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Speakers

Invertibility criteria in C^*-algebras of functional operators

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Abstract

Functional operators of the form $\sum_{g\in F} a_g U_g$, with different classes of coefficients a_g and shifts operators of the type $U_g : f \to f \circ g$ associated with groups G, play an important role in studying the solvability of functional, integro-functional and pseudodifference equations.

Invertibility criteria are established for the operators in the C^*-algebra

$$\mathcal{A} := \mathrm{alg}(PQC, U_G) \subset \mathcal{B}(L^2(T))$$

generated by all functional operators where $a_g I$ are multiplication operators by piecewise quasicontinuous functions $a_g \in PQC$ on the unit circle T, $U_g : \varphi \mapsto |g'|^{1/2}(\varphi \circ g)$ are unitary weighted shift operators on $L^2(T)$, associated with G, an amenable discrete group of shifts on T, which acts topologically freely on the set $T \setminus \Lambda^\circ$, where Λ° is the interior of a nonempty closed set $\Lambda \subset T$ composed by all common fixed points for all $g \in G$.

Keywords: piecewise quasicontinuous function, functional operator, C^*-algebra, invertibility.

Non-Hermitian quantum thermodynamics

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Abstract

The appearance, in quantum physics, of non-Hermitian Hamiltonians possessing a discrete real spectrum inspired a remarkable research activity. In this note we revisit standard concepts of thermodynamics for systems described by a non-Hemitian Hamiltonian with real eigenvalues. We mainly focus on the standard case where the energy is the unique conserved quantity. However, other conserved quantities may be considered.

Operator semigroups for numerical analysis

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Abstract

Natural, financial, and even social scientific phenomena are due to time-dependent processes whose precise description is inevitable for forecasting the future state of the system. This is done by establishing a mathematical model, usually a partial differential equation or their system whose exact solution is usually unknown. The mathematical model should therefore be treated numerically, that is, its exact solution is approximated by using certain space and time discretization methods. The question is then how "good" the approximation is. The possibly most important property is the convergence which ensures the approximate solution to get closer to the exact one when refining the parameters of the numerical method.

The talk gives an insight into the convergence analysis by presenting a whole class of problems in an abstract form of evolution equations. It is then possible to treat them in an abstract framework by using functional analytic tools, especially operator semigroup theory. For a summary of the linear theory, see Engel and Nagel [1], for the results in the nonlinear case we refer to Ito and Kappel [2].

We introduce the notions of operator semigroup and its generator, and present the seminal results in convergence analysis such as Chernoff's and Trotter–Kato theorems. Applications are also shown at the end of the talk.

Keywords: operator semigroup theory, convergence analysis, Chernoff's theorem, Trotter–Kato theorem.

References

[1] K-J. Engel, R. Nagel (2000) *One-Parameter Semigroups for Linear Evolution Equations*, Springer-Verlag.

[2] K. Ito, F. Kappel (2002) *Evolution Equations and Approximations*, World Scientific.

Jordan structures in certain real operator spaces

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Abstract

In 1995, J.M. Isidro, W. Kaup and A. Rodríguez extended the JB*-triple theory to the real setting by defining *real JB*-triples* as those norm-closed real subtriples of (complex) JB*-triples. Real JB*-triples can be regarded as real forms of JB*-triples, that is, given a real JB*-triple E, there exists a unique (complex) JB*-triple structure on its algebraic complexification $X = E \oplus iE$, and a conjugation (i.e. a conjugate linear isometry of period 2) τ on X such that

$$E = X^\tau = \{z \in X : \tau(z) = z\}.$$

This class of Banach spaces includes, for instance, the spaces of all bounded linear operators between two real, complex, or quaternionic Hilbert spaces. Additionally, the Jordan triple structure underlying any C*-algebra allows us to regard every real C*-algebra as a real JB*-triple. Some real JB*-triples are essentially real operator spaces: for example every real C*-algebra is isometrically *-isomorphic to a norm-closed self-adjoint subalgebra of the space of bounded linear operators on a real Hilbert space. Actually, excluding the exceptional ones, real Cartan factors also conform a new kind of real operator spaces which can be treated as real JB*-triples.

The intention of this talk is to take advantage of the existing links between operator theory and JB*-triple theory, and to explore the facial structure of certain subspaces of operators from a more general point of view, namely, by describing the facial of any real JB*-triple. Using triple techniques we

culminate a question which, in words of C.A. Akemann and G.K. Pedersen, "is as old as the operator algebra theory itself".

Keywords: real JB*-triple, facial structure, operator theory.

On continuity of solutions for parabolic control systems and input-to-state stability

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Abstract

We study minimal conditions under which mild solutions of linear evolutionary control systems are con-tinuous for arbitrary bounded input functions. This question naturally appears when working with boundary controlled, linear partial differential equations. Here, we focus on parabolic equations which allow for operator-theoretic methods such as the holomorphic functional calculus. Moreover, we investigate stronger conditions than continuity leading to input-to-state stability with respect to Orlicz spaces. This also implies that the notions of input-to-state stability and integral-input-to-state stability coincide if additionally the uncontrolled equation is dissipative and the input space is finite-dimensional.

Keywords: Abstract parabolic control system; Admissible operator; Orlicz space; Bounded functional calculus; H^∞-calculus; Input-to-state stability

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Noncompactness of Fourier convolution operators on Banach function spaces

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Abstract

Let $X(\mathbb{R})$ be a separable Banach function space such that the Hardy-Littlewood maximal operator M is bounded on $X(\mathbb{R})$ and on its associate space $X'(\mathbb{R})$. Suppose a is a Fourier multiplier on the space $X(\mathbb{R})$. We show that the Fourier convolution operator $W^0(a)$ with symbol a is compact on the space $X(\mathbb{R})$ if and only if $a = 0$. This result implies that nontrivial Fourier convolution operators on Lebesgue spaces with Muckenhoupt weights are never compact.

Keywords: Fourier convolution operator, compactness, Banach function space.

Conjugations in L^2

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Abstract

Denote by $\mathcal{H}$ a complex Hilbert space. A *conjugation* C in $\mathcal{H}$ is an anti-linear isometric involution, i.e., $C^2 = I_{\mathcal{H}}$ and

$$\langle Cf, Cg\rangle = \langle g, f\rangle \quad f, g \in \mathcal{H}. \tag{1}$$

We will consider conjugations in the classical L^2 space on the unit circle and in L^2 spaces with values in a certain Hilbert space $\mathcal{H}$. A characterisation of all conjugations commuting with M_z or intertwining operators M_z and $M_{\bar{z}}$ will be given. Behaviour of such conjugations will be also studied in connection with an analytic part of the space L^2 and model spaces, in particular we give a characterisation of all conjugations leaving invariant the whole Hardy space and model spaces.

Joint work with C. Câmara, B. Łanucha and M. Ptak.

Keywords: conjugation, Hardy space, model space.

Toeplitz operators on the weighted Bergman space and their complex symmetry

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Abstract

In this paper, we study a characterization of a complex symmetric Toeplitz operator T_φ on the weighted Bergman space $A^2_\alpha(D)$. First, we state properties of complex symmetric Toeplitz operators T_φ on $A^2_\alpha(D)$. Next, we consider complex symmetric Toeplitz operators T_φ on $A^2_\alpha(D)$ with a special conjugation.

Keywords: Complex symmetric operator, Toeplitz operator, Weighted Bergman space.

Eigenvalues inequalities for Kubo-Ando operator connections

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Abstract

Recalling the Kubo-Ando axiomatic theory of connections and means [2] for pairs of positive operators, some eigenvalues and singular values inequalities, involving operator connections are established. As a consequence, some previous results from [1, 3, 4] are revisited, extended, complemented or refined. In particular, the antisymmetric tensor power technique is used and some log-majorization relations are obtained.

Keywords: Kubo-Ando theory; operator connections and means; eigenvalues; singular values; inequalities; log-majorization.

References

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Schur multipliers and positive extensions

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Abstract

We introduce partially defined operator-valued Schur multipliers and provide a Grothendieck-type characterisation. After a brief introduction, I will talk about the positive extension problem of Schur multipliers and characterise its affirmative solution in terms of structures on an operator system associated with the domain of the Schur multipliers.

Keywords: Schur multiplier, operator system, positive extension.

Schur complements for selfadjoint operators with applications

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Abstract

For tackling a variety of problems in functional analysis and its applications, Schur complements for positive operators in Hilbert spaces, along with their variational properties, have proved particularly useful. In this talk, we discuss an extension of the definition of the Schur complement to Hilbert space (and more generally, Krein space) self adjoint operators which retains these variational properties. The key hypothesis making this possible is that of weak complementability, a generalization of a notion first introduced by Ando. We obtain a min-max variational characterization of the Schur complement, and show that the set of selfadjoint operators admitting a Schur complement with such variational properties coincides with the set of weakly complementable selfadjoint operators. Applications are also discussed.

Keywords: Schur complement, Krein space, semi-closed projection.

Kernels of Toeplitz operators

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Abstract

We study kernels of Toeplitz operators in terms of a factorization of their symbol, applying the results to unbounded symbols and to bounded piecewise continuous symbols.

This presentation is based on joint work with M. Cristina Câmara and Jonathan Partington.

Keywords: Toeplitz operators.

An algebra of sequences of variable Toeplitz matrices

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Abstract

An algebra of sequences of variable Toeplitz matrices with continuous symbol is considered. More general than the concept of a stable sequence is the notion of a Fredholm sequence. We will show a relation between this notion and spectral properties of the sequence, in particular the asymptotic behaviour of the singular values. The talk is based on joint work with Bernd Silbermann.

Adjoints of Composition Operators and their Kernels on the Hardy Space

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Abstract

Let φ be a rational map from $\mathbb{D}$ to itself that is analytic on $\mathbb{D}$. Then, the composition operator C_φ, with symbol φ, is defined by $C_\varphi f = f \circ \varphi$ for f in a Hilbert space of analytic functions on $\mathbb{D}$. In 2008, Hammond, Moorhouse, and Robbins gave an explicit formula for the adjoint C_φ^* in the Hardy space. If φ is not univalent, it is well known that the kernel of C_φ^* is infinite dimensional. In this talk, I will show how their formula leads to a functional equation whose solutions are functions in $\ker C_\varphi^*$ for symbols φ that are rational maps of degree 2. In some cases, the kernel of C_φ^* can be described explicitly.

Keywords: rational map, composition operator, adjoint of an operator.

Stationary solutions for a free boundary problem modeling three-dimensional MEMS

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Abstract

An idealized electrostatic microelectromechanical system (MEMS) consists of a rigid ground plate above which a thin elastic plate is suspended. The elastic plate is assumed to be hinged on its boundary. Applying a voltage difference between the two plates induces a Coulomb force that deforms the elastic plate. The corresponding mathematical model couples a fourth-order parabolic equation for the vertical deformation of the elastic plate to the harmonic electrostatic potential in the free domain between the two plates.

The existence of an asymptotically stable stationary solution is shown in case of small voltage values. Non-existence of stationary solutions is also established when the applied voltage difference is large.

Keywords: MEMS, free boundary problem, hinged plate equation, stationary solutions.

Contributions on Wiener-Hopf-Hankel operators

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Abstract

Wiener-Hopf-Hankel operators are well-known to play an important role in several applied areas. E.g., this is the case in certain wave diffraction problems, digital signal processing, discrete inverse scattering, and linear prediction. In this talk, we present our contribution in the study of the invertibility and Fredholm property of Wiener-Hopf-Hankel operators with almost periodic, semi-almost periodic or piecewise almost periodic symbols and acting between L^p Lebesgue spaces ($1 < p < \infty$). The work is based on the construction of explicit operator relations and a factorization technique.

The talk is based on joint works with L.P. Castro.

Keywords: Wiener-Hopf-Hankel operator, invertibility, Fredholm property, factorization, almost periodic function, semi-almost periodic function, piecewise almost periodic function.

Hermitian operators and surjective isometries on vector-valued Lipschitz spaces

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Abstract

Let (X, d) be a compact metric space and $(E, \|\cdot\|_E)$ a Banach space. We say that an E-valued continuous map $F : X \to E$ is a Lipschitz map if

$$L(F) := \sup_{x \neq y \in X} \left\{ \frac{\|F(x) - F(y)\|_E}{d(x, y)} \right\} < \infty.$$

We denote the space of all E-valued Lipschitz maps on X by $\mathrm{Lip}(X, E)$.

There are several norms on $\mathrm{Lip}(X, E)$, which guarantee $\mathrm{Lip}(X, E)$ to be a Banach space. One of them is

$$\|F\|_M = \max\{\|F\|_\infty, L(F)\}, \quad F \in \mathrm{Lip}(X, E),$$

where $\|F\|_\infty = \sup_{x \in X} \|F(x)\|_E$ is the supremum norm of F. A characterization for Hermitian operators on $\mathrm{Lip}(X, E)$ with $\|\cdot\|_M$ has been given by Botelho, Jamison, Jiménez-Vargas and Villegas-Vallecillos [1, Theorem

2.4]. They proved that if X is a compact and 2-connected and E is a complex Banach space, then the T on $\mathrm{Lip}(X, E)$ is Hermitian if and only if $TF(x) = \phi(F(x))$, where ϕ is a Hermitian operator on E.

In this talk we study Hermitian operators on $\mathrm{Lip}(X, E)$ with the norm

$$\|F\|_L = \|F\|_\infty + L(F), \quad F \in \mathrm{Lip}(X, E).$$

Our aim in this talk is for a finite dimensional Banach space E to give a characterization of Hermitian operators on $\mathrm{Lip}(X, E)$ with $\|\cdot\|_L$ without assuming 2-connectivity of X. We deduce that for a compact metric space X, T on $\mathrm{Lip}(X, E)$ is Hermitian if and only if there exists a Hermitian operator ϕ on E such that $TF(x) = \phi(F(x))$. As an application, we give a form of surjective unital linear isometries between Banach algebras of matrix-valued Lipschitz maps. This talk is based on [2].

Keywords: Hermitian operator, surjective isometry, Lipschitz space.

References

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Projections and multiplication operators on JB*-triples

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Abstract

A JB*-triple is a complex Banach space having an intrinsic algebraic structure known as a triple product. The class of JB*-triples comprises, for example, C*-algebras, the Cartan factor $B(H, K)$ of bounded linear operators from a complex Hilbert space H to a complex Hilbert space K and spin triples. In this talk we show that a purely algebraic characterisation of Hermitian projections on a JB*-triple is possible and how it leads to determining under which conditions those projections can be realised as a sum of multiplication operators.

Keywords: JB*-triple, Hermitian projection, multiplication operator.

Inversion of structured matrices

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Abstract

The talk starts with discussions on four important classes of structured matrices the representatives of which are the standard examples, (1) Vandermonde matrices, (2) Cauchy matrices, (3) Hankel matrices, and (4) Toeplitz matrices. The main idea of constructing inverses for Cauchy and Vandermonde matrices is their connection with polynomial or rational interpolation. In the Hankel and Toeplitz cases, an important tool in the design of fast inversion algorithms is the displacement structure of these matrices. Here we first discover the Bezoutian structure of their inverses. Thus, in the first part of the talk we also introduce the classes of Hankel-Bezoutians and Toeplitz-Bezoutians.

In Part 2 we discuss how to compute the parameters occurring in these Bezoutian formulas.

Part 3 is dedicated to matrices which are the sum of a Toeplitz and a Hankel matrix, briefly denoted by T+H matrices. Their inverses again have a Bezoutian-like structure. Hence, we introduce the class of T+H-Bezoutians and discuss - also in this more complicated case - how to construct the parameters occuring in these Bezoutians.

In Parts 4 and 5 we deal with the reversed problem: How to obtain inverses of Bezoutians. We start with the inversion of Toeplitz-Bezoutians. Since we know that the inverse of a Toeplitz-Bezoutian is a Toeplitz matrix,

the only open question is how to compute the parameters of these Toeplitz matrices in a fast way.

The last part of the talk is dedicated to the problem of inverting T+H-Bezoutians possessing the additional property to be centrosymmetric or centroskewsymmetric. Unfortunately, up to now the general case is unclear to a great extend.

The results presented in Parts 4 and 5 are recent results of joint papers with Torsten Ehrhardt.

Keywords: structured matrices, Bezoutians.

Convolution type operators associated with some oscillatory integral transforms on the half-line

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Abstract

The main purpose of this talk is to present three new convolutions related to some oscillatory integral operators defined on the positive half-line and in the framework of L^1 Lebesgue spaces. For that purpose, some operational properties of the mentioned integral operators are exhibited. One of the most important properties of a convolution is to satisfy a factorization property which is typically associated with one or more than one integral operators (Convolution Theorem). In most of the cases, such factorization property is fundamental to solve consequent integral equations which can be characterized by those convolutions. In this sense, we show that the convolutions introduced exhibit certain factorization identities when considering the integral operators under studied.

Keywords: integral operator, convolution, factorization.

Algebraic properties of Toeplitz operators

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Abstract

In the beginning - Toeplitz operators were thought of as linear operators represented by matrices with constant diagonals. Over the last couple of centuries - there have been many generalizations of this. By thinking of these matrices as representing a combination of multiplications and orthogonal projections - it is very natural to generalize to operators on all sorts of classical spaces - the Hardy space which can be thought of as a subset of L^2 of the circle (functions with negative Fourier coefficients equal to zero); all sorts of natural invariant subspaces of this Hardy space called model spaces; the Bergman space which can be thought of as a subset of L^2 of the disc (the equivalence classes of analytic functions), the Harmonic Bergman space, and the same sort of spaces in several variables.

I am going to talk about a series of classical and more modern results - by some great mathematicians and their students - and by me and my students - concerning these generalized operators and their algebraic properties - from products to commutativity to spectrum.

Keywords: Toeplitz operators, Hardy space, Bergman space, Model spaces.

Posters

On the kernel of special classes of paired singular integral operators with *Mathematica*

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Abstract

The development of operator theory is motivated by the need to solve problems emerging from several fields in mathematics and physics. On the study of the operator's kernel some progress has been achieved for some classes of singular integral operators whose properties allow the use of particular strategies. However, the existing algorithms allow, in general, to study the kernel of some kind of singular integral operators but they are not designed to be implemented on a computer. The main goal of this work is to show how the symbolic and numeric capabilities of the computer algebra system *Mathematica* can be used to study/compute the kernel of special classes of paired singular integral operators. It is considered the one-dimensional and the matrix cases. Some nontrivial examples obtained with the use of symbolic computation are presented.

Keywords: paired singular integral operator, kernel, *Mathematica*.

Minimal bimodules of a Banach space nest algebra

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Abstract

Each bimodule of a Banach space nest algebra determines and, to some extent, is determined by a so-called support function pair, i.e., a pair of order homomorphisms on the nest satisfying certain conditions. We characterise the minimal bimodule having a given support function pair when the underlying Banach space is reflexive.

Keywords: Nest Algebras, Banach Spaces, Bimodules.