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ABSTRACTS

Operator Theory and Its Applications

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Splitting properties for n-inverses of tensor products of operators

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Let $B(X)$ be the algebra of all bounded operators on a Banach space X. Let

$$p(y, x) = \sum_{i,j=0}^{n} c_{ij} y^i x^j.$$

For $S, T \in B(X)$, we define the functional calculus $p(S, T)$ by

$$p(S, T) = p(y, x)|_{y=S,x=T} = \sum_{i,j=0}^{n} c_{ij} S^i T^j$$

where S is always on the left side of T.

As in [1] and [2], S is a left n-inverse of T (or T is a right n-inverse of S) if

$$\beta_n(S, T) = (yx - 1)^n|_{y=S,x=T} = \sum_{k=0}^{n} (-1)^{n-k} \binom{n}{k} S^k T^k = 0.$$

In this talk, I will present some basic properties of left n-inverses of T. Mainly I will focus on the following theorem proved in [1].

Theorem 1 *Let $S_1, T_1 \in B(X)$ and $S_2, T_2 \in B(Y)$. If S_1 is a strict left m-inverse of T_1 and S_2 is a strict left l-inverse of T_2, then $S_1 \otimes S_2$ is a strict left n-inverse of $T_1 \otimes T_2$ where $n = m + l - 1$.*

The converse of this theorem is verified for small n in [3]. Recently in a joint work with Stepan Paul, we are able to prove the converse by applying some techniques from algebraic geometry.

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On generalized criss-cross, near commutativity and common spectral properties

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For two bounded linear operators A and B on a Banach space, "$I - AB$ is invertible if and only if $I - BA$ is invertible" is known as Jacobson's lemma. We'll discuss here a generalization of it and its n-tuple versions and consequently the common spectral properties shared by the involved operators.

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On Kadison's transitive algebra problem: A metric property

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Let $\mathcal{H}$ be a separable, infinite dimensional, complex Hilbert space and let $\mathcal{L}(\mathcal{H})$ be the algebra of all bounded, linear operators on $\mathcal{H}$. We also write $\mathbf{K}$ for the ideal of compact operators in $\mathcal{L}(\mathcal{H})$ and denote the quotient (Calkin) map $\mathcal{L}(\mathcal{H}) \to \mathcal{L}(\mathcal{H})/\mathbf{K}$ by π. For each $T \in \mathcal{L}(\mathcal{H})$ we employ the notation $\sigma(T)$ and $\sigma_e(T) := \sigma(\pi(T))$ for the spectrum and essential spectrum of T, respectively, and we write $\|T\|_e := \|\pi(T)\|$.

In what follows, $\mathbb{A}$ will always denote a unital, norm-closed, subalgebra of $\mathcal{L}(\mathcal{H})$ and $\mathbb{A}^{-W}$ the closure of $\mathbb{A}$ in the weak (equivalently, strong) operator topology (herein denoted WOT and SOT, respectively). Recall that a subalgebra $\mathbb{A} \subset \mathcal{L}(\mathcal{H})$ is called *transitive* if the only subspaces left invariant by every $A \in \mathbb{A}$ are (0) and $\mathcal{H}$, and recall also that long ago, motivated by Burnside's theorem for finite dimensional spaces, R. Kadison in 1955 raised the (still open) problem whether every transitive subalgebra $\mathbb{A}$ of $\mathcal{L}(\mathcal{H})$ satisfies $\mathbb{A}^{-W} = \mathcal{L}(\mathcal{H})$. The following is a variant of the Kadison problem:

Problem A. If there exists a transitive subalgebra $\mathbb{A}$ of $\mathcal{L}(\mathcal{H})$ such that $\mathbb{A}^{-W} \neq \mathcal{L}(\mathcal{H})$, is it necessarily true that $\| \ \|$ and $\| \ \|_e$ are equivalent norms on $\mathbb{A}$?

Of course, since no such transitive algebra $\mathbb{A}$ with $\mathbb{A}^{-W} \neq \mathcal{L}(\mathcal{H})$ is presently known to exist, it would certainly be difficult to give a negative answer to Problem A. But we were strongly motivated to solve Problem A affirmatively because such a result would yield immediately the existence of nontrivial invariant subspaces for a large class of operators including all operators of the form $S+K$, where S is subnormal and $K \in \mathbf{K}$. In this talk we discuss a new metric property via Problem A, that some operator algebras on Hilbert space possess and some resulting consequences concerning transitivity and structure theory of such algebras.

(This is a joint work with C. Foias, E. Ko and C. Pearcy)

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Spectral properties of m-complex symmetric operators

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In this paper we study several spectral and local spectral properties of m-complex symmetric operators. Moreover, we prove that a power of an m-complex symmetric is also m-complex symmetric with conjugation C. Furthermore, we investigate the decomposability of an m-complex symmetric operator. Finally, we give several examples of m-complex symmetric with conjugation C.

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Reconsideration of the cubic moment problem

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The cubic moment problem of complex version was solved recently by D. Kimsey. In his paper, it was shown that if a cubic moment sequence has a (minimal) representing measure, then it is at most 4-atomic. We would like to present a simpler solution to the problem using recursively determinateness of an extension of the given moment sequence; we will also use properties of localizing matrices. To simplify complex cubic moment sequences, it is essential to apply equivalence of complex and real moment problems, and invariance of the moment problem under a degree-one transformation.

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Products of truncated Hankel operators

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We characterize the pairs of truncated Hankel operators on the model spaces $K_u^2(= H^2 \ominus uH^2)$ whose products result in truncated Toeplitz operators when the inner function u has a certain symmetric property.

(This is a joint work with Dong-O Kang)

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Isomorphisms of operator systems

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Very recently, Davidson and Kennedy confirmed Arveson's intuition about the fact that boundary representations were the right tool to obtain the C^*-envelope of an operator system. Motivated in part by their result, together with joint previous work with D. Farenick, I consider the problem o f establishing complete order isomorphism classes of operator systems. The problem is surprisingly hard, even in the case of 3-dimensional operator systems inside a finite-dimensional C^*-algebra.

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On semi-cubically hyponormal weighted shifts

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In this talk we discuss the semi-cubical hyponormality of weighted shifts. It is known that a semi-cubically hyponormal weighted shift does not satisfy the flatness property, which provides a good motivation to study this topic. We discuss a semi-cubically hyponormal weighted shift with first two equal weights. Let $\alpha : 1, 1, \sqrt{x}, (\sqrt{u}, \sqrt{v}, \sqrt{w})^\wedge$ be a backward 3-step extension of a recursively generated weighted sequence with $1 \leq x \leq u \leq v \leq w$ and let W_α be the associated weighted shift with a weight sequence α. We discuss a necessary and sufficient condition for the semi-cubical hyponormality of W_α and some related properties.

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Commutators on the Dirichlet space

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Let D denote the classical Dirichlet space of analytic functions f in the open unit disc $\mathbb{D}$ with finite Dirichlet integral, $\int_{\mathbb{D}} |f'|^2 dA < \infty$. And let H_d^2 be the Drury-Arveson space determined by the kernel $k_\zeta(z) = \frac{1}{1-\langle z,\zeta\rangle}$. There are some similar properties between these two spaces: both spaces have complete Nevanlinna-Pick kernel; the multiplier algebra of D is strictly contained in $H^\infty(\mathbb{D})$, and it is shown by Arveson [1] that the multiplier algebra of H_d^2 is strictly contained in $H^\infty(\mathbb{B})$. In this talk, we will show that for each f in the multiplier algebra of D, the commutator $[M_f^*, M_z]$ is in the Schatten p-class, $p > 1$. This result is similar to the one in [2] that for each f in the multiplier algebra of H_d^2, the commutators $[M_f^*, M_{z_i}], i = 1, \cdots, d$ belong to the Schatten p-class, $p > 2d$.

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Spectra of weighted Fourier algebras on non-compact Lie groups: the case of the Euclidean motion group

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If we recall that the spectrum of the Fourier algebra is nothing but the underlying group itself (as a topological space), then it is natural to be interested in determining the spectrum of weighted Fourier algebras. We will first introduce a model for a weighted version of Fourier algebras on non-compact Lie groups and then we will demonstrate that the spectrum of the resulting commutative Banach algebra is realized inside the complexification of the underlying Lie group by focusing on the case of the Euclidean motion group. The main difficulty here is that there is no abstract vs concrete Lie theory correspondence available for us. The key ingredient to overcome this difficulty is to use the underlying Euclidean structure on the group and solve a Cauchy type of functional equation for certain functionals. This is a joint work with Nico Spronk.

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On composition operators for which $|C_\varphi^2| \geq |C_\varphi|^2$

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For an analytic self-map φ of the open unit disk $\mathbb{D}$, the *composition operator* C_φ on the Hardy space $H^2(\mathbb{D})$ is defined by $C_\varphi f = f \circ \varphi$ for $f \in H^2$. In this talk, we consider composition operators C_φ on the Hardy space H^2 such that $|C_\varphi^2| \geq |C_\varphi|^2$; in this case, we say that C_φ belongs to *class A* (notation : $C_\varphi \in \mathcal{A}$). We show that if $C_\varphi \in \mathcal{A}$, then 0 is a fixed point of φ. As an application, we obtain that each invertible composition operator in $\mathcal{A}$ is unitary. In addition, we give spectral properties of composition operators in $\mathcal{A}$. We also examine composition operators whose adjoints belong to $\mathcal{A}$.

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Subnormality of unbounded operators via inductive limits

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Unbounded composition operators in L^2-spaces and weighted shifts on directed trees have proved to be a source of interesting problems and results. Many of them are related to the subnormality, a subject widely recognized as difficult and important in operator theory. As far as we know, there is no effective general criterion for subnormality of unbounded operators and, as a consequence, the methods of verifying the subnormality of an operator depend on its properties. For example, for an operator with a dense set of C^∞-vectors the moment problem approach can be successful, while for unbounded composition operators the consistency condition approach is far better. This calls for testing various methods when studying the subject. It turns out that inductive limit techniques might also be helpful in this matter, especially in the case of composition operators or weighted shifts on directed trees. The talk is aimed at presenting recent results concerning this topic.

The talk is based on joint work with P. Dymek, A. Płaneta, and Z. J. Jabłoński, I. B. Jung and J. Stochel.

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Abrahamse's Theorem for matrix-valued symbols

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In this talk we consider the subnormality of Toeplitz operators with matrix-valued symbols and, in particular, with an appropriate reformulation of Halmos' Problem 5: Which subnormal Toeplitz operators with matrix-valued symbols are either normal or analytic? In 1976, M.B. Abrahamse showed that if $\varphi \in L^\infty$ is such that φ or $\overline{\varphi}$ is of bounded type, and if the Toeplitz operator T_φ is subnormal, then T_φ is either normal or analytic. We establish a complete generalization, to the matrix-valued case, of Abrahamse's Theorem.

(This is a joint work with R. Curto and I.S. Hwang)