WOAT 2012

Workshop on Operator Theory and Operator Algebras 2012

(Dedicated to Professor Ferreira dos Santos)

Programme

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Book of Abstracts

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List of Participants

Programme

	Tuesday, September 11, 2012		
08:30-10:00	Registration (Anf. Complexo)		
10:00-10:35	Opening session (Anf. Complexo)		
10:40-11:10	Coffee break		
11:10-12:00	Marinus Kaashoek (Anf. Complexo)		
12:05-12:55	Yuri Karlovich (Anf. Complexo)		
13:00-14:00	Lunch		
14:00-14:50	Roland Duduchava (Anf. Complexo)		
14:55-15:45	Frank Speck (Anf. Complexo)		
15:50-16:10	Coffee break		
16:10-16:40	Cristina Câmara (Anf. Complexo)	Sérgio Mendes (Sala 3.10)	Mohamed Bendaoud (Sala 3.31)
16:45-17:15	Marcus Carlsson (Anf. Complexo)	Wicharn Lewkeeratiyutkul (Sala 3.10)	Cristian Bereanu (Sala 3.31)
17:20-17:50	Cláudio Fernandes (Anf. Complexo)	Baruch Schneider (Sala 3.10)	Hudson Akewe (Sala 3.31)
17:55-18:25	Rui Marreiros (Anf. Complexo)	Rahma Agroum (Sala 3.10)	Ioanis Dassios (Sala 3.31)

	Wednesday, September 12, 2012		
08:30-09:20	Bernd Silbermann (Anf. Complexo)		
09:25-10:15	Helmuth Malonek (Anf. Complexo)		
10:20-10:40	Coffee break		
10:40-11:30	Alois Kufner (Anf. Complexo)		
11:35-12:25	Lars-Erik Persson (Anf. Complexo)		
12:30-13:00	Steffen Roch (Anf. Complexo)		
13:00-14:00	Lunch		
14:00-14:50	Luís Castro (Anf. Complexo)		
14:55-15:45	José Petronilho (Anf. Complexo)		
15:50-16:10	Coffee break		
16:10-16:40	Alla Kuznetsova (Anf. Complexo)	Zoubir Dahmani (Sala 3.10)	Mustapha Sarih (Sala 3.31)
16:45-17:15	Piotr Dymek (Anf. Complexo)	Natasha Samko (Sala 3.10)	Salvatore Triolo (Sala 3.31)
17:20-17:50	Nazife Erkursun (Anf. Complexo)	Alexei Karlovich (Sala 3.10)	Ali Armandnejad (Sala 3.31)
17:55-18:25	Haykel Gaaya (Anf. Complexo)	Amar Debbouche (Sala 3.10)	Lahcène Mezrag (Sala 3.31)

	Thursday, September 13, 2012	
08:30-09:20	Ronald Douglas (Anf. Complexo)	
09:25-10:15	Pere Ara (Anf. Complexo)	
10:20-10:40	Coffee break	
10:40-11:30	Ruy Exel (Anf. Complexo)	
11:35-12:25	Nadia Larsen (Anf. Complexo)	
12:30-13:00	Fernando Lledó (Anf. Complexo)	
13:00-14:00	Lunch	
14:00-14:50	Michael Semenov-Tian-Shansky (Anf. Complexo)	
14:55-15:45	Nenad Manojlovic (Anf. Complexo)	
15:50-16:10	Coffee break	
16:10-16:40	Bartosz Kwasniewski (Anf. Complexo)	Ana Conceição and José Pereira (Sala 3.10)
16:45-17:15	Rui Palma (Anf. Complexo)	Juan Rodríguez (Sala 3.10)
17:20-17:50	Yuriy Savchuk (Anf. Complexo)	Dana Bereanu (Sala 3.10)
17:55-18:25	Ahmed Al-Rawashdeh (Anf. Complexo)	Ana Moura Santos (Sala 3.10)
18:30-19:00	Pedro Santos (Anf. Complexo)	Martin Bohata and Jan Hamhalter (Sala 3.10)
20:30-23:00	Conference Dinner	

	Friday, September 14, 2012
08:30-09:20	Luís Sanchez (Anf. Complexo)
09:25-10:15	Mário Figueira (Anf. Complexo)
10:20-10:40	Coffee break
10:40-11:10	Franciszek Szafraniec (Anf. Complexo)
11:15-12:05	Amílcar Branquinho (Anf. Complexo)
12:10-13:00	Ilya Spitkovsky (Anf. Complexo)
13:00-14:00	Lunch
14:00-20:00	Excursion

Book of abstracts

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Spectral discretization of Darcy's equations

The system of unsteady Darcy's equations considered here models the time-dependent flow of an incompressible fluid such as water in a rigid porous medium. We propose a discretization of this problem that relies on a backward Euler's schema for the time variable and spectral methods for the space variables. We prove a priori error estimates that justify the optimal convergence properties of the discretization.

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Fixed point theorem for mappings satisfying contractive condition of integral type

In this talk, we prove some theorems on fixed and common fixed points for mappings satisfying general contractive condition of integral type in a complete G-metric space. Our results are extensions of the results of Debashis Dey, Anamika Ganguly and Mantu Saha and generalizations of several results in the literature including the results of Branciari.

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On the classification of C^*-algebras using unitary groups

In 1955, Dye proved that the discrete unitary group in a factor determines the algebraic type of the factor. Using Dye's approach, we prove similar results to a larger class of amenable unital C^*-algebras including simple unital AH-algebras (of SDG) with real rank zero. If φ is an isomorphism between the unitary groups of two unital C^*-algebras, it induces a bijective map θ_φ between the sets of projections of the algebras. For some UHF-algebras, we construct an automorphism φ of their unitary group, such that θ_φ does not preserve the orthogonality of projections. For a large class of unital C^*-algebras, we show that θ_φ is always an orthoisomorphism. This class includes in particular the Cuntz algebras $\mathcal{O}_n$, $2 \leq n \leq \infty$, and the simple unital AF-algebras having 2-divisible K_0-group. If φ is a continuous automorphism of the unitary group of a UHF-algebra A, we show that φ is implemented by a linear or a conjugate linear $*$-automorphism of A.

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C^*-algebras of separated graphs

C^*-algebras of separated graphs have been introduced recently by Ara, Exel, Goodearl and Katsura. A separated graph is a pair (E, C) where E is a graph, $C = \bigsqcup_{v \in E^0} C_v$, and C_v is a partition of $s^{-1}(v)$ (into pairwise disjoint nonempty subsets) for every vertex v.

Given a separated graph (E, C), there are four C^*-algebras associated to it, the full graph C^*-algebra $C^*(E, C)$, the reduced graph C^*-algebra $C^*_{\mathrm{red}}(E, C)$, the full Cuntz-Krieger graph C^*-algebra $\mathcal{O}(E, C)$ and the reduced Cuntz-Krieger graph C^*-algebra $\mathcal{O}^r(E, C)$. I will define all these C^*-algebras and give a summary of the results we have obtained on them. Some concrete motivating examples will be considered. For a trivially separated graph (i.e. a separated graph (E, C) such that $C_v = \{s^{-1}(v)\}$ for all $v \in E^0$), the four C^*-algebras mentioned above coincide with the usual graph C^*-algebra $C^*(E)$ associated to the directed graph E.

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Majorization induced by special types of matrices

Let $\mathbf{M}_n$ be the set of $n \times n$ real matrices. An element D of $\mathbf{M}_n$ with nonnegative entries is called doubly stochastic if the sum of every row and every column of D is 1. The classical majorization is induced by doubly stochastic matrices, i.e. for every $x, y \in \mathbb{R}^n$, x is majorized by y if and only if $x = Dy$ for some doubly stochastic matrix D. The linear preservers of the classical majorization are characterized by Ando in [1]. In this talk we consider some new types of stochastic matrices. The majorizations introduced by these matrices are investigated and finally the structure of their linear preservers will be characterized, for more details see [2, 3, 4].

References

[1] T. Ando. *Majorization, doubly stochastic matrices, and comparison of eigenvalues.* Linear Algebra and its Applications, **118** (1989), 163–248.

[2] A. Armandnejad and Z. Gashool. *Strong linear preservers of g-tridiagonal majorization on* $\mathbb{R}^n$. Electronic Journal of Linear Algebra, **123** (2012), 115-121.

[3] A. Armandnejad and A. Ilkhanizadeh Manesh. *Gut-majorization and its linear preservers.* Electronic Journal of Linear Algebra, **123** (2012), 646–654.

[4] Geir Dahl, *Tridiagonal doubly stochastic matrices.* Linear Algebra and Its Applications, **390** (2004), 197–208.

Mohamed Bendaoud

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Nonlinear mappings preserving local spectra of operators

In this talk we present new results concerning nonlinear mappings preserving some spectral functions or certain spectral quantities such as the local spectrum, the convexified local spectrum, and the local spectral radius distance of operators at a nonzero fixed vector.

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Nonlinear perturbations of the relativistic operator

In this talk we present some existence and multiplicity results concerning periodic solutions of some nonlinear perturbations of the relativistic operator. The perturbations are of concave-convex type or of pendulum type. Our main tool is Szulkins critical point theory. The talk is based upon joint works with P. Jebelean, J. Mawhin and P.J. Torres.

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Spectral theory for linear relations via linear operators

In this talk we develop a spectral theory for some closed linear operators. This approach, essentially expressed in terms of linear operators, provides a better understanding of the spectral theory for closed linear relations. This is a joint work with F.-H. Vasilescu in Pacific Journal of Mathematics, 255 (2012), 349-372.

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Structures on operator algebras and Jordan isomorphisms

There are many structures associated with operator algebras which are motivated both physically and mathematically and such that their symmetries lead surprisingly to Jordan isomorphisms. A prototypical example is the celebrated Wigner Theorem describing the maps preserving transition probabilities of a quantum system via Jordan isomorphisms. The aim of this note is to review some recent results of the authors showing that isomorphisms of various operator structures are induced by Jordan maps.

The first structure considered is statistical. For an element a of a JB (Jordan-Banach) algebra A, we define its maximal deviation, $\|a\|_v$, as

$$\|a\|_v = \sup_{\varphi \in S(A)} \sqrt{\varphi((a - \varphi(a)\mathbf{1})^2)},$$

where $S(A)$ denotes the state space of A (i.e. the set of all normalized positive functionals on A). Our main result says that any linear bijection $\Phi : A \to B$ between JBW algebras A and B, where A does not have Type I_2 direct summand, is of the form $\Phi(a) = \tau\Psi(a) + \theta(a)\mathbf{1}$, where $\tau \in \{-1, 1\}$, $\Psi : A \to B$ is a Jordan isomorphism and $\theta : A \to \mathbb{R}$ is a linear map. This result was obtained earlier by L.Molnár for special case of self-adjoint parts of von Neumann algebras.

Second structure studied is the poset of abelian subalgebras which plays an important role in topos approach to quantum theory recently. Let A be a unital C^*-algebra. We denote by $\mathcal{C}(A)$ the set of all unital abelian subalgebras of A ordered by set theoretic inclusion. Suppose that $\Phi : \mathcal{C}(A) \to \mathcal{C}(B)$ is an order isomorphism, where A and B are von Neumann algebras such that A has no Type I_2 direct summand and $\dim A \geq 3$. Then there is a unique Jordan isomorphism $\Psi : A \to B$ such that $\Phi(X) = \Psi(X)$ for all $X \in \mathcal{C}(A)$.

Finally we deal with symmetries of the star order which has been studied for matrices and operators intensely. Let a and b be elements of a C^*-algebra A. We say that a is less or equal to b in the star order if $a^*a = a^*b$ and $aa^* = ba^*$. Suppose that A is a von Neumann algebra without Type I_2 direct summand and B is another von Neumann algebra. If $\Phi : A_{sa} \to B_{sa}$ is a continuous bijective map (not necessarily linear) between self-adjoint parts that preserves the star order in both directions and that is linear on the one-dimensional subspace generated by the unit, then Φ is the restriction of a Jordan $*$-isomorphism between A and B. In a more general result we show that a wide range of nonlinear preservers of the star order arise from Jordan isomorphisms combined with the function calculus.

Structures studied are different and so description of their symmetries requires different techniques. Nevertheless a common aspect of all cases is the fact that one of the essential ingredients of the proofs is application of the Generalized Gleason Theorem.

References

[1] M. Bohata and J. Hamhalter, *Nonlinear maps on von Neumann algebras preserving the star order*, to appear.

[2] J. Hamhalter, *Isomorphism of ordered structures of abelian C^*-subalgebras*, Journal of Mathematical Analysis and Applications **383** (2011), 3812–3820.

[3] J. Hamhalter, *Maps on Jordan algebras preserving maximal deviation*, to appear.

[4] J. Hamhalter and E. Turilova, *Structure of associative subalgebras of Jordan operator algebras*, Quarterly Journal of Mathematics, Oxford Univ. Press, to appear.

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Dynamics and interpretation of some integrable systems via multiple orthogonal polynomials

The relation between the solutions of the full Kostant-Toda lattice and the discrete KdV equation is analyzed. Some discrete dynamical systems defined by a Lax pair are considered. The method of investigation is based on the analysis of the matricial moments for the main operator of the pair. The solutions of these systems are studied in terms of properties of this operator, giving under some conditions, explicit expressions for the resolvent function. As a consequence of the matricial interpretation of this method, we extend the Darboux transform for general Hessenberg banded matrices. Is a joint work with D. Barrios Rolanía (Universidad Politécnica de Madrid) and A. Foulquié Moreno (Universidade de Aveiro).

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Kernels of asymmetric Toeplitz operators and finite interval convolution equations in L^2

A Riemann-Hilbert approach to the study of finite interval convolution equations is presented, based on finding particular solutions to a related homogeneous Riemann-Hilbert problem. The space of solutions of the latter is described in terms of the kernels of certain associated asymmetric Toeplitz operators, which are introduced and discussed.

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FICO's and frequency estimation

We will discuss Finite Interval Convolution Operators, especially of Hilbert-Schmidt type, and their connection to frequency estimation of signals via alternating projection schemes.

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A crack problem in wave diffraction

for different types of boundary conditions

We prove the unique existence of solutions for different types of wave diffraction boundary value problems with a crack perpendicular to the main boundary. Representations of the solutions are also obtained upon the consideration of some associated operators. This is done in a Bessel potential spaces framework and for complex wave numbers. The investigation is mostly based on the construction of explicit operator relations, the potential method, and certain factorizations. The talk is based on a joint work with David Kapanadze.

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An algorithm for explicit rational functions factorizations with symbolic computation

A factorization method for the class of rational matrix functions was proposed by F. D. Gahov, in 1952. At present time, this is the class for which the factorization problem is further developed, having already been found a complete and explicit factorization algorithm. A contemporary description of this well known and widely used algorithm can be found, for instance, in [MP]. Due to these facts, and in accordance with our previous work ([CKP1] and [CKP2]), it seemed natural for us to attempt the implementation on a computer of such an important algorithm.

The main goal of this talk is to present the implementation of the rational functions factorization algorithms, for the scalar ([ARFact-Scalar]) and matrix ([ARFact-Matrix]) cases (see [CKP3]). Both the algorithms were implemented using the computer algebra system *Mathematica*.

This talk is based on a joint work with Viktor G. Kravchenko.

References

[CKP1] A. C. Conceição, V. G. Kravchenko, and J. C. Pereira, *Factorization algorithm for some special non rational matrix functions.* Oper. Theory Adv. Appl. 202 (2010), 87–109.

[CKP2] A. C. Conceição, V. G. Kravchenko, and J. C. Pereira, *Computing some classes of singular integrals with Mathematica software.* Accepted in Adv. Comput. Math. (2012).

[CKP3] A. C. Conceição, V. G. Kravchenko, and J. C. Pereira, *Explicit rational functions factorizations with symbolic computation.* Accepted in J. Symbolic Comput. (2012).

[MP] S. G. Mikhlin, and S. Prössdorf, Singular integral operators. Springer-Verlag, 1986.

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New results using Riemann-Liouville fractional operators

In this talk, we present recent results related to the integral inequality theory by using the Riemann-Liouville integral operator. These results allow us to deduce some classical inequalities as some special cases. On the other hand, using the differential operator in the sense of Caputo, we study a class of fractional boundary value problems and we establish sufficient conditions to prove the existence and uniqueness of solutions for this class by using Banach fixed point theory. Some illustrative examples are also presented.

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Algebraic duality of a class of singular linear discrete time systems

The main objective of this talk is to provide a link between the solutions of a class of singular linear discrete time systems and their proper (and transposed) dual systems. First we study the prime system and by using the invariants of its matrix pencil we give necessary and sufficient conditions for existence and uniqueness of solutions and we obtain formulas for the solutions. After we prove that by using the same matrix pencil we can study the existence and uniqueness of solutions of the proper and transposed dual system. Moreover their solutions when they exist can be explicitly represented without resorting to further processes of computations for each one separately.

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New concepts on some fractional differential equations

In this talk, we present some new tools to formulate the solution representation and establish the existence, regularity and controllability results for some classes of fractional differential systems in Banach spaces. As applications, we give some illustrated examples.

Ronald Douglas

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Canonical models, quotient modules and similarity

We consider the question of similarity for canonical models for operators in the context of quotient Hilbert modules. Joint work with Y.-S. Kim, H. Kwon, and J. Sarkar.

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Mellin convolutions in the Bessel potential spaces and boundary-value problems in angular $2D$-domains

There is found a criteria for a one dimensional Fourier convolution operator W_a (a Wiener-Hopf operator) and a Mellin convolution operator (an operator with homogeneous kernel) on the half-axes $\mathbb{R}^+$ with symbols of bounded variation to commute modulo compact operators with the Bessel potentials $\Lambda^s_- : \mathbb{H}^r_p(\mathbb{R}^+) \to \mathbb{H}^{r-s}_p(\mathbb{R}^+)$ and $\Lambda^s_+ : \widetilde{\mathbb{H}}^r_p(\mathbb{R}^+) \to \widetilde{\mathbb{H}}^{r-s}_p(\mathbb{R}^+)$, arranging isomorphisms of the Bessel potential spaces for arbitrary $r, s \in \mathbb{R}$, $1 < p < \infty$. Although all these operators are pseudodifferential, their commutators are not always compact.

The result is applied to find a Fredholmity criteria for a Mellin convolution operators $\mathfrak{M}_a : \widetilde{\mathbb{H}}^s_p(\mathbb{R}^+) \to \mathbb{H}^s_p(\mathbb{R}^+)$ and $\mathfrak{M}_a : \mathbb{H}^s_p(\mathbb{R}^+) \to \mathbb{H}^s_p(\mathbb{R}^+)$. Similar results for the Lebesgue spaces are well known (see [Du1, Du2, Du3] and the literature cited therein), but for the Bessel potential spaces are new.

The obtained results are applied to the investigations of boundary value problems (with the Dirichlet, Neumann, mixed or impedance conditions) for the Helmholtz equation in 2D domains with angular points on the boundary. The problems are reduced to the equivalent boundary pseudodifferential equations which, in their turn, are transformed to equivalent systems of singular integral equations with fixed singularities in the kernel. Further the unique solvability criterion for the BVPs under consideration are derived.

Next the case of two domains with the common part of the boundary is considered. The corresponding equations have different frequency parameters in different domains.

The interest to such problems was revived recently due to the modern and important investigations of Surface Plasmon Polaritons (SPPs), which is believed will play a crucial role in the development and miniaturization of information processors based on a light transmission. Some new artificial meta-materials, have negative electric permittivity and magnetic permeability and composites of such materials with dielectrics require investigation of scattering of electromagnetic waves in domains with angular points on the boundary (see [CC1]). Even more difficulty is associated with the sign-changing of the leading order coefficients of the equation, which leads to the loss of ellipticity of the BVP.

The approach, in contrast to the the approach based on Lax-Milgram Lemma, also provides precise and detailed asymptotic expansion of a solution in the vicinity of singular points on the boundary.

This is a joint work with D. Kapanadze, G. Tepnadze, and M. Tsaava.

References

[CC1] L. Chesnel, P. Ciarlet Jr., *Compact imbeddings in electromagnetism with interfaces between classical and meta-materials.* SIAM J. Math. Anal. **43** (2011), 2150- 2169.
[Du1] R. Duduchava, *Integral equations with fixed singularities.* Teubner, Leipzig, 1979.
[Du2] R. Duduchava, *On general singular integral operators of the plane theory of elasticity.* Rendiconti Sem. Mat. Univers. e Politecn. Torino **42** (1984), 15–41.
[Du3] R. Duduchava, *General singular integral equations and basic theorems of the plane theory of elasticity.* Proceedings A. Razmadze Mathematical Institute **82** (1986), 45–89 (Russian).

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Subnormality of weighted shift operators on directed trees

Weighted shifts on directed trees form a relatively new class of operators which serves as an interesting research area with many open problems. This class provides fascinating examples of operators which fulfill surprising properties not satisfied by operators from well known classes.

Subnormal operators constitute a wide and intensively studied class of operators defined in Hilbert spaces, however, there does not exist a simple and efficient subnormality criterion, which could be used in order to verify whether a given weighted unbounded shift on a tree is subnormal.

On the basis of Ando's construction [A63], we provide sufficient and necessary conditions for subnormality and the subnormal extension in the case of a weighted shift operator on a directed tree with one branching point.

References

[A63] T. Ando, *Matrices of normal extensions of subnormal operators.* Acta Sci. Math. (Szeged) **24** (1963), 91–96.

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A new generalisation of numerical ranges, higher rank numerical range

The study of the numerical range and numerical radius of a Hilbert space has a long history, and there is much current research on these concepts and their generalisations, e.g., *Quadratic numerical range, H-joint numerical range, k-th numerical range etc.*

The quadratic numerical range as studied by C. Tretter depends on a decomposition of the Hilbert space. However the block numerical ranges with respect to two different decomposition have different geometric properties. Moreover, the k-th numerical range of matrix is convex or starshaped under some conditions on the eigenvalues of this matrix. These results are complete for hermitian matrices and partial results are known for general matrices.

In this talk, we introduce a new concept of higher rank numerical range and discuss its properties and its relations to previous concepts.

This work is the joint work with Waed Dada.

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Interactions

Given a C^*-algebra B, a closed $*$-subalgebra $A \subset B$, and a partial isometry S in B which interacts with A in the sense that $S^*aS = H(a)S^*S$ and $SaS^* = V(a)SS^*$ for all $a \in A$, where V and H are positive linear operators on A, we derive a few properties which V and H are forced to satisfy. Removing B and S from the picture we define an *interaction* as being a pair of maps (V, H) satisfying the derived properties. Starting with an abstract interaction (V, H) over a C^*-algebra A we construct a C^*-algebra B containing A and a partial isometry S whose interaction with A follows the above rules. We then discuss the possibility of constructing a covariance algebra from an interaction. This turns out to require a generalization of the notion of correspondences (also known as Pimsner bimodules) which we call a generalized correspondence. Such an object should be seen as an usual correspondence, except that the inner-products need not lie in the coefficient algebra. The covariance algebra is then defined using a natural generalization of Pimsner's construction of the celebrated Cuntz-Pimsner algebras. Time permitting we will explore a concrete example of this situation based on the notion of separated graph C^*-algebras.

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Fredholmness in a C^*-algebra of singular integral operators with shifts similar to affine mappings

A Fredholm symbol for a nonlocal C^*-algebra $\mathfrak{B}$ of singular integral operators with piecewise slowly oscillating coefficients and unitary shift operators is constructed. The group of unitary shift operators U_g of the C^*-algebra $\mathfrak{B}$ is associated with the solvable discrete group of homeomorphisms $g : \mathbb{T} \to \mathbb{T}$ that are similar to affine shifts on the real line. Such shifts have common fixed points for all $g \in G$ and fixed points disjoint for different shifts. The local-trajectory method combined with the lifting theorem will provide the key to the construction of the desired symbol calculus for $\mathfrak{B}$.

This talk is based on a joint work with M. Amélia Bastos and Yuri Karlovich.

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Global well-posedness and blow-up results for damped nonlinear Schrödinger equations

We consider the Cauchy problem for the nonlinear Schrödinger equation perturbed by a dissipative term,

$$\begin{cases} i\partial_t u = \Delta u + |u|^{p-1}u - i\dfrac{a}{2}u, \quad u = u(x,t), \quad x \in \mathbb{R}^N, \quad t \geq 0, \\ \\ u(x,0) = u_0(x), \quad u_0 \in H^1(\mathbb{R}^N) \end{cases}$$

with $a = a(x) \geq 0$ a nonnegative regular function. Under certain conditions for the function a, we prove a blow-up result and we obtain a lower bound for $|u|_{L^\infty(0,t;L^q)}$, $0 \leq t < T_{\max}$, $2 < q \leq \infty$. We also consider the nonlinear damping case and we discuss some open problems. This is a joint work with J.P. Dias.

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Constrained von Neumann inequalities, higher rank numerical range and application to harmonic analysis

Let denote by $S(\phi)$ the extremal operator defined by the compression of the unilateral shift S to the model subspace $H(\phi) = \mathbb{H}^2 \ominus \phi\mathbb{H}^2$ as the following $S(\phi)f(z) = P(zf(z))$, where P denotes the orthogonal projection from $\mathbb{H}^2$ onto $H(\phi)$ and ϕ is an inner function on the unit disc. In this talk, we give an explicit formula of the numerical radius of $S(\phi)$ in the particular case where ϕ is a finite Blaschke product with unique zero and an estimate on the general case. We establish also a sharpened Schwarz-Pick operatorial inequality generalizing a U. Haagerup and P. de la Harpe result for nilpotent operators [2].

References

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Structures on operator algebras and Jordan isomorphisms

There are many structures associated with operator algebras which are motivated both physically and mathematically and such that their symmetries lead surprisingly to Jordan isomorphisms. A prototypical example is the celebrated Wigner Theorem describing the maps preserving transition probabilities of a quantum system via Jordan isomorphisms. The aim of this note is to review some recent results of the authors showing that isomorphisms of various operator structures are induced by Jordan maps.

The first structure considered is statistical. For an element a of a JB (Jordan-Banach) algebra A, we define its maximal deviation, $\|a\|_v$, as

$$\|a\|_v = \sup_{\varphi \in S(A)} \sqrt{\varphi((a - \varphi(a)\mathbf{1})^2)},$$

where $S(A)$ denotes the state space of A (i.e. the set of all normalized positive functionals on A). Our main result says that any linear bijection $\Phi : A \to B$ between JBW algebras A and B, where A does not have Type I_2 direct summand, is of the form $\Phi(a) = \tau\Psi(a) + \theta(a)\mathbf{1}$, where $\tau \in \{-1, 1\}$, $\Psi : A \to B$ is a Jordan isomorphism and $\theta : A \to \mathbb{R}$ is a linear map. This result was obtained earlier by L.Molnár for special case of self-adjoint parts of von Neumann algebras.

Second structure studied is the poset of abelian subalgebras which plays an important role in topos approach to quantum theory recently. Let A be a unital C^*-algebra. We denote by $\mathcal{C}(A)$ the set of all unital abelian subalgebras of A ordered by set theoretic inclusion. Suppose that $\Phi : \mathcal{C}(A) \to \mathcal{C}(B)$ is an order isomorphism, where A and B are von Neumann algebras such that A has no Type I_2 direct summand and $\dim A \geq 3$. Then there is a unique Jordan isomorphism $\Psi : A \to B$ such that $\Phi(X) = \Psi(X)$ for all $X \in \mathcal{C}(A)$.

Finally we deal with symmetries of the star order which has been studied for matrices and operators intensely. Let a and b be elements of a C^*-algebra A. We say that a is less or equal to b in the star order if $a^*a = a^*b$ and $aa^* = ba^*$. Suppose that A is a von Neumann algebra without Type I_2 direct summand and B is another von Neumann algebra. If $\Phi : A_{sa} \to B_{sa}$ is a continuous bijective map (not necessarily linear) between self-adjoint parts that preserves the star order in both directions and that is linear on the one-dimensional subspace generated by the unit, then Φ is the restriction of a Jordan $*$-isomorphism between A and B. In a more general result we show that a wide range of nonlinear preservers of the star order arise from Jordan isomorphisms combined with the function calculus.

Structures studied are different and so description of their symmetries requires different techniques. Nevertheless a common aspect of all cases is the fact that one of the essential ingredients of the proofs is application of the Generalized Gleason Theorem.

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The inverse problem for Kreĭn orthogonal matrix functions

In the mid fifties M.G. Kreĭn introduced continuous analogues of the Szegő orthogonal polynomials on the unit circle, and he established for the scalar case their main properties. This talk concerns matrix-valued generalizations of Kreĭn's results and of subsequent results he obtained jointly with H. Langer. Two main theorems will be presented. They are much more involved than their scalar counterparts. The first has a band method flavor and reduces the inverse problem to a certain entire matrix function equation. The second contains new conditions based on Jordan chains and root functions, and requires new techniques based on recent results from the theory of continuous analogues of resultant and Bézout matrices. The talk is based on joint work with the late Israel Gohberg and Leonid Lerer (Technion, Haifa).

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Pseudodifferential operators on Banach function spaces

We show that if the Hardy-Littlewood maximal operator is bounded on a separable Banach function space $X(\mathbb{R}^n)$ and on its associate space $X'(\mathbb{R}^n)$, then a pseudodifferential operator $\mathrm{Op}(a)$ is bounded on $X(\mathbb{R}^n)$ whenever the symbol a belongs to a certain class of rough symbols. This result is applied to the case of variable Lebesgue spaces $L^{p(\cdot)}(\mathbb{R}^n)$ and their weighted analogues.

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Algebras of local and nonlocal convolution type operators with piecewise slowly oscillating data

Let $\mathcal{B}_{p,w}$ denote the Banach algebra of all bounded linear operators acting on the weighted Lebesgue space $L^p(\mathbb{R}, w)$ where $1 < p < \infty$ and w is a Muckenhoupt weight. We study the Banach subalgebra $\mathfrak{A}_{p,w}$ of $\mathcal{B}_{p,w}$ generated by all convolution type operators of the form $a\mathcal{F}^{-1}b\mathcal{F}$ where $\mathcal{F}$ is the Fourier transform, the functions $a, b \in L^\infty(\mathbb{R})$ admit piecewise slowly oscillating discontinuities on $\mathbb{R} \cup \{\infty\}$ and b is a Fourier multiplier on $L^p(\mathbb{R}, w)$. Applying results on Fourier and Mellin pseudodifferential operators with non-regular symbols, the Allan-Douglas local principle, the two idempotents theorem and the method of limit operators, we construct a Fredholm symbol calculus and obtain a Fredholm criterion for the operators $A \in \mathfrak{A}_{p,w}$ in terms of their Fredholm symbols.

Then we study the C^*-subalgebra $\mathfrak{B}$ of $\mathcal{B}_{2,1}$ generated by all operators $A \in \mathfrak{A}_{2,1}$ and by unitary shift operators U_g associated with the commutative group of all translations $g : \mathbb{R} \to \mathbb{R}$. A Fredholm symbol calculus for the C^*-algebra $\mathfrak{B}$ and a Fredholm criterion for the operators $B \in \mathfrak{B}$ are established by applying the local-trajectory method for studying C^*-algebras associated with C^*-dynamical systems and by using spectral measures.

The talk is based on a joint work with Iván Loreto Hernández.

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Inequalities against equations

The already known close connection between differential equations (DE) and integral inequalities (II) and their mutual influence will be illustrated on the symbiosis of the Hardy inequality (= a weighted II) and the spectrum of some (nonlinear, degenerated/singular) elliptic DE.

This interaction allows to derive some interesting extensions if the classical Sturm-Liouville theory.

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Main properties of C^*-algebra generated by mapping

Let $\varphi : X \to X$ be a mapping of a countable set X into itself. Let cardinalities of preimages are bounded under the action of the mapping φ. I will introduce the family of partial isometries associated with this mapping. I am going to speak about properties of C^*-algebra $C^*_\varphi(X)$ generated by this family. Also I will consider some examples of such algebras.

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On transfer operators for C^*-dynamical systems

We discuss the question of existence, uniqueness and basic structure of non-degenerate transfer operators for endomorphisms of (not necessarily unital) C^*-algebras. In particular, we give necessary and sufficient conditions for existence of transfer operators for commutative systems, discuss their form for endomorphisms of $B(H)$, and present a new (not classical) "non-commutative shift" on the core subalgebra of a graph C^*-algebra whose crossed product yields the graph algebra.

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Inner coactions on C^*-algebras and faithfulness of representations

A crossed product of a C^*-algebra A by an abelian group admits a dual action of the dual group. When the group is no longer abelian, the role of the dual action is played by a coaction. Coactions of discrete groups on C^*-algebras arise naturally in more general crossed product constructions, such as for example crossed products by endomorphic actions of semigroups, and play a role in answering questions about faithfulness of representations. A coaction of a discrete group G on a C^*-algebra A is inner when there is a family of projections with certain good properties. We shall describe the relevance of inner coactions in regard to faithfulness of representations. As application we investigate existence of inner coactions in the context of the universal C^*-algebra and the Toeplitz algebra associated by Nica to a quasi-lattice ordered group-subsemigroup pair. This is joint work with Steve Kaliszewski and John Quigg.

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Operator connections and Borel measures on the unit interval

A connection is a binary operation for positive operators satisfying the monotonicity, the transformer inequality and the joint-continuity from above. A mean is a normalized connection. In this paper, we show that there is a 1-1 correspondence between connections and finite Borel measures on the unit interval. Every connection can be regarded as a weighted series of weighted harmonic means. Moreover, we investigate decompositions of connections,

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Følner sequences in operator theory and operator algebras

In the first part of this talk I will introduce the notion and first properties of Følner sequences in the context of Operator Theory and Operator Algebras. Let $\mathcal{T} \subset \mathcal{L}(\mathcal{H})$ be a set of bounded linear operator acting on a complex separable Hilbert space $\mathcal{H}$. An increasing s equence of non-zero finite rank orthogonal projections $\{P_n\}_{n\in\mathbb{N}}$ strongly converging to $I_{\mathcal{H}}$ is called a Følner sequence for $\mathcal{T}$, if

$$\lim_n \frac{\|TP_n - P_nT\|_2}{\|P_n\|_2} = 0\,, \quad T \in \mathcal{T}\,,$$

where $\|\cdot\|_2$ is the Hilbert-Schmidt norm. Følner sequences generalize the notion quasi-diagonality for operators and can also be applied to spectral approximation problems.

In the second part of the talk I will present recent results in separate joint works with Pere Ara and Dmitry Yakubovich: we prove that each element in the following class of operators has a Følner sequence: isometries, essentially normal operators and quasinormal operators. In addition, we give examples of operators without a Følner sequence and analyze its structure. Finally, we will give an intrinsic characterization of concrete unital and separable C^*-algebras with a Følner sequence in terms of completely positive maps. We will also mention some properties of this class of algebras.

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On operator theoretical aspects in hypercomplex function theory

The increasing number of operator theoretical subjects treated by methods of Hypercomplex Function Theory (HFT) during the past 30 years is a stimulatng and well recognized contribution to the development of both theories.

The main goal of this talk is to make a survey of past and recent contributions in this field. Moreover, we present new tools of HFT that in our opinion can be useful in Operator Theory.

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Integrable systems with non-periodic boundary conditions

We briefly review Sklyanin's approach to classical integrable systems with non-periodic boundary conditions. Then we illustrate how this method works in the quantum case by studying the XXX spin 1 chain.

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Estimates for the dimension of the kernel of singular integral operators with non-Carleman shift

We consider the operator $T = I - cUP_+$: $L_2^n(\mathbb{R}) \to L_2^n(\mathbb{R})$, on the real line, where I is the identity operator, $c \in C^{n\times n}(\dot{\mathbb{R}})$ is a continuous matrix function on $\dot{\mathbb{R}} = \mathbb{R} \cup \{\infty\}$, the one point compactification of $\mathbb{R}$, $(U\varphi)(t) = \varphi(t+\mu)$, $\mu \in \mathbb{R}$, is the shift operator, and $P_\pm = \frac{1}{2}(I \pm S)$ are the complementary projection operators, with $(S\varphi)(t) = (\pi i)^{-1} \int_{\mathbb{R}} \varphi(\tau)(\tau - t)^{-1} d\tau$ the operator of singular integration with Cauchy kernel. It is supposed that all the eigenvalues of the matrix $c(t)$ at ∞, simultaneously belong either to the interior of the unit circle $\mathbb{T}$ or to its exterior. Under these conditions, estimates for the dimension of the kernel of the operator T are obtained. We obtain analogous estimates, under similar conditions, for an operator with polynomial coefficient relative to the shift operator.

This talk is based on a joint work with Viktor Kravchenko.

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Base change for the reduced Iwahori-Hecke C^*-algebra of $GL(n)$

According to the Baum-Connes conjecture for $G = GL(n)$, there is a canonical isomorphism

$$\mu : K_*^G(\underline{E}G) \to K_* C_r^* G$$

where $\underline{E}G$ is a universal example for the action of G. Quite specific, $\underline{E}G$ is the affine Bruhat-Tits building for G, also denoted βG. Let $C_r^*(G//I)$ denote the reduced Iwahori-Hecke C^*-algebra of $GL(n)$ and let Σ be a single apartment in βG. Then, $\Sigma = \underline{E}W$ is a model for the universal example $\underline{E}W$ of the the affine Weyl group W of G. Localized to the apartment Σ, the Baum-Connes conjecture modulo torsion is an isomorphism

$$K_j(C_r^*(G//I) \otimes_{\mathbb{Z}} \mathbb{C} \cong K_j^W(\Sigma) \otimes_{\mathbb{Z}} \mathbb{C}.$$

Let E/F be a finite Galois extension of local nonarchimedean fields. Base change lifts a representation of $GL(n, F)$ to a representation of $GL(n, E)$. This creates a map from the tempered dual of $GL(n, F)$ to the tempered dual of $GL(n, E)$. We use the Baum-Connes conjecture to relate functoriality of buildings with base change. We illustrate this relation with the reduced Iwahori-Hecke C^*-algebra of $GL(n, E)$ and $GL(n, F)$.

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Kwapien's theorem for multilinear operators

We consider the class of Cohen strongly multilinear operators and we prove some inclusion and coincidence properties with different old classes. As consequence, we give some multilinear characterizations of certain Banach spaces by using inclusion theorems similar to the linear case obtained by Kwapien.

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Inverses of a class of convolution type operators

The class of convolution type operators under consideration arises from an operator model for wave diffraction by infinite periodic gratings with strips and gaps of unequal widths. The formulation of the corresponding boundary transmission value problem leads first to a convolution type operator on a finite interval, and then by means of equivalence relations to a Toeplitz operator defined on two parallel straight lines. We aim to find explicit formulas for the factors of a generalized factorization of the symbol of the Toeplitz operator associated to both the Neumann and the oblique derivative boundary value problems, and with such general geometry of the grating, based on an operator approximation regarding small wave numbers.

This is a joint work with M.A. Bastos.

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Quasi-symmetric group algebras and C^*-completions of Hecke algebras

Hecke algebras can be seen as an analogue of group algebras of quotient groups G/H when H is no longer a normal subgroup. They admit several canonical C^*-completions and it has been of interest to understand what kind of properties of the pair (G, H) force some of these completions to coincide. In this talk we will be mostly interested in the completions $C^*(L^1(G, H))$ and $pC^*(\overline{G})p$, which are respectively the enveloping C^*-algebra of the L^1-Hecke algebra and the canonical corner of the group C^*-algebra of the Schlichting completion of G. We will show that these two completions coincide when $L^1(\overline{G})$ satisfies a spectral property which we dub "quasi-symmetry", which is satisfied by the class of Hermitian groups and groups with subexponential growth, extending in this way a result by Kaliszewski, Landstad and Quigg. Some consequences to the question of Hall's equivalence will then be discussed. We will also show that these two completions do not always coincide, with the pair $(SL_2(\mathbb{Q}_p), SL_2(\mathbb{Z}_p))$ providing one such example.

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An algorithm for explicit rational functions factorizations with symbolic computation

A factorization method for the class of rational matrix functions was proposed by F. D. Gahov, in 1952. At present time, this is the class for which the factorization problem is further developed, having already been found a complete and explicit factorization algorithm. A contemporary description of this well known and widely used algorithm can be found, for instance, in [MP]. Due to these facts, and in accordance with our previous work ([CKP1] and [CKP2]), it seemed natural for us to attempt the implementation on a computer of such an important algorithm.

The main goal of this talk is to present the implementation of the rational functions factorization algorithms, for the scalar ([ARFact-Scalar]) and matrix ([ARFact-Matrix]) cases (see [CKP3]). Both the algorithms were implemented using the computer algebra system *Mathematica*.

This talk is based on a joint work with Viktor G. Kravchenko.

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Scales of conditions to characterize Hardy type inequalities

First we present some historical remarks concerning the classical conditions to characterize weighted Hardy type inequalities (see e.g. [1, 2, 3]). After that we will present an alternative condition to the usual Muckenhoupt type condition (see [6]). This step was important to discover that in fact the classical conditions can be replaced even by infinite many conditions, more exactly by at least four different scales of conditions (see the review article [4] and the references given there) in all cases. Finally, we will mention some possible applications and concluding remarks e.g. a surprisingly simple proof of elementary forms of Hardyns inequality, which we hope can be useful for the further development of Hardy type inequalities (see [5] and the references given there).

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Orthogonal polynomials, polynomial mappings, and applications to Jacobi operators theory

Using the theory of orthogonal polynomials (OPs) we discuss some problems from approximation theory and the spectral theory of Jacobi operators. The first one is focused on a generalization of the concept of coherent pair of measures introduced by A. Iserles, P. E. Koch, S. P. Nørsett, and J. M. Sanz-Serna, extensively studied in the last years by several authors, both from the algebraic and the analytical points of view, and in particular in the framework of the theory of Sobolev OPs. The second one is related with polynomial mappings in the theory of OPs. In the so-called positive-definite case, the general theory of OPs tells us that the polynomials are indeed orthogonal with respect to a certain inner product defined by a positive Borel measure. It turns out that when this measure has compact support, then we may associate to the corresponding OPS a bounded self-adjoint Jacobi operator acting in the space $\ell^2(\mathbb{C})$, and the orthogonality measure becomes the spectral measure for this Jacobi operator. This connection leads us to describe the spectra, and in particular the essential spectra, of Jacobi operators such that their corresponding OPS are connected by a polynomial mapping in the sense mentioned before. For instance, periodic Jacobi operators fits into this theory, using the well known Chebyshev polynomials of the second kind.

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Essential spectral approximation, Arveson dichotomy, and fractality

The notions of fractal and essentially fractal algebras of approximation sequences on the one hand, and of the Arveson dichotomy (each point is either transient or essential) on the other hand have proved extremely useful for several spectral approximation problems. I will explain these notions in the beginning of the talk. The purpose of the talk is then to relate essential fractality with Arveson dichotomy, to prove Arveson dichotomy for large classes of algebras of approximation sequences, and to derive a restriction theorem for essential fractality.

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About the factorization of rational matrix-functions

Let A be an $n \times n$ regular matrix-function on the unit circle $\mathbb{T}$. By (left) factorization of A relative to $\mathbb{T}$, we mean the following representation:

$$A(t) = A_+(t)\Lambda(t)A_-(t), \quad t \in \mathbb{T},$$

where

$$\Lambda(t) = \operatorname{diag}(t^{\kappa_1}, \ldots, t^{\kappa_n})$$

with $\kappa_1 \geq \cdots \geq \kappa_n$, $\kappa_i \in \mathbb{Z}$, and $A_+^{\pm 1}$ ($A_-^{\pm 1}$) is analytic and regular in $\mathbb{T}_+$ ($\mathbb{T}_-$).

The matrix-function factorization find applications in many fields like diffraction theory, the theory of differential equations and the theory of singular integral operators.

However, only for a few classes of matrices is known the explicit formulas for the factors of the factorization. In our talk we show a new method to obtain a factorization of rational matrix-functions.

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Commutators of Hardy operators

in weighted Morrey spaces

We study boundedness of commutators of the multi-dimensional Hardy type operators with BMO-type coefficients, in weighted global and/or local generalized Morrey spaces $L^{p,\varphi}_{\Pi}(\mathbf{R}^n, w)$ and vanishing local Morrey spaces $VL^{p,\varphi}_{\mathrm{loc}}(\mathbf{R}^n, w)$ defined by an almost increasing function $\varphi(r)$ and radial type weight $w(|x|)$.

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On a question by Markus Seidel

When using Banach Algebras techniques to describe conditions for applicability of approximation methods to convolution-type operators on the real line, part of the involved homomorphisms are traditionally used on the so-called "essentialization step" and the rest on the "identification step". In 2011, Markus Seidel asked the author if it was possible to use all homomorphisms on the essentialization step. The answer seems to be positive.

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Stability of B-Fredholm spectrum and applications

It is well known that the upper semi-Browder spectrum, the Weyl spectrum, the Weyl essential approximate spectrum and the essential spectrum of a bounded linear operator T acting on a Banach space X are stable under perturbations. In this talk, we prove that a similar nilpotent perturbation result is valid for the left Drazin spectrum and we give sufficient conditions, which ensure the preservation of B-Fredolm spectra under perturbation by commuting nilpotent operators.

This is a joint work with M. Bendaoud, M. Berkani and H. Zariouh.

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A class of C^*-algebras generated by unbounded elements

I will define a C^*-envelope for a certain class of unbounded *-algebras which includes Weyl algebra, q-CCR algebras, q-deformed enveloping algebras and others. The key ingredient is the notion of unbounded operator affiliated with a C^*-algebra developed by Woronowicz. Most of these C^*-algebras can be described using the R.Exel's construction of crossed product by a partial group action.

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The role of the operators in the theory of first order linear partial differential equations all of whose solutions are harmonic functions

We present work with Ricardo Abreu Blaya, Juan Bory Reyes and Alí Guzmán Adán, where we study some problems for a first order linear partial differential equations all of whose solutions are harmonic functions by the help of quaternionic analysis.

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Poisson structure of Lax equations, exchange algebras and differential/difference Galois theory

Differential or Difference Galois group acts in the space of solutions of the auxiliary linear problem associated with an integrable non-linear equation. I'll discuss the Poisson structures compatible with this action which leads to a new type of classical r-matrices and of the associated factorization problems.

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Fredholm theory for Toeplitz plus Hankel operators in case of piecewise continuous generating functions

The theory of Toeplitz plus Hankel operators with piecewise continuous generating functions has a long history. Despite the importance of this class of operators for applications (diffraction theory, random matrices, numerical analysis for singular integral operators on intervals) their theory is less complete than that of singular integral operators with piecewise continuous coefficients. The aim of the talk is to present some recent developments in this field, including a symbol calculus and an index formula. The talk is partly based on a joint work with Steffen Roch.

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Operator factorization and boundary value problems

Boundary value problems in Mathematical Physics are often proved to be Fredholm or even well-posed, sometimes explicitly solvable by formulas in closed analytical form. Many of these conclusions can be formulated in terms of operator factorization methods (in Banach spaces as central case). We explain various principles and their realization in applications. The advantages are (1) very clear and compact formulations, e.g., of "equivalent reduction" of operators associated to boundary value problems to "more convenient operators" (like boundary pseudodifferential operators), (2) explicit representation of resolvent operators by operator factorization methods, (3) the invention of related concepts such as reduction to semi-homogeneous problems, normalization and others. Several examples will underline the ease and usefulness of operator factorization. The talk is based upon joint work with E. Meister, R. Duduchava, F.S. Teixeira, L.P. Castro and A. Moura Santos.

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Toeplitz operators with symbols G and $\det G$

We explore new classes of matrix functions G which are factorable simultaneously with $\det G$ and have the total index coinciding with the index of $\det G$. Under some additional conditions, these matrix functions also have all partial (almost periodic, if the matrix itself is such) indices of the same sign, thus guaranteeing the one sided invertibility of the Toeplitz operator T_G. The defining properties of these G are in terms of their submatrices which are obtained from G by deleting one row or column. This required some background on one sided invertibility of matrices over commutative rings.

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News from the operator $\mathrm{i}\frac{\mathrm{d}}{\mathrm{d}x}$

The operator in question is a standard textbook example of an unbounded one, therefore everything concerning it seems to be definite. Nevertheless I intend to disclose the (still) hidden part of its live. The reference is D. Cichoń, J. Stochel and F.H. Szafraniec, *Naimark extensions for indeterminacy in the moment problem. An example*, Indiana Univ. Math. J., **59**(2010), 1947–1970.

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Extensions of positive linear functionals

We discuss a general strategy which produces a special classes of extensions (positive, positively regular, absolutely convergent) of a positive linear functional defined on a dense *-subalgebra A_o of *-algebra $A[\tau]$. The obtained results are applied to the commutative integration theory to recover from the abstract setup the well-known extensions of Lebesgue integral and, in noncommutative integration theory, for introducing a generalized integral of operators measurable w. r. to a given trace σ.

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