

SEAM XVII
Main Lectures & Twenty-Minute Talks

All talks will be held in the Boyd Graduate Studies Building. See the conference schedule (<http://www.math.uga.edu/seam17/#sched>) for rooms and times.

Greg Adams, Bucknell University

Title: *Analytic reproducing kernels of bandwidth three and an interesting example*

Abstract: This talk will focus on reproducing kernel Hilbert spaces with orthonormal bases of the form $\{(a_{n,0} + a_{n,1}z + \cdots + a_{n,J}z^J)z^n, n \geq 0\}$. The primary focus is on the tridiagonal case where $J = 1$ and how it compares to the diagonal case where $J = 0$. The question of when multiplication by z is a bounded operator is investigated and aspects of this operator are discussed. In the well studied diagonal case M_z is a weighted unilateral shift. In the tridiagonal case this need not be so and an example is given in which the commutant of M_z on a tridiagonal space is strikingly different from that on any diagonal space. This is joint work with Paul McGuire.

Donald J. Bindner, Truman State University

Title: *On the space spanned by the powers of a weighted shift and its adjoint*

Classification: 47

Animikh Biswas, University of North Carolina at Charlotte

Title: *Extended eigenvalues and the Volterra operator*

Abstract: For a Hilbert space \mathcal{H} , let $\mathcal{L}(\mathcal{H})$ denote the set of all bounded linear operators on \mathcal{H} . We say that a complex number λ is an *extended eigenvalue* of $A \in \mathcal{L}(\mathcal{H})$ if there is a nonzero $X \in \mathcal{L}(\mathcal{H})$ satisfying the equation $XA = \lambda AX$. The above intertwining relation was used in order to extend the invariant subspace result of Lomonosov by S. Brown, Kim and Pearcy, and independently by Shields. Quite recently, some progress in this direction was made by Lauric. Here we consider the integral Volterra operator on the space $L^2(0,1)$. We show that the set of extended eigenvalues of V is precisely the interval $(0, \infty)$ and in fact X may be chosen to be an integral operator as well. As an application of our method, it follows that the operators V and λV are not quasi-similar in case $\lambda \neq 1$.

Vladimir Bolotnikov, College of William and Mary

Title: *An interpolation problem for contractive multipliers between two reproducing kernel Hilbert spaces*

Classification: 47

Abstract: Let $k_1(z, w)$ and $k_2(z, w)$ be two positive (matrix-valued) kernels on $\Omega \times \Omega$ ($\Omega \in \mathbb{C}^d$) and let $H(k_1)$ and $H(k_2)$ be the corresponding reproducing kernel Hilbert spaces. A function S analytic on Ω is a contractive multiplier from $H(k_1)$ to $H(k_2)$ if the kernel $k_2(z, w) - S(z)k_1(z, w)S(w)^*$ is positive on $\Omega \times \Omega$. A general tangential interpolation problem will be posed for the class of such functions and the set of all solutions characterized in terms of a certain positive kernel constructed from the interpolation data. This positive kernel is an analogue of Potapov's fundamental matrix inequality. It will be shown that in the special case when Ω is the unit ball of \mathbb{C}^d and $k_1(z, w) = k_2(z, w) = (1 - z_1\bar{w}_1 - \dots - z_d\bar{w}_d)^{-1}$, the fundamental matrix inequality leads easily to a parametrization of all solutions of the interpolation problem in terms of a linear fractional transformation.

Rick Chartrand, The University of Illinois at Chicago

Title: *Carleson measures and multipliers for $D(\mu)$*

Classification: 46

Abstract: For the Dirichlet-type space $D(\mu)$ associated with a measure μ on the unit circle, the question of which functions multiply the space into itself is answered in terms of " μ -Carleson measures." In this talk, this and other questions and properties of μ -Carleson measures will be discussed.

Raul E. Curto, The University of Iowa

Title: *Triangular Toeplitz Contractions and Cowen Sets for Analytic Polynomials*

Classification: 47

Abstract: For f an analytic polynomial, let G'_f denote the reduced Cowen set for f , that is, $G'_f := \{g \in H^\infty(\mathbb{T}) : g(0) = 0 \text{ and the Toeplitz operator } T_{f+\bar{g}} \text{ is hyponormal}\}$. In joint work with Muneo Cho and Woo Young Lee, we show that G'_f is strictly convex. We obtain this as a corollary of the following result.

Theorem. *Let \mathfrak{T}_N be the collection of $N \times N$ lower triangular Toeplitz contractions. Then \mathfrak{T}_N is compact and strictly convex in the spectral norm; that is, \mathfrak{T}_N is compact, convex, and $\partial\mathfrak{T}_N \subseteq \text{ext}\mathfrak{T}_N$.*

Lower triangular Toeplitz contractions arise naturally in the solution of the Caratheodory-Schur interpolation problem (CSIP). In fact, CSIP is solvable iff the associated Toeplitz matrix C is contractive, i.e., $I - CC^* \geq 0$. Moreover, CSIP has a unique solution iff $\det(I - CC^*) = 0$, and the unique solution is a Blaschke product. Our proof relies on a careful analysis of the extreme points of \mathfrak{T}_N and its associated Blaschke products.

John Daughtry, East Carolina University

Title: *Extreme Point Questions*

Abstract: We examine further questions about extreme points in a particular Banach algebra studied by Lambert and Weinstock.

Michael Dritschel, University of Newcastle

Title: *Factorization and Model Theory*

Classification: 47

Abstract: We explore the subtle connection between positive operator-valued trigonometric polynomials and Agler's model theory.

Nathan Feldman, Washington & Lee University

Title: *Somewhere Dense Orbits are Everywhere Dense*

Classification: 47A16

Abstract: We will discuss the following theorem: If the orbit of a vector under a linear operator is somewhere dense then it must be everywhere dense. This question was raised by Alfredo Peris and two immediate corollaries are an answer to a question of Herrero's and another proof of Ansari's Theorem, both concerning hypercyclic operators. This is joint work with Paul Bourdon.

Lawrence Fialkow, SUNY at New Paltz

Title: *The Truncated Complex Moment Problem: A Conjecture*

Abstract: We discuss a conjectured solution to TCMP (equivalently, to the truncated 2-dimensional real power moment problem) in terms of algebraic and geometric invariants of the moment matrix associated to the data.

Alan Hopenwasser, University of Alabama

Title: *Regularity of Embeddings of Finite Dimensional Nest Algebras*

Classification: 47L40

Abstract: I will discuss two notions of regularity, one global and one local, for embeddings of finite dimensional nest algebras. In general, a regular embedding is one which can be written as a sum of multiplicity one embeddings. A locally regular embedding is one which preserves regularity of partial isometries (with respect to some block matrix structure). Regularity of a partial isometry, in turn, means that the block entries of the partial isometry are again partial isometries. The main result is that, in the context of finite dimensional nest algebras, these two notions agree. This result is useful in the theory of direct limit algebras; in this talk, however, I will focus on the finite dimensional linear algebra.

Zhangjian Hu, University of North Carolina at Chapel Hill

Title: *Characterizations for Some Function Spaces in the Unit Ball of \mathbb{C}^n*

James Jamison, Univeristy of Memphis

Title: *Isometric Equivalence of Some Banach Space Operators*

Classification: 47A62

Abstract: Let X be a Banach space and S_1 and S_2 be elements of $B(X)$. Operators S_1 and S_2 are said to be isometrically equivalent if there exists a surjective isometry U of X such that $US_1 = S_2U$. For example, let $X = C_p(H)$ be the Schatten class of a complex separable Hilbert space H and A_k and B_k ($k = 1, 2$) be members of $B(H)$. Define $S_k(T) = A_kT - TB_k$. We give necessary and sufficient conditions for S_1 to be isometrically equivalent to S_2 . We will also give some other results in different settings.

Srilal Krishnan, University of Alabama

Title: *Principal ideals in subalgebras of groupoid C^* -algebras*

Classification: 47L40

Abstract: The study of different types of ideals in non self-adjoint operator algebras has been a topic of recent research. This paper studies one of the basic types of ideals, a principal ideal in some non self-adjoint limit algebras. An ideal is said to be principal if it is generated by a single element of the algebra. In this paper we look at the ideals in subalgebras of certain groupoid C^* -algebras and prove that every ideal is principal. We obtain the same result for regular canonical subalgebras of approximately finite C^* -algebras as a particular case.

Michael Lacey, Georgia Institute of Technology

Title: *Solution of the Kato Square Root Problem*

Classification: 42, 35J

Abstract: Let $L = -\operatorname{div}A\nabla$ be a differential operator in which A is a bounded measurable function taking values in $d \times d$ matrices with complex entries. Assume that “ A is uniformly accretive” in this sense. There are constants $0 < \lambda < \Lambda < \infty$ for which

$$\lambda|\xi|^2 < \operatorname{Re}\langle A(x)\xi, \xi \rangle < \Lambda|\xi|^2.$$

Then, one can define through an appropriate functional calculus a square root of L . The theorem is that this operator maps the Sobolev space H^1 into L^2 . That is $L^{1/2}$ acts like the gradient. This is joint work with Pascal Auscher, Steve Hoffmann, Alan McIntosh, and Philippe Tchamitchian.

Alec Matheson, Lamar University

Title: *Some remarks on regular majorants*

Classification: 46

Abstract: A majorant is a continuous increasing function $\omega(t)$ on $[0, \infty)$ with $\omega(0) = 0$. The majorant $\omega(t)$ is regular if there are positive constants c_1 and c_2 such that $\int_0^t \frac{\omega(s)}{s} ds \leq c_1 \omega(t)$ and $t \int_t^\infty \frac{\omega(s)}{s^2} ds \leq c_2 \omega(t)$. The functions t^α , $0 < \alpha < 1$, are prototypical regular majorants. Regular majorants are important in part because smoothness classes determined by them are closed under harmonic conjugation. We characterize regular majorants by showing that each is equivalent to another regular majorant $\omega(t)$ satisfying $t^\beta \leq \omega(t) \leq t^\alpha$ for all $t \geq 0$ and some exponents $0 < \alpha \leq \beta < 1$. We give examples to show that this characterization is best possible.

John McCarthy, Washington University

First Lecture: Pick's theorem - What's the big deal ?

Abstract: Suppose N points in the unit disk, $\lambda_1, \dots, \lambda_N$ are given, along with N complex numbers w_1, \dots, w_N . In 1916, Georg Pick considered the question of when one could find a function ϕ holomorphic in the unit disk and with positive real part that interpolated the data, i.e. satisfied $\phi(\lambda_i) = w_i$ for every i .

Pick completely answered the question, and his criterion — that the matrix

$$\left(\frac{w_i + \bar{w}_j}{1 - \lambda_i \bar{\lambda}_j} \right)$$

be positive semi-definite — can be proved using fairly basic function theory.

Yet operator theorists still write hundreds of papers a year about this problem - why? The purpose of this expository talk is to explain why Pick's problem is important to engineers, and how it is related to operator theory.

John McCarthy, Washington University

Second Lecture: Generalizations of Pick's Theorem

Abstract: We shall discuss some extensions of Pick's theorem to other settings.

Scott McCullough, University of Florida

Title: *Bergman-type kernels, factorization, contractive divisors, wandering subspaces, and dilations*

Classification: 47A20

Abstract: A representation theorem for a multiplier invariant subspaces of a reproducing kernel Hilbert spaces whose kernel behaves like the Bergman kernel is established. Consequences include contractive divisor properties, a wandering subspace theorem, and dilation results. This is joint work with Stefan Richter.

Ioana Mihalía, Coastal Carolina University

Title: *A Multiplicative-Periodic Function on C_0*

Classification: 30B

Abstract: This talk will present an explicit construction of a multiplicative-periodic meromorphic function on C_0 . The construction is based on considering the Riemann surfaces obtained by factoring C_0 through a discrete multiplicative subgroup.

Vivien Miller, Mississippi State University

Title: *Local spectral theory and weighted shifts*

Classification: 47B37, 47B40

Abstract: We show that the spectrum of a decomposable bilateral weighted shift must be a circle. As a corollary, we characterize the weighted shifts that are generalized scalar.

Cornel Pasnicu, University of Puerto Rico

Title: *Tensor products of C^* -algebras with the ideal property*

Classification: 46L06, 46L05

Abstract: My talk will be based on a joint work (with the above title) with Mikael Rordam, published in the Journal of Functional Analysis 177,(2000),130-137. Answering into negative a conjecture of Brown and Pedersen, Kodaka and Osaka have shown that a minimal tensor product of real rank zero C^* -algebras is not necessarily real rank zero. We push this pathology (pertaining to what one may call noncommutative dimension theory) much further by showing that in the case of nonexact real rank zero C^* -algebras A and B , the minimal tensor product of A with B may not only fail to have real rank zero, but it may have ideals not generated by projections (even in the separable case); we also point out that this phenomenon is specific for nonexact C^* -algebras. In particular, this implies that the ideal property is not preserved under forming minimal tensor products - even in the separable case (a C^* -algebra has the ideal property if any of its (closed,two-sided) ideals is generated (as an ideal) by projections). The proofs rely on results by Kirchberg, Dadarlat and myself.

Gabriel Prajitura, Bucknell University

Title: *Classes of λ commuting operators*

Classification: 47

Abstract: We consider three classes of operators on a complex Hilbert space: operators λ commuting with a non-zero finite rank operator; operators λ commuting with a non-zero compact operator and operators λ commuting with a non-zero operator. A complete description, in terms of the spectrum, will be given for the closures of these classes and for some of the interiors.

Vasiliy Prokhorov, University of South Alabama

Title: *On Hankel operators associated with functions $f \in L_p$, $1 \leq p < \infty$*

Classification: 47

Abstract: We consider some questions related to the theory of Hankel operators. Let G be a bounded simple connected domain with the boundary Γ consisting of a closed analytic Jordan curve. Denote by $\mathcal{M}_{n,p}(G)$, $1 \leq p \leq \infty$, the class of all meromorphic functions on G that can be represented in the form $h = 3D\beta/\alpha$, where β belongs to the Smirnov class $E_p(G)$, α is a polynomial degree at most n , $\alpha \not\equiv 0$. We obtain estimates of s -numbers of the Hankel operator A_f constructed from $f \in L_p(\Gamma)$, $1 \leq p < \infty$, in terms of the best approximation $\Delta_{n,p}$ of f in the space $L_p(\Gamma)$ by functions belonging to the class $\mathcal{M}_{n,p}(G)$.

Alexander Richman, Purdue University

Title: *Spectra of composition operators in several variables with linear fractional symbol*

Abstract: Linear fractional maps on the complex plane that carry the open unit disk into itself play a central role in developing and understanding the theory of composition operators on the classical spaces of functions analytic on the disk. Linear fractional maps in several variables generalize classical linear fractional maps in the complex plane; for example, the class of linear fractional maps that carry the unit ball in \mathbf{C}^N into itself include the automorphisms of the ball.

Previous work of Barbara MacCluer and Carl Cowen studied basic properties of these linear fractional maps and showed that they induce bounded composition operators on the Hardy spaces and some weighted Bergman spaces of functions analytic in the unit ball in \mathbf{C}^N . In this talk, we will review some of the earlier work on linear fractional composition operators in several variables and present new work on the spectra of these operators, focusing on the interesting case of a single fixed point on the boundary and no interior fixed points.

James Rovnyak, University of Virginia

Title: *Nudelman's problem, revisited*

Classification: 47A57

Abstract: Nudelman's problem is to find Schur functions $w(z)$ such that $b = w(A)c$ for given vectors b and c and an operator A . Particular cases include classical interpolation theorems. The main results are extended to meromorphic functions which belong to the generalized Schur class.

Alexei Rybkin, University of Alaska at Fairbanks

Title: *On asymptotic behavior of the Titchmarsh-Weyl m -function associated with one dimensional Schrodinger operators; some final results.*

Abstract: For the general one dimensional Schrodinger operator $-\frac{d^2}{dx^2} + q(x)$ with real $q \in L_1(\mathbb{R})$ we present a new series representation of the Jost solution which, in turn, implies a new asymptotic representation of the Weyl m -function for locally summable q . This representation is then applied to smooth potentials q to obtain Weyl m -function power asymptotics. We show that the condition $q^{(N)} \in L_1(x_0, x_0 + \delta)$, $N \in \mathbb{N}_0$, allows one to derive the $(N + 1)$ - term for almost all $x \in [x_0, x_0 + \delta)$ that refines relevant results by Danielyan, Levitan and Simon. All our main results are complete.

Ilya Spitkovsky, College of William and Mary

Title: *Toeplitz Operators with Frequency Modulated Semi-Almost Periodic Symbols*

Classification: 47

Abstract: It is well known that amplitude modulation does not affect Fredholmness of Toeplitz operators. The same is true for frequency modulation provided the symbol of the operator is piecewise continuous. In the present paper, it is shown that frequency modulation can destroy Fredholmness for Toeplitz operators with almost periodic symbols; the corresponding example is based on the observation that certain almost periodic functions become semi-almost periodic functions after appropriate frequency modulation. Moreover, the paper contains several results that can be employed in order to decide whether a Toeplitz operator with a frequency modulated semi-almost periodic symbol is Fredholm.

Tavan Trent, University of Alabama

Title: *An $H^2(D^2)$ -corona Theorem for Infinitely many Functions on the Bidisk*

Classification: 47A57

Abstract: We extend a corona theorem of Li (Corona Problems of several Variables, Contemporary Mathematics, Vol. 137, Amer. Math. Soc., 1991) and Lin (M.R. 94c:46106) to the case of infinitely many functions on the bidisk.

Zhijian Wu, University of Alabama

Title: *Q spaces and Morrey spaces*

Abstract: Analytic Q spaces can be described by p -Carleson measures. By studying the derivatives of functions in Q spaces, we show that functions in Q spaces are certain fractional differentials of functions in Morrey spaces.

Rongwei Yang, University of Georgia

Title: *Trace formula for isometric pairs*

Abstract: It is well known that for every isometry V , $tr[V^*, V] = -ind(V)$. This fact for the shift operator is the basis for many important developments in operator theory as well as in topology. In this talk we show an analogous formula for a pair of isometries (V_1, V_2) , namely $tr[V_1^*, V_1, V_2^*, V_2] = -2ind(V_1, V_2)$, where $[V_1^*, V_1, V_2^*, V_2]$ is the complete anti-symmetric sum and $ind(V_1, V_2)$ is the Fredholm index of the pair (V_1, V_2) . Two examples are considered.

Guoliang Yu, Vanderbilt University

First Lecture: Large scale geometry of groups

Abstract: Large scale geometry was first introduced by Mostow in the proof of his famous rigidity theorem. It is popularized by Gromov's work on geometric group theory. In this talk, I will explain the basic ideas of large scale geometry. In particular, I will discuss Gromov's concept of uniform embedding into Hilbert space.

Guoliang Yu, Vanderbilt University

Second Lecture: Novikov's Conjecture

Abstract: A fundamental problem in the topology of high-dimensional manifolds is the Novikov conjecture. Roughly speaking the Novikov conjecture states that manifolds are rigid at a certain infinitesimal level. In my second talk, I will explain what is the Novikov conjecture, why it is interesting, and how it is related to large scale geometry of groups via K -theory of C^* -algebras.

Ruhan Zhao, University of Virginia

Title: *Essential Norms of weighted composition operators between Bloch type spaces*

Classification: 47B38

Abstract: Let D be the open unit disk in the complex plane. Let u be a fixed analytic function on D and φ an analytic self-map of D . A weighted composition operator, which can be regarded as a generalization of a multiplication operator and a composition operator, is defined by $uC_\varphi f = uf \circ \varphi$. In this talk we estimate the essential norms of the weighted composition operators between Bloch type spaces (including the Lipschitz spaces Lip_α and the Bloch space). This is a joint work with Barbara MacCluer.