(m_\alpha)$. In particular, by applying an argument of Cowen together with a Paley-Wiener theorem for $L^2_a(m_\alpha)$ due to Duren, Gallardo-Gutiérrez and Montes-Rodríguez, we identify $\nu > 0$ for which C_ν is subnormal or subscalar on $L^2_a(m_\alpha)$.

Vivien Miller, Mississippi State University

Spectral Properties of a Class of Averaging Operators

We consider a class of averaging operators

$$A_g f(z) = \tfrac{1}{z-1} \int_1^z f(\omega)g(\omega)\, d\omega$$

corresponding to a bounded analytic function g. For a large class of symbols g, we determine the spectrum, point spectrum and surjectivity spectrum of A_g acting on the classical Hardy spaces on the unit disc. In addition, We show that these operators have the decomposition property (δ). This is joint work with E. Albrecht.

Mishko Mitkovski, Georgia Tech

Universality limits and de Branges spaces

Various statements on the distribution of eigenvalues of random matrices can be obtained by considering the limiting behavior of the normalized reproducing kernels of a certain naturally associated sequence of orthogonal polynomials. We will discuss some results about these universality limits in the case when the underlying measure doesn't have finite moments. In this case the orthogonal polynomials are replaced by a nested family of de Branges spaces.

Maria Neophytou, Purdue University

On the Point Spectrum of the Adjoints of Some Composition Operators

If φ is an analytic map of the unit disk into itself, the composition operator C_φ with symbol φ, on the Hardy-Hilbert space H^2, is defined by $C_\varphi f = f \circ \varphi$. Many properties of the adjoint can be determined by considering its action on the reproducing kernel functions, namely $C_\varphi^* K_w = K_{\varphi(w)}$. We look at adjoints of composition operators with symbols φ that have a fixed point inside the disk and a fixed point on the boundary with finite angular derivative there. By imposing a few extra assumptions on φ, we show that the point spectrum of the adjoint contains a disk centered at the origin, and that the corresponding eigenspaces are infinite-dimensional. We also identify a subspace of H^2 which is invariant for C_φ^* and on which C_φ^* acts like a weighted shift.

Mehdi Nikpour, University of Toledo

On parametric Toeplitz operators on the Hilbert-Hardy space

From the matricial point of view, moving one step to the southeast, provides us a bounded operator-valued linear transformation on the C*-algebra of all bounded linear operators on the Hilbert-Hardy space to itself, which enables us first to answer partially a question raised by Paul R. Halmos, and second to embed Toeplitz operators in an extended setting.

Bob Olin, University of Alabama

Bloom where you are planted!

We will undertake an epistemological review of the gardener. In this talk I will study the Master Gardener from three perspectives: The Husband and Dad, the Mentor, and the Mathematician. We shall review his produce and the tools he used.

Z. Patrick Pan, Saginaw Valley State University

Derivational points of Banach bimodules

A linear mapping δ from an algebra $\mathcal{A}$ to an $\mathcal{A}$-bimodule $\mathcal{M}$ is called derivable at a fixed point $c \in \mathcal{A}$ if $\delta(xy) = \delta(x)y + x\delta(y)$ for all $x, y \in \mathcal{A}$ satisfying $xy = c$. We call $c \in \mathcal{A}$ a derivational point of $\mathcal{M}$ if whenever δ is derivable at c then δ is derivable everywhere, i.e. δ is a derivation. Some recent results regarding derivational points will be discussed (joint work with Jiankui Li).

Linda Patton, Cal Poly

Non-Circular Numerical Ranges

If T is a quadratic operator on any Hilbert space H, then Tso and Wu showed that the numerical range $W(T)$ is a possibly degenerate open or closed ellipse with foci at the eigenvalues of T. Consequently, if the quadratic operator T has distinct eigenvalues then $W(T)$ is not a circular disk. We will show that if T is an operator on a finite-dimensional Hilbert space such that the minimal polynomial of T has no repeated roots, then the numerical range of T is not a circular disk. However, an example will show it is possible for an operator T on an infinite dimensional Hilbert space to have numerical range equal to an open disk even if it has minimal polynomial $p(z) = z^3 - 1$. This is joint work with T.R. Harris, M. Mazzella, D. Renfrew, and I. Spitkovsky.

Gabriel Prajitura, SUNY Brockport

Orbital behaviour, inverses and adjoints

We will discuss connections (or lack of) between the orbital behaviour of an operator and the orbital behaviour of its adjoint. In the case of invertible operators we have a similar discussion about the connections between the orbits of an operator and those of its inverse.

Katie Quertermous, James Madison University

C^*-algebras Generated by Linear-fractionally-induced Composition Operators

Let φ be an analytic self-map of the unit disk $\mathbb{D}$, and let $H^2(\mathbb{D})$ denote the Hardy space of the disk. The composition operator C_φ is defined by $C_\varphi f = f \circ \varphi$ for all $f \in H^2(\mathbb{D})$. We are particularly interested in composition operators induced by linear-fractional, non-automorphism self-maps of $\mathbb{D}$ that fix a given point ζ on the unit circle and satisfy $\varphi'(\zeta) \neq 1$.

In this talk, we consider two types of C*-algebras: $C^*(C_\varphi, \mathcal{K})$, the unital C*-algebra generated by the ideal of compact operators and a single composition operator of the form described above, and $C^*(\mathcal{F}_\zeta)$, the unital C*-algebra generated by the collection of all composition operators induced by linear-fractional non-automorphisms that fix a given point ζ on the unit circle. We show that each of these C*-algebras is isomorphic, modulo the ideal of compact operators, to the unitization of an appropriate crossed product C*-algebra. We then apply known results for crossed products by the integers and techniques that were developed in the study of singular integral operators with a shift to calculate the essential spectra of a class of operators in $C^*(C_\varphi, \mathcal{K})$.

Mrinal Raghupathi, Vanderbilt University

Nevanlinna-Pick interpolation and the distance formula

In this talk I will describe the long-standing connection between the Nevanlinna-Pick interpolation problem and the associated distance computation. I will mention some results obtained with Brett Wick about a Pick theorem "up to a constant" and its application to interpolating sequences. Finally, I will describe some recent work of Davidson-Hamilton and Hamilton and myself which extends the Nevanlinna-Pick type theorems for subalgebras of H^∞ to the setting of subalgebras of a Complete Nevanlinna-Pick space.

Bill Ross, University of Richmond

Boundary values of functions in the range of a truncated Toeplitz operator

In this recent joint work with Andreas Hartmann we will discuss the non-tangential boundary behavior of functions which belong to the rage of a truncated Toeplitz operator.

Sonmez Sahutoglu, University of Toledo

Hankel operators and dbar-Neumann problem

I will discuss how Hankel operators on domains in C^n is related to an operator in several complex variables called the dbar-Neumann problem. One can use this relation to explore how the boundary geometry of the domain is related to compactness of Hankel operators. This is joint work with Zeljko Cuckovic and Mehmet Celik.

David Scheinker, UC San Diego

Some theorems about bounded analytic functions on the polydisc

The Schur Class of $\mathbb{D}^n$ is the set of analytic functions mapping $\mathbb{D}^n$ to $\mathbb{D}$. We give a sufficient condition for an analytic function f on $\mathbb{D}^n$ to be uniquely determined in the Schur class of $\mathbb{D}^n$ by its values on a finite set of points. In terms of the Pick problem on $\mathbb{D}^n$, we give sufficient conditions for the Pick problem with data $x_1, \ldots, x_N$ and $f(x_1), \ldots, f(x_N)$ to have a unique solution. We discuss why our results can be though of as a generalization of the classic Schwarz Lemma on the disc.

David Sherman, University of Virginia

*Conditional expectations onto maximal abelian *-subalgebras*

A conditional expectation (CE) from a von Neumann algebra onto a maximal abelian *-subalgebra (MASA) is simply a projection of norm one. In 1959 Kadison and Singer used a detailed calculation in Fourier analysis to prove that there are multiple CEs from $B(\ell^2)$ onto a continuous MASA; this implies that some pure states on the MASA have nonunique extensions to $B(\ell^2)$. They also showed that there is a unique CE from $B(\ell^2)$ onto a discrete MASA, famously leaving open the question of uniqueness of pure state extensions.

Chuck Akemann and I recently answered the general question, "When is there a unique CE from a separably-acting semifinite von Neumann algebra onto a MASA?" Our methods rely on the new observation that a unique CE onto a singly-generated MASA must be weak* continuous, and in particular provide a short, Fourier-free route to the results for $B(\ell^2)$.

Ilya Spitkovsky, College of William and Mary

Some new developments in the theory of Toeplitz operators with matrix almost periodic symbols

Toeplitz operators T_f with scalar almost periodic (AP) symbols f are invertible if and only if f is invertible (as an element of AP or, equivalently, L_∞) and has zero mean motion. In the matrix case, however, things are much more complicated, and the invertibility criterion is actually not known. We will describe several particular classes for which necessary and sufficient invertibility conditions were obtained recently. Time permitting, we will also mention some results on the topological properties of the set of $g \in AP$ for which T_g are invertible.

Ronald Walker, Penn State Harrisburg

Boundaries of Holomorphic Chains in Vector Bundles over Complex Projective Space

The characterization of boundaries of holomorphic chains take widely different characteristics when considered in projective space as opposed to affine space. We will examine the family of holomorphic vector bundles over projective space, which provides a range of examples intermediate to these two extremes. We will discuss a unified way of expressing characterizations of boundaries of holomorphic chains for spaces within this family. Also we reveal one key difference between the case of holomorphic vector bundles with rank two or more versus the case of holomorphic line bundles.

Kai Wang, Texas A&M

Essential normality of the cyclic submodule generated by any polynomial

Guo and the speaker showed that the closure $[I]$ in the Drury-Arveson space of a homogeneous principal ideal I in $\mathbb{C}[z_1, \cdots, z_n]$ is essentially normal. The proof exploited combinatorial relations between the weights of the shift operators on the space. One can show that their result extends to the Bergman space for the ball $\mathbb{B}_n$ and closely related spaces, but thus far no one has been able to extend the result to other ideals in pursuit of the conjecture of Arveson. In this talk, we use techniques from harmonic analysis involving the radial derivative and the complex tangential derivative to extend the result to the closure of any principal polynomial ideal in the Bergman space. In particular, the commutators and cross-commutators of the restrictions of the multiplication operators are shown to be in the Schatten p-class for $p > n$. Moreover, the maximal ideal space X_I of the resulting C^*-algebra for the quotient module is shown to be contained in $Z(I) \cap \partial\mathbb{B}_n$, where $Z(I)$ is the zero variety for I, and to contain all points in $\partial\mathbb{B}_n$ that are limit points of $Z(I) \cap \mathbb{B}_n$. As a consequence, $X_I = Z(I) \cap \partial\mathbb{B}_n$ in the case that I is quasi-homogeneous.

Gary Weiss, University of Cincinnati

Subideals of operators

Techniques developed in the last decade generalize to arbitrary ideals the 1983 Fong-Radjavi determination of which principal ideals of compact operators are also $B(H)$ ideals. This involves generalizing a notion of soft ideals introduced by Kaftal-Weiss. Knowing this leads to a characterization of all principal ideals inside an arbitrary $B(H)$ ideal. Modest generalizations of these are presented as evidence of a completely general conjecture. This work is joint with Sasmita Patnaik.

Brett Wick, Georgia Tech

Carleson Measures for Besov-Sobolev Spaces and Non-Homogeneous Harmonic Analysis

In this talk we will discuss the characterization of Carleson measures for the Besov–Sobolev space of analytic functions B_2^σ on the complex ball of $\mathbb{C}^d$. In particular, we demonstrate that for any $\sigma \geq 0$, the Carleson measures for the space are characterized by a "T1 Condition". The method of proof of these results is an extension and another application of the work originated by Nazarov, Treil and Volberg. Additionally, the method of non-homogeneous harmonic analysis of Nazarov, Treil and Volberg is extended to handle "Bergman–type" singular integral operators, which is key to the characterization of Carleson measures.

Manwah Lilian Wong, Georgia Tech

Orthogonal polynomials and applications to mathematical physics

Orthogonal polynomials come up in various contexts in mathematical physics, the better known ones are Legendre polynomials and Hermite polynomials. In this talk, I will start from the definitions of orthogonal polynomials on the unit circle and on the real line, to be followed by a discussion of basic properties like recurrence coefficients and Jacobi matrices, as well as the connection between orthogonal polynomials and mathematical physics. In particular, topics on the discrete Schroedinger operator and Toeplitz determinants will be covered. Finally, recent results obtained will be presented.

Pei Yuan Wu, Dept. of Applied Mathematics, National Chiao Tung University

A journey through numerical ranges

The numerical range $W(A)$ of a bounded linear operator A on a complex Hilbert space H is the subset of the complex plane consisting of the inner products of the vectors Ax and x with x any unit vector in H, and the numerical radius $w(A)$ of A is the maximum modulus of the elements in $W(A)$.

In this talk, we briefly discuss three topics in the study of numerical ranges which we have worked on, together with Hwa-Long Gau, over the past ten years:

(1) Anderson's theorem from the early 1970s on the condition for the numerical range of a finite matrix to be equal to a circular disc,

(2) Holbrook's conjecture from 1969 on the numerical radius of the product of two commuting operators, and

(3) Williams and Crimmins's result from 1967 on the condition for the equality of the numerical radius to half of the norm of an operator.

Zhijian Wu, University of Alabama

A New Characterization for Carleson Measures and Some Applications

We provide a new characterization for Carleson measures in terms of the L^p behaviors of certain functions represented as an integration on a non-tangential cone. Applications for characterizing the boundedness and compactness of Volterra type operators from Hardy spaces to some holomorphic spaces are also presented.

Daoxing Xia, Vanderbilt University

Operator Identities for Subnormal Tuples of Operators

Let M be the closure of the span of the range of all self commutators of a subnormal k-tuple S of operators on a Hilbert space H, with m.n.e. N. Let C's and L's be the restriction of the commutators and the adjoint of these operators in the tuple S. In this talk, we will give some formulas of the restriction on M of the products of the resolvents of operators in the tuple N expressed by those C's, L's and the mosaics of S. As the corollary, we will give some formulas of the restriction of the product of the resolvents of the operators in the tuple S on M by those C's and L's. The method in this work is based on the analytic model for the subnormal tuple of operators. Besides, we will give the generalization of some result above to the commuting k-tuple of operators.

Ruhan Zhao, SUNY Brockport

New estimates of Essential norms of weighted composition operators between Bloch type spaces

For $\alpha > 0$, the α-Bloch space is the space of all analytic functions f on the unit disk D satisfying

$$\|f\|_{B^\alpha} = \sup_{z \in D} |f'(z)|(1-|z|^2)^\alpha < \infty.$$

Let φ be an analytic self-map of D and u be an analytic function on D. The weighted composition operator induced by u and φ is defined by $uC_\varphi(f)(z) = u(z)f(\varphi(z))$. In this talk we give estimates of the essential norms of uC_φ between different α-Bloch spaces in terms of the n-th power of φ. We also give similar characterizations for boundedness and compactness of uC_φ between different α-Bloch spaces. This is a joint work with Jasbir Singh Manhas.
