Preliminary book of abstracts

Don't be a fool; this is not for print. Save paper and ink, as you will get a much better looking formatted hardcopy at the conference.

Plenary talks:

- Harm Bart: *Marinus A. Kaashoek: half a century of operator theory in Amsterdam*
- Mark Embree: *Spectral calculations for quasiperiodic Schrödinger operators*
- Frances Kuo: *High-dimensional integration: the Quasi-Monte Carlo (QMC) way*
- Fritz Gesztesy: *Spectral shift functions and Dirichlet-to-Neumann maps*
- Christiane Tretter: *Challenges in non-selfadjoint spectral problems*

Semi-plenary talks:

- Marcel Hansmann: *On the distribution of eigenvalues of compactly perturbed operators*
- Helton: *\inserttitle*
- Marinus Kaashoek: *Finite rank perturbations of Volterra operators and completeness theorems*
- Alexei Karlovich: *Semi-Fredholm theory for singular integral operators with shifts and slowly oscillating data*
- Greg Knese: *Moment problems and stable polynomials*
- Marko Lindner: *Limit Operators: Getting your hands on the essentials*
- Alejandra Maestripieri: *Oblique projections and applications to Procrustes type problems in Hilbert spaces*
- Jonathan Partington: *Toeplitz kernels, model spaces, and multipliers*
- Stefanie Petermichl: *Characterization of multi-parameter BMO spaces through commutators*
- Alexander Pushnitski: *Hankel and Helson matrices*
- Konrad Schmuedgen: *Unbounded operators on Hilbert C^*-modules*
- Carola-Bibiane Schönlieb: *Differential operators in image processing: from theory to application*
- Bernd Silbermann: *On the spectrum of the Hilbert matrix operator*
- Ilya Spitkovsky: *A tale of two projections — A never ending story?*
- Sanne ter Horst: *The coupling method and operator relations*

Functional calculus

Heads: Markus Haase & Christian Le Merdy

Functional calculus is a multi-faceted domain of operator theory, with many applications to various branches of analysis. Generally speaking, a functional calculus for a linear operator T is a method of associating to a function φ defined on a subset of $\mathbb{C}$ (containing the spectrum of T) a new operator $\varphi(T)$ in such a way that computations with operators can be reduced to computations with functions.

Many problems (for instance about the well-posedness of evolution equations and regularity of their solutions) can be reduced to the question whether for a certain operator T and certain functions φ the operator $\varphi(T)$ is bounded and one has certain estimates for the operator norm $\|\varphi(T)\|$.

A particularly important example of such a functional calculus is the so-called H^∞-functional calculus for sectorial operators, introduced by A. McIntosh some 30 years ago. This theory has developed in many directions, showing many remarkable connections with harmonic analysis (in particular Fourier multipliers, square functions, maximal functions), evolution equations (in particular elliptic operators, analytic semigroups, abstract maximal regularity) and Banach space theory. This session will offer the opportunity to discuss some of the most recent contributions to these and related topics and its applications. It will highlight the role of functional calculus in the study of special classes of operators such as Fourier multipliers, Schur multipliers, and Ornstein–Uhlenbeck operators, in its applications to non-commutative harmonic analysis and to differential operators, and in ongoing developments concerning subordination, Ritt operators and spectral sets.

- Charles Batty: *Holomorphic functions which preserve holomorphic semigroups*
- Yuri Tomilov: *On the approximation theory of C_0-semigroups*
- Gordon Blower: *Operational calculus for groups with finite propagation speed*
- Oliver Dragičević: *p-ellipticity*
- Christoph Kriegler: *Dimension free bounds for the vector valued Hardy–Littlewood maximal operator*
- Alex Amenta: *A first-order approach to elliptic boundary value problems with complex coefficients and fractional regularity data*

- Jörg Seiler: *Bounded H_∞-calculus for closed extensions of cone differential operators*
- Yong Jiao: *Noncommutative harmonic analysis on semigroups*
- Hubert Klaja: *K spectral sets for the numerical radius*
- Christian Le Merdy: *The Ritt property of subordinated operators in the group case*

Riemann–Hilbert problems and their applications in random matrix theory

Head: Jani Virtanen

The Riemann–Hilbert problem (RHP) (of finding an analytic function in the complex plane with a prescribed jump across a given curve) has a long and impressive history going back to Riemann's dissertation (1851) and Hilbert's related results at the beginning of the 20th century. More recently, in the 1990s in a series of works of Its, Izergin, Fokas, Kitaev, Korepin, Slavnov, Deift, and Zhou, the Riemann–Hilbert method was developed to deal with quantum exactly solvable models, orthogonal polynomials and matrix models.

Currently there is a considerable interest in using the Riemann–Hilbert method to treat a variety of problems in mathematical physics and random matrix theory. In this mini symposium we will see a number of such examples, which also involve Toeplitz and Hankel determinants, Fisher–Hartwig symbols, Painlevé equations, point processes, and quantum spin chains. Our aim is to provide a forum for participants to discuss the current state of the field, new developments and open problems in the framework of talks given by mostly PhD students and postdoctoral researchers.

- Christophe Charlier: *Asymptotics of Hankel determinants with a one-cut regular potential and Fisher–Hartwig singularities*
- Doereane: *inserttitle*
- Gyorgy Pal Geher: *Quantum spin chains and limiting entropy*
- Sergey Grudskiy: *Double barrier option under Lévi processes and the theory of Toeplitz operators*
- Kozlowska: *inserttitle*
- Jani Virtanen: *Szegő, Fisher–Hartwig and transition asymptotics of Toeplitz determinants*

Structured matrices and operators — in memory of Georg Heinig

Head: Karla Rost

The mini symposium is dedicated to investigations in which structured matrices or operators occur. In particular, Toeplitz, Hankel, or Toeplitz-plus-Hankel structures are under consideration. It is a matter of fact and underlines the importance of this topic that almost each mathematician, sooner or later, has to deal with structured problems and has to answer, e.g., the question on how to use the structure to obtain more efficient algorithms, more exact solutions, easier proofs or ideas for connected interesting results or problems. Thus, the speakers of this mini symposium are from different fields of analysis, operator theory or numerical linear algebra.

An important aspect aggregating the researchers on structured matrices and operators is that they cannot avoid to refer the fundamental papers and results of one mathematician: Georg Heinig. He was one of the most important researchers in this field. In about 120 papers he developed the foundations and the main ideas on tackling structured problems successfully. Moreover, he had an extraordinary gift to explain complicated scientific results, so that also his talks at international conferences helped to promulgate these results.

Georg Heinig was born on November 24, 1947 in the small town of Zschopau, just about 20 km away from Chemnitz. He unexpectedly passed away on May 10, 2005, in Kuwait. On the occasion of his 70th birthday, the participants of this mini symposium want to remember him with honour, admiration and gratitude.

- Jürgen Leiterer: *On the similarity of holomorphic matrices*
- Sergey Grudskiy: *Uniform individual asymptotics for the eigenvalues and eigenvectors of large Toeplitz matrices*
- Egor Maximenko: *Avram–Parter and Szegő limit theorems: from weak convergence to uniform approximation*
- Yuri Karlovich: *One-sided invertibility of infinite band-dominated matrices*
- Viktor Didenko: *Invertibility conditions for Toeplitz plus Hankel operators and representations for their inverses*
- Torsten Ehrhardt: *Inversion of Toeplitz-plus-Hankel Bezoutians*

- Elias Wegert: *Blaschke products, equilibria of electric charges, Stieltjes polynomials, and moment problems*

New approaches for high dimensional integration in light of physics applications

Heads: Karl Jansen & Frances Kuo

High dimensional integrals appear in many applications in physics. For example, gauge theories in particle physics are described by very high dimensional integrals over group elements from conjugacy classes. Their solutions are extremely demanding computationally, and it requires state of the art supercomputers running for months or even years on a single problem. In this session we will discuss new high dimensional integration methods for these and other physics applications, with methods that have the potential to substantially reduce the cost of very demanding calculations and allow for solutions where the so far used Monte Carlo methods fail. We will explore the use of quasi-Monte Carlo methods which are known to achieve algebraic rates $N^{-\alpha}$ for $\alpha > 1/2$, independently of dimension, when the integrands fall in the 'right' theoretical settings.

- Dirk Nuyens: *Strang splitting for the time-dependent Schrödinger equation and quasi-Monte Carlo methods*
- Yoshihito Kazashi: *Discrete maximal regularity and discrete error estimate of a non-uniform implicit Euler–Maruyama scheme for a class of stochastic evolution equations*
- Tobias Hartung: *Feynman path integral regularization using Fourier integral operator ζ-functions*
- Julia Volmer: *Improving Monte Carlo integration by symmetrization*
- Leoevey: *inserttitle*

Semigroups and evolution equations

Heads: András Bátkai & Christian Seifert

The theory of (strongly continuous) semigroups on Banach spaces started to develop in the first half of the 20th century to find abstract principles in solving evolution equations, for example time-dependent partial differential equations. By means of semigroups one can obtain qualitative as well as quantitative statements concerning the solution of these equations.

Although the foundations of the theory are by now standard, during the last decades there has been a focus on various applications of semigroup methods, for example in partial differential equations, stochastic processes, quantum mechanics, infinite-dimensional control theory, transport theory and many other areas.

The aim of this mini symposium is to present recent developments in the theory and various applications of it in different fields.

- Sascha Trostorff: *A Note on differential-algebraic equations in infinite dimensions*
- Marcel Kreuter: *Mapping theorems for Sobolev spaces of vector-valued functions*
- András Bátkai: *Positivity and delay equations*
- Luciano Abadias: *Spatial bounds for resolvent families and applications to PDE's with critical non-linearities*
- Jens Wintermayr: *Positivity on extrapolation spaces for semigroups*
- Reinhard Stahn: *Fine scales of decay of operator semigroups and an application to decay of waves in a viscoelastic boundary damping model*
- Christian Seifert: *On perturbations of positive semigroups*
- Marcus Waurick: *Fibre homogenisation*
- Markus Haase: *Functional calculi related to semigroups*
- Yuri Tomilov: *On lower bounds for C_0-semigroups*
- Christian Budde: *Desch–Schappacher perturbations and extrapolation spaces for bi-continuous semigroups*

- Felix Schwenninger: *On certain optimal constants in semigroup theory*

Toeplitz and related operators

Heads: Santeri Miihkinen & Jani Virtanen

Classes of bounded linear operators in (analytic) function spaces have played an important role in mathematics and its applications since the 1960s. In addition to their importance in a variety of problems in engineering and (mathematical) physics, they have demonstrated fruitful interaction between functional analysis (operators), complex analysis (generating functions), linear algebra (asymptotics and truncations) and more recently formed links with analytic number theory. Despite the relatively long history of these topics, they continue to attract a considerable interest both in new and long-standing problems, and developments of new ideas and challenges.

In this mini symposium we focus on some of the most important non-self-adjoint operators, including Toeplitz, Hankel and integral operators, composition operators, and multiplicative Toeplitz matrices, which act on various Hilbert and Banach spaces, such as Hardy, Bergman and Fock spaces. Of particular interest are spectral, Fredholm, and other fundamental properties (such as boundedness and compactness) of these operators and matrices.

Our aim is to provide a forum for participants to discuss the current state of the field, new developments and open problems. It features a number of talks by PhD students, postdoctoral researchers and experienced researchers.

- Raffael Hagger: *On the essential spectrum of Toeplitz operators*
- Bartosz Łanucha: *Asymmetric truncated Toeplitz operators of rank one*
- Mikael Lindström: *Compactness and weak compactness of weighted composition operators on dual Banach spaces of analytic functions*
- Małgorzata Michalska: *Truncated Hankel operators and their matrices*
- Santeri Miihkinen: *Strict singularity of a Volterra-type integral operator on* H^p
- Hasen Mekki Öztürk: *Indefinite linear matrix pencil and multi-eigenvalue problem*

- Alexander Pushnitski: *Spectral asymptotics for a class of compact Toeplitz operators on Bergman space*
- Haripada Sau: *Toeplitz operators on the symmetrized bidisc*
- Jari Taskinen: *Recent developments on boundedness of Toeplitz operators in Bergman spaces*
- Thorn: *Properties of multiplicative Toeplitz operators*

Luciano Abadias

Spatial bounds for resolvent families and applications to PDE's with critical non-linearities

We present spatial bounds for the resolvent families associated to several nonlinear fractional Cauchy problems in order to study global and blow up mild solutions when the nonlinearity satisfies a locally Lipschitz condition. Moreover, the case of critical nonlinearities is also treated.

Alex Amenta

A first-order approach to elliptic boundary value problems with complex coefficients and fractional regularity data

We consider well-posedness of boundary value problems associated with divergence-form elliptic equations with complex t-independent coefficients on the upper half-space, and with boundary data in Besov–Hardy–Sobolev (BHS) spaces. Our work is based on a theory of BHS spaces adapted to bisectorial operators with bounded H^∞ functional calculus, and which satisfy certain off-diagonal estimates. Within a range of exponents determined by properties of adapted BHS spaces, we show that well-posedness of a boundary value problem is equivalent to an associated projection being an isomorphism. As an application, in the case of real coefficients, we extend known well-posedness results for the regularity problem with data in Hardy and Lebesgue spaces to a large range of BHS spaces. This is joint work with Pascal Auscher.

Harm Bart

Marinus A. Kaashoek: half a century of operator theory in Amsterdam

This lecture is meant to honor Marinus A. Kaashoek, prominent figure in IWOTA circles. It is delivered on the occasion of Kaashoek becoming eighty years of age in November of this year. In the half century of his professorship at the VU Amsterdam, Kaashoek worked on a variety of mathematical topics. As a rule in close contact with colleagues and PhD students. In this way he had a significant influence on the development of operator theory and made Amsterdam a center of gravity in this area. The talk will focus on some of the main ideas that were leading in Kaashoek's work.

Harm Bart

The logarithmic residue theorem in higher dimensions: following an early lead by Marinus A. Kaashoek

The logarithmic residue theorem from complex function theory gives a connection between the number of zeros of an analytic function f in a domain D and the contour integral of the logarithmic derivative f'/f over the boundary of D. What is the situation when one considers analytic functions having their values in target Banach algebras more general than the complex plane? Two issues are at stake. First: what can be said when the logarithmic residue vanishes (so that there are no 'zeros' inside the contour)? Second: what kind of elements are logarithmic residues (i.e., in what sense might they resemble nonnegative integers)?
The suggestion to look at problems of this type came from Marinus A. Kaashoek almost half a century ago in the context of a PhD project. In the course of the years, it led to surprising connections with a variety of topics, such as Integer Programming, Banach Space Geometry, General Topology, Non-commutative Gelfand Theory and Graph Theory. The aim of the talk is to briefly exhibit these connections and give an impression of the results obtained so far. The talk is a report on long-standing joint work with Torsten Ehrhardt and Bernd Silbermann.

András Bátkai

Positivity and delay equations

Old and new results concerning positivity of delay equations will be presented. The results can be used to obtain results on asymptotic behaviour of solutions. In the end some open problems will also be mentioned. The talk is based on *Positive Operator Semigroups*, a joint work with M. Kramar Fijavž and A. Rhandi.

Charles Batty

Holomorphic functions which preserve holomorphic semigroups

Operator semigroups provide an abstract approach to various types of PDEs, particularly diffusion equations, involving a time variable and a generator A which is typically a differential operator in space variables. The greatest regularity of the solutions occurs when the semigroup is holomorphic in the time-variable. The generators of such semigroups are known as sectorial operators. There are many situations where one wishes to replace the generator A by $f(A)$ for some holomorphic function f. For example, Bochner's notion of subordination in probability corresponds exactly to this procedure for the class of Bernstein functions (various other names are used for the same class). Thus it is natural to ask when $f(A)$ is sectorial. This talk will discuss versions of this question and provide some answers.

Glenier L. Bello-Burguet

Spectral analysis for classes of operators, defined by operator inequalities

Let $\alpha(t) = \sum_{n=0}^{\infty} \alpha_n t^n$ be a function with real coefficients. Let T be a bounded linear operator on a Hilbert space H of class $\mathcal{C}_\alpha$, by which we mean that

$$\alpha[T^*, T] := \sum_{t=0}^{\infty} \alpha_n T^{*n} T^n \geq 0.$$

We consider two cases:

(i) The spectrum $\sigma(T)$ is contained in the closed unit disc and the series for α converges in a disc $|t| < R$ for some $R > 1$;

(ii) T is power bounded and α belongs to the analytic Wiener algebra A_W (that is, the series $\sum |\alpha_n|$ converges).

In both cases, $\alpha[T^*, T]$ is well defined. Functional models of operators of this type have been constructed by Agler, Müller, Olofsson, Pott and others; the case of tuples of operators has also been studied intensively. We assume that α has the form

$$\alpha(t) = (1 - t)\tilde{\alpha}(t)$$

for some $\tilde{\alpha} \in A_W$ such that $\tilde{\alpha}$ has no roots in $[0, 1]$ and $\tilde{\alpha}(0) > 0$. (For instance, if $\tilde{\alpha} \equiv 1$ and $\alpha(t) = 1 - t$, then the class $\mathcal{C}_\alpha$ coincides with the class of all contractions on H.) If in addition, $\tilde{\alpha}(t)$ has no roots for any complex t, $|t| \leq 1$ and T^n converge strongly to zero, then Agler's model implies that T is similar to a contraction. This model does not apply if $\tilde{\alpha}(t)$ has zeros in the closed unit disc. We show, however, that the similarity to a contraction still holds true without these two last assumptions. This is a joint work with Dmitry Yakubovich.

Irina Blinova

Quantum graph with the Dirac operator and resonance state completeness

Dirac quantum graphs having two semi-infinite edges is considered. We construct resonances and resonance states for the tree graph and graphs with loops. The completeness of the states in the space of square integrable functions on finite subgraph is analyzed. The technique is related to the Sz.-Nagy functional model. A factorization theorem for inner matrix-functions is used. The result is compared with the corresponding completeness theorem for the Schrödinger quantum graph.

Gordon Blower

Operational calculus for groups with finite propagation speed

Let A be the generator of a strongly continuous cosine family $(\cos(tA))_{t\in\mathbf{R}}$ on a complex Banach space E. We develop an operational calculus for integral transforms and functions of A using the generalized harmonic analysis associated to certain hypergroups. It is shown that characters of hypergroups which have Laplace representations give rise to bounded operators on E. Examples include the Mehler–Fock transform. We use functional calculus for the cosine family $\cos(t\sqrt{\Delta})$ which is associated with waves that travel at unit speed. The main results include an operational calculus theorem for Sturm–Liouville hypergroups with Laplace representation as well as analogues to the Kunze–Stein phenomenon in the hypergroup convolution setting. The talk is based on a joint work with Ian Doust.

Christian Budde

Desch–Schappacher perturbations and extrapolation spaces for bi-continuous semigroups

The theory of perturbations and extrapolation spaces is well-known for the case of strongly continuous semigroups of operators. One observes that there are also operator semigroups which are not strongly continuous with respect to the norm. One typical example is the left translation semigroup on the space of bounded continuous functions. For that reason there is the class of bi-continuous semigroups, which are developed by F. Kühnemund. This talk will tread the theory of extrapolation spaces of this semigroups, since it is a priori not clear how to construct such spaces with nice properties. We will use this to discuss a Desch–Schappacher perturbation result for bi-continuous semigroups which makes use of this extrapolation space.

Salma Charfi

On a Riesz basis of finite-dimensional invariant subspaces of a family of non-normal operators and application

This talk deals with the non-normal operator

$$T(\xi) := T_0 + \xi_1 T_1 + \xi_2 T_2 + \cdots + \xi_k T_k + \cdots$$

where $\xi = (\xi_k)_{k\geq 1}$ is a sequence of complex numbers such that $\tau(\xi) = \sum_{k=1}^{\infty} |\xi_k| < \infty$, T_0 is a normal, closed densely defined linear operator on a separable Hilbert space $\mathcal{H}$, with compact resolvent and with domain $\mathcal{D}(T_0)$, while $T_k, k = 1, ...n$ are linear operators on $\mathcal{H}$ with the same domain $\mathcal{D} \subseteq \mathcal{D}(T_0)$, which satisfy a specific growing inequality. We are mainly concerned with the existence of a Riesz basis of finite-dimensional invariant subspaces $T(\xi)$. Finally, we apply the obtained results to a nonself-adjoint Gribov operator in Bargmann space.

Christophe Charlier

Asymptotics of Hankel determinants with a one-cut regular potential and Fisher–Hartwig singularities

We obtain asymptotics of large Hankel determinants whose weight depends on a one-cut regular potential and any number of Fisher–Hartwig singularities. This generalises two results:

1) a result of Berestycki, Webb and Wong for root-type singularities, and

2) a result of Its and Krasovsky for a Gaussian weight with a single jump-type singularity.

In the presentation, we will briefly discuss some known results for particular values of the parameters and present some applications. We will show that when we apply a piecewise constant thinning on the eigenvalues of a random Hermitian matrix drawn from a one-cut regular ensemble, the gap probability in the thinned spectrum, as well as correlations of the characteristic polynomial of the associated conditional point process, can be expressed in terms of these determinants. The result is proved via the Riemann–Hilbert method.

Ole Christensen

Operator representations of frames

A frame in a Hilbert space $\mathbf{H}$ is a sequence $\{f_k\}_{k=1}^{\infty} \subset \mathbf{H}$ that allows each $f \in \mathbf{H}$ to be represented in the form $f = \sum_{k=1}^{\infty} c_k f_k$ for some scalar coefficients $\{c_k\}_{k=1}^{\infty} \in \ell^2(\mathbf{N})$. The classical orthonormal bases are special cases of frames; but in contrast to a basis, a frame can be redundant, i.e., the scalar coefficients c_k are not necessarily unique. Large parts of frame theory can be described either directly in terms of the sequence $\{f_k\}_{k=1}^{\infty}$ or via certain associated operators. The talk will give an overview of frame theory in Hilbert spaces and its connection to operator theory. Special attention will be given to recent results concerning representation of frames in terms of iterated systems of operators acting on a collection of vectors in the underlying Hilbert space; the results obtained here are joint work with Marzieh Hasannasab. Several open problems and their relation to harmonic analysis will be discussed.

Rosario Corso

Representation theorems for solvable sesquilinear forms

Given a bounded sesquilinear form Ω defined on a Hilbert space $(\mathcal{H}, \langle\cdot|\cdot\rangle)$, a basic result establishes that there exists a unique bounded linear operator T which *represents* Ω, i.e.

$$\Omega(\xi, \eta) = \langle T\xi|\eta\rangle, \qquad \forall \xi, \eta \in \mathcal{H}.$$

Representation theorems for unbounded forms have been formulated by many authors (one of the first was Kato), and a recent version concerns *solvable* forms (with Trapani, Di Bella). More precisely, for a solvable sesquilinear form Ω, defined on a dense subspace $\mathcal{D} \subseteq \mathcal{H}$, there exists a closed operator T (called *associated* to Ω) with domain $D(T) \subseteq \mathcal{D}$ dense in $\mathcal{H}$, such that

$$\Omega(\xi, \eta) = \langle T\xi|\eta\rangle, \qquad \forall \xi \in D(T), \eta \in \mathcal{D}.$$

In this talk, we discuss properties of these sesquilinear forms and of their associated operators (for instance uniqueness, resolvent sets, adjoint operators, numerical ranges). We also present some generalizations of Kato's second representation theorem, that says: if T is the self-adjoint operator associated to a densely defined closed positive form Ω then the domain of Ω is $\mathcal{D} = D(T^{\frac{1}{2}})$ and

$$\Omega(\xi, \eta) = \langle T^{\frac{1}{2}}\xi|T^{\frac{1}{2}}\eta\rangle, \qquad \forall \xi, \eta \in \mathcal{D}.$$

Zoubir Dahmani

New operators on fractional calculus and applications

In this talk, we introduce new operators on fractional calculus that generalize those established in the fractional integration theory. We prove some of their properties, such as: commutativity and semi group. Then, we present some applications on inequality theory and differential equations.

Kousik Dhara

The (n, ε)-pseudospectrum of an element of a Banach algebra

Let A be a complex unital Banach algebra, $a \in A$, $n \in \mathbb{Z}_+$ and $\varepsilon > 0$. The (n, ε)-pseudospectrum $\Lambda_{n,\varepsilon}(a)$ of a is defined as

$$\Lambda_{n,\varepsilon}(a) := \big\{\lambda \in \mathbb{C} : \lambda - a \text{ is not invertible or}$$
$$\lambda - a \text{ is invertible and } \|(\lambda - a)^{-2^n}\|^{1/2^n} \geq \tfrac{1}{\varepsilon}\big\}.$$

The idea of (n, ε)-pseudospectrum for an operator T on a separable Hilbert space was first studied by Hansen in 2010. The usual pseudospectrum $\Lambda_\varepsilon(a)$ of a is a special case of this, namely $\Lambda_{0,\varepsilon}(a)$. Some elementary properties of $\Lambda_{n,\varepsilon}(a)$ are discussed. These are similar to the properties of the pseudospectrum as recently discussed by Arundhathi Krishnan and S.H. Kulkarni. These include the following:

1. $\Lambda_{n,\varepsilon}(a)$ has no isolated points.
2. $\Lambda_{n,\varepsilon}(a)$ has finite number of connected components and each component contains an element from $\sigma(a)$.

These are illustrated with some examples. The talk is on a joint work with S.H. Kulkarni.

Viktor Didenko

Invertibility conditions for Toeplitz plus Hankel operators and representations for their inverses

Necessary conditions for the invertibility of Toeplitz plus Hankel operators $T(a) + H(b)$ with generating functions $a, b \in L_\infty(\mathbb{T})$ satisfying the relation $a(t)a(1/t) = b(t)b(1/t)$, $t \in \mathbb{T}$ are obtained. In addition, sufficient conditions for the invertibility of such operators are also provided and efficient representations for the corresponding inverses are derived. This is based on joint work with Bernd Silbermann.

Marko Djikić

Coherent pairs, partial orders and certain majorization relations of Hilbert space operators

We consider the following problem. Let $A, B : \mathcal{H} \to \mathcal{K}$ be two bounded linear operators between Hilbert spaces, $\mathcal{M}$ and $\mathcal{N}$ two closed subspaces of $\mathcal{H}$, and $C : \mathcal{M} + \mathcal{N} \to \mathcal{K}$ the linear transformation which coincides with A on $\mathcal{M}$ and with B on $\mathcal{N}$ simultaneously (well-defined as soon as A and B coincide on $\mathcal{M} \cap \mathcal{N}$). What are necessary and sufficient conditions for C to be bounded (closable, closed)? Such a problem is closely related (at least) to the study of lattice properties of certain partial orders on an algebra of Hilbert space operators, which extend the usual order of the lattice of orthoprojections. Particularly interesting and often studied is the so-called star partial order defined by: $A \leq B$ iff $A = PB = BQ$ for some orthoprojections P and Q. We will give a simple solution to the problem of determining which operators admit the supremum in this partial order. We will also explain how the problem mentioned in the beginning is related to certain majorization relations (e.g. the relation $T \preceq S$ iff $\lim Sx_n = 0 \Rightarrow \lim Tx_n = 0$ for every sequence $(x_n) \subseteq \mathcal{H}$), and give the characterization of the pairs in these relations.

! Doereane

\inserttitle

Lorem ipsum dolor sit amet, consectetuer adipiscing elit. Ut purus elit, vestibulum ut, placerat ac, adipiscing vitae, felis. Curabitur dictum gravida mauris. Nam arcu libero, nonummy eget, consectetuer id, vulputate a, magna. Donec vehicula augue eu neque. Pellentesque habitant morbi tristique senectus et netus et malesuada fames ac turpis egestas. Mauris ut leo. Cras viverra metus rhoncus sem. Nulla et lectus vestibulum urna fringilla ultrices. Phasellus eu tellus sit amet tortor gravida placerat. Integer sapien est, iaculis in, pretium quis, viverra ac, nunc. Praesent eget sem vel leo ultrices bibendum. Aenean faucibus. Morbi dolor nulla, malesuada eu, pulvinar at, mollis ac, nulla. Curabitur auctor semper nulla. Donec varius orci eget risus. Duis nibh mi, congue eu, accumsan eleifend, sagittis quis, diam. Duis eget orci sit amet orci dignissim rutrum.

Venku naidu Dogga

On absolutely norm attaining operators

Let H be a complex Hilbert space and $T : H \to H$ be a bounded linear operator. Then T is said to be norm attaining if there exists a unit vector x_0 such that $\|Tx_0\| = \|T\|$. If the restriction $T|M : M \to H$ of T to any closed subspace M of H is norm attaining, then T is said to be absolutely norm attaining. We give necessary and sufficient conditions for a bounded operator defined on a complex Hilbert space to be absolutely norm attaining. We discuss the structure of such operators in the case of self-adjoint and normal operators separately. Finally, we discuss several properties of absolutely norm attaining operators. This is a joint work with G. Ramesh.

Leo Doktorski

An application of limiting interpolation to Fourier series theory

The limiting real interpolation method is applied to describe the behaviour of the Fourier coefficients of functions that belong to spaces which are "very close" to L_2.

Ian Doust

Isomorphisms of $AC(\sigma)$ spaces

In the theory of normal operators on a Hilbert space it is an important fact that the C^*-algebra generated by T is isometrically isomorphic to $C(\sigma(T))$. The Banach–Stone Theorem then classifies these algebras according to the homeomorphism classes of the spectra of the operators. One generalization of this to Banach space operators is the theory of $AC(\sigma)$ operators. This theory deals with operators which admit a spectral decomposition, but one of a conditional rather than unconditional nature. A natural question in this theory is to ask whether there is an analogue of the Banach–Stone theory for the function spaces $AC(\sigma)$. We will show that if $AC(\sigma_1)$ is isomorphic (as a Banach algebra) to $AC(\sigma_2)$ then the compact sets σ_1 and σ_2 must be homeomorphic. The converse implication fails in general, but does hold if one restricts the sets σ to polygonal regions. This is joint work with Michael Leinert.

Oliver Dragičević

p-ellipticity

Suppose A is a complex uniformly strictly accretive matrix function and $p > 1$. We introduce a condition which we call p-ellipticity of A and explain that it lies at the junction of several phenomena in analysis and PDE which may occur in the presence of complex accretive matrices. They are:

(i) convexity of power functions,

(ii) dimension-free bilinear embeddings,

(iii) contractivity of semigroups,

(iv) holomorphic functional calculus, and

(v) regularity theory of elliptic PDE with complex coeffcients.

The talk is based on a joint work with Andrea Carbonaro, with the exception of part (v) which is due to a recent preprint by Martin Dindoš and Jill Pipher.

Rolandi Duduchava

Mixed boundary value problems for the Laplace–Beltrami equation

Let $\mathcal{C}$ be a smooth hypersurface in $\mathbb{R}^3$ with a smooth boundary decomposed into two connected $\partial\mathcal{C} = \Gamma = \Gamma_D \cup \Gamma_N$ and non-intersecting $\Gamma_D \cap \Gamma_N = \emptyset$ parts. Let $\nu(\omega) = (\nu_1(\omega), \nu_2(\omega), \nu_3(\omega))$, $\omega \in \overline{\mathcal{C}}$ be the unit normal vector field. Consider the Laplace–Beltrami operator (in terms of Günter's tangent derivatives) $\Delta_{\mathcal{C}} := \mathcal{D}_1^2 + \mathcal{D}_2^2 + \mathcal{D}_3^2$, $\quad \mathcal{D}_j := \partial_j - \nu_j \partial_\nu$, $\partial_\nu = \sum_{j=1}^3 \nu_j \partial_j$. Let $\nu_\Gamma(t) = (\nu_{\Gamma,1}(t), \nu_{\Gamma,2}(t), \nu_{\Gamma,3}(t))$, $t \in \Gamma$, be the unit normal vector field on the boundary Γ, which is tangential to the surface $\mathcal{C}$ and directed outside of the surface. We study the mixed BVP

$$\begin{cases} \Delta_{\mathcal{C}} u(t) = f(t), & t \in \mathcal{C}, \\ u^+(\tau) = g(\tau), & \tau \in \Gamma_D, \\ (\partial_{\nu_\Gamma} u)^+(\tau) = h(\tau), & \tau \in \Gamma_N, \qquad \partial_{\nu_\Gamma} := \displaystyle\sum_{j=1}^{3} \nu_{\Gamma,j} \mathcal{D}_j. \end{cases}$$

Lax–Milgram's lemma gives that it has a unique solution in the classical setting $f \in \widetilde{\mathbb{H}}^{-1}(\mathcal{C})$, $\quad g \in \mathbb{H}^{1/2}(\Gamma)$, $\quad h \in \mathbb{H}^{-1/2}(\Gamma)$. But in some problems, for example in approximation methods, it is important to know the solvability properties in the non-classical setting

$$f \in \widetilde{\mathbb{H}}^{s-2}_p(\mathcal{C}),\ g \in \mathbb{W}^{s-1/p}_p(\Gamma),\ h \in \mathbb{W}^{s-1-1/p}_p(\Gamma), \quad 1 < p < \infty,\ s > \frac{1}{p}.$$

The BVP then is not Fredholm if and only if

$$\cos^2 \pi s - \left| \sin 2\pi \left(s - \frac{1}{p} \right) \right| \neq 0.$$

In particular, it has a unique solution u in the non-classical setting if the point $(s, 1/p)$ belongs to the open curved quadrangle around the point $(1, 1/2)$. The co-author of the investigation is M. Tsaava.

Torsten Ehrhardt

Inversion of Toeplitz-plus-Hankel Bezoutians

Toeplitz-plus-Hankel Bezoutians are the inverses of Toeplitz-plus-Hankel matrices and have a particular structure, which is similar to, but more complicated than the usual Toeplitz Bezoutians or Hankel Bezoutians. In this talk, we describe a method how to invert centrosymmetric and centroskewsymmetric Toeplitz-plus-Hankel Bezoutians. It is based on considering so-called split-Bezoutians and their inversion. All matrices are assumed to have entries from a field with characteristic different from 2. This is joint work with Karla Rost.

Mark Embree

Spectral calculations for quasiperiodic Schrödinger operators

Among the class of discrete Schrödinger operators, those with quasiperiodic potentials exhibit the most exotic spectral behavior. Many aspects of such models in one-dimension are well understood. For example, the spectrum is often a Cantor set, and the dimension of that set can inform the rate at which wave-packet solutions to the time-dependent Schrödinger equation spread. The Cantor structure of these spectra poses a significant challenge for numerical calculations. Periodic approximations play a critical role; via Floquet theory, their spectra comprise the union of real intervals whose size generally diminishes as the period increases. Good approximations to quasiperiodic models require long periods, again challenging attempts at good numerical work. Models in higher dimension remain considerably more challenging and only now are coming within reach. Even simple models composed from one-dimensional models (giving a spectrum that is the sum of Cantor sets) are difficult to understand. This talk will address a variety of questions relating to spectral calculations for discrete Schrödinger operators. We will show how to efficiently approximate Cantor spectrum

for one-dimensional models (and the limits of these techniques), and explore some intriguing questions about the band structure of higher-dimensional models.
The talk is based on joint work with David Damanik, Jake Fillman, and Anton Gorodetski

Arthur Frazho

Spectral methods to compute a solution to some H^∞ interpolation problems

We will show how one can use fast Fourier transforms and alternating projections to compute the solution to some classical and non-standard interpolation problems. Computing inner outer factorization, all solutions in the band method, the distance from a function in H^2 to the Schur functions and other examples will be discussed.

Dale Frymark

Boundary conditions associated with the left-definite theory for differential operators

In the early 2000's, Littlejohn and Wellman developed a general left-definite theory for certain self-adjoint operators which explicitly determined their domains. However, the description of these domains does not contain boundary conditions. We present characterizations of these domains given by the left-definite theory for all operators which possess a complete system of orthogonal eigenvectors, in terms of classical boundary conditions. The talk is based on a joint work with Matthew Fleeman and Constanze Liaw.

Gyorgy Pal Geher

Quantum spin chains and limiting entropy

The limiting entropy of an interval of length n in an XY spin chain as $n \to \infty$ has been calculated by A.R. Its, B.-Q. Jin and V.E. Korepin in 2007. Their method was to express the entropy through a block Toeplitz determinant and then utilise the theory of integrable Fredholm operators and the Riemann–Hilbert analysis. Recently, there has been a growing interest in computing the entropy of subsystems consisting of two disjoint intervals. This talk is concerned with the case of XX spin chains with zero magnetic field and the subsystem under consideration is the union of two disjoint intervals separated by one spin. It is joint work with A.R. Its and J. Virtanen.

Fritz Gesztesy

Spectral shift functions and Dirichlet-to-Neumann maps

The spectral shift function of a pair of self-adjoint operators is expressed via an abstract operator valued Titchmarsh–Weyl m-function. This general result is applied to different self-adjoint realizations of second-order elliptic partial differential operators on smooth domains with compact boundaries and Schrödinger operators with compactly supported potentials. In these applications the spectral shift function is determined in an explicit form with the help of (energy parameter dependent) Dirichlet-to-Neumann maps. This is based on joint work with J. Behrndt and S. Nakamura.

Rolf Gohm

A category of completely positive maps on $B(H)$

In *Weak Markov Processes as Linear Systems*, we described a category of processes where the objects are contractive operator tuples on a Hilbert space H and the morphisms are intertwiners. It is possible and very natural to interpret these objects as completely positive maps on $B(H)$, the algebra of bounded linear operators on H. As parameters describing subprocesses and quotient processes we have certain contractions and associated defect spaces and defect operators. This leads to an application of operator theory to quantum channels.

Ramesh Golla

Absolutely norm attaining paranormal operators

A bounded linear operator $T : H \to H$ on a Hilbert space H is norm attaining if $\|Tx_0\| = \|T\|$ with some unit vector x_0. If for any closed subspace M of H, the restriction $T|M : M \to H$ of T to M is norm attaining, then T is called an absolutely norm attaining operator or $\mathcal{AN}$-operator. These operators are studied by, e.g., Carvajal, Neves, Panday and Paulsen. In this talk we present the structure of paranormal $\mathcal{AN}$-operators and give a necessary and sufficient condition under which a paranormal $\mathcal{AN}$-operator is normal.

Anna Goncharuk

The generalized backward shift operator on $\mathbb{Z}[[x]]$, Cramer's formulas for solving infinite linear systems, and p-adic integers

Let $a = (a_1, a_2, a_3, \ldots)$ be a sequence of positive integers. Define the operator on the ring of the formal power series with the integer coefficients by $A(f_0 + f_1x + f_2x^2 + \ldots) = a_1f_1 + a_2f_2x + a_3f_3x^2 + \ldots$. We consider the equation

$$(Ay)(x) + f(x) = y(x),$$

where $f(x) = f_0 + f_1x + f_2x^2 + \ldots \in \mathbb{Z}[[x]]$ and study solutions from $\mathbb{Z}[[x]]$.
Using a-adic integers, we prove that the equation has the following unique solution in $\mathbb{Z}_a[[x]]$:

$$y(x) = f(x) + (Af)(x) + (A^2f)(x) + (A^3f)(x) + \ldots.$$

We can prove that this solution belongs to $\mathbb{Z}[[x]]$ if and only if the sum of the series $f_0 + a_1f_1 + a_1a_2f_2 + a_1a_2a_3f_3 + a_1a_2a_3a_4f_4 + \ldots$ is an integer in the ring $\mathbb{Z}_a$.

Notice, that if $a = (1, 2, 3, 4, \ldots)$, then A is the differentiation operator. Then the equation is written as $y'(x) + f(x) = y(x)$ and if $a = (b, b, b, b, \ldots)$, then $A = bS^*$, where S^* is a backward shift operator. Then the equation is written as $bS^*(y)(x) + f(x) = y(x)$ and for the integer coefficients y_n of the series y we have the difference equation $by_{n+1} + f_n = y_n$. Moreover, the solution of this system obtained with the aid of some analog of Cramer's rule is the only solution we need from $\mathbb{Z}[[x]]$. This is a joint work with S. Gefter.

Sergey Grudskiy

Double barrier option under Lévi processes and the theory of Toeplitz operators

In this talk the problem of determination of the no arbitrage price of double barrier options in the case of stock prices is modelled on Lévy processes is considered. Under the assumption of existence of the Equivalent Martingale Measure this problem is reduced to the convolution equation on a finite interval with symbol generated by the characteristic function of the Lévy process. We work out a theory of unique solvability of the getting equation and stability of the solution under relatively small perturbations.

Sergey Grudskiy

Uniform individual asymptotics for the eigenvalues and eigenvectors of large Toeplitz matrices

The asymptotic behavior of the spectrum of large Toeplitz matrices has been studied for almost one century now. Among this huge work, we can find the Szegő theorems on the eigenvalue distribution and the asymptotics for the determinants, as well as other theorems about the individual asymptotics for the smallest and largest eigenvalues. The first results about uniform individual asymptotics for all the eigenvalues and eigenvectors appeared in 2008/2009. The goal of the present lecture is to review this area, to talk about the obtained results, and to discuss some open problems. This review is based on joint works with Manuel Bogoya, Albrecht Böttcher, and Egor Maximenko.

Hocine Guediri

Toeplitz and Hankel operators on polyanalytic Bergman spaces over the upper-half plane

We study algebraic and spectral properties of Toeplitz and Hankel operators on polyanalytic Bergman spaces over the complex upper-half plane. In particular, we establish some fundamental properties of these operators, and we characterize symbols giving rise to bounded, compact and finite-rank Toeplitz operators. Further related questions are also discussed.

Assia Guezane-Lakoud

On a mixed fractional boundary value problem

In this talk, we discuss the existence of solutions for a boundary value problem involving both left Riemann–Liouville and right Caputo types fractional derivatives. For this, we convert the posed problem to a sum of two integral operators and then apply Krasnoselskii's fixed point theorem to conclude the existence of nontrivial solutions.

Gajath Gunatillake

Groups of unitary composition operators on Hardy–Smirnov spaces

Let Ω be an open simply connected proper subset of the complex plane. We identify, up to isomorphism, which groups are possible for the group of unitary composition operators of a Hardy–Smirnov space defined on Ω. We also study the relationship between the geometry of Ω and the corresponding group. The talk is based on joint work with Wayne Smith and Mirjana Jojovic.

Markus Haase

Functional calculi related to semigroups

I shall examine the relation of semigroup theory on one hand and functional calculus theory on the other. For example, it is investigated which properties of a semigroup are reflected in properties of the functional calculus for its generator, and which are not.

Raffael Hagger

On the essential spectrum of Toeplitz operators

For $p \in (1, \infty)$ let $L^p(\mathbb{B}^n)$ denote the usual Lebesgue space over the unit ball and let $A^p(\mathbb{B}^n)$ denote the subspace of holomorphic functions. In this talk we introduce a certain type of bounded linear operators that we will call band-dominated operators. This notion originates from the theory of infinite matrices, where band-dominated operators appear as a limit of band matrices acting on the sequence space $\ell^p(\mathbb{Z})$. These operators have a very rich Fredholm theory and a lot of progress has been made in recent years (e.g. by Lindner and Seidel). Our goal is to show similar results for Toeplitz operators on $A^p(\mathbb{B}^n)$. The key observation here is that Toeplitz operators are actually band-dominated if we extend them to all of $L^p(\mathbb{B}^n)$. This allows us to use similar methods as in the sequence space case and show equally strong results in terms of limit operators. Roughly speaking, limit operators are operators that appear when we shift our operator to the boundary $\partial\mathbb{B}^n$. As our main result we obtain that an operator in the Toeplitz algebra is Fredholm if and only if all of its limit operators are invertible. This extends a lot of well known results, e.g. that a Toeplitz operator T_f with $f \in C(\overline{\mathbb{B}^n})$ is Fredholm if and only if f has no zeros on the boundary $\partial\mathbb{B}^n$.

Marcel Hansmann

On the distribution of eigenvalues of compactly perturbed operators

The distribution of eigenvalues of compact operators is a classical and well-studied subject. For instance, in 1949 Weyl has shown that if the sequence of singular numbers of a compact Hilbert space operator is in $l_p(\mathbb{N})$, then the same is true of its sequence of eigenvalues. To mention

another example, Grothendieck showed in 1955 that the sequence of eigenvalues of a nuclear operator on a general Banach space is always in $l_2(\mathbb{N})$. Many more examples could be added to this list and it is fair to say that the eigenvalue distribution of compact operators is by now very well understood.
However, the same cannot be said for *compactly perturbed* operators. That is, if A is some known bounded operator and K is compact, how fast do the discrete eigenvalues of $A + K$ accumulate at the (essential) spectrum of A? In this talk, we will present some recent results for this generalized problem, focusing on the case of operators on general Banach spaces.
This talk is partly based on joint work with M. Demuth, F. Hanauska and G. Katriel.

Tobias Hartung

Feynman path integral regularization using Fourier integral operator ζ-functions

In this talk, we will have a closer look at a regularized path integral definition based on the generalized Kontsevich–Vishik trace, as well as physical examples. Using Feynman's path integral formulation of quantum mechanics, it is possible to formally write partition functions and expectations of observables in terms of operator traces. Unfortunately, these operators are not of trace-class in general. Hence, a number of techniques have been developed to compute these path integrals by replacing the operators in question by matrices, trace-class operators, or pseudo-differential operators. However, there are many physical applications in which these known methods aren't applicable. Studying the operator traces in question directly, one observes that they are closely related to traces of Fourier Integral Operators. Thus, we are looking for a trace that extends the classical trace on trace-class operators to pseudo-differential operators and Fourier Integral Operators. Since the Kontsevich–Vishik trace is the only trace on the algebra of pseudo-differential operators that restricts to the classical trace on trace-class operators, the generalized Kontsevich–Vishik trace (that is, the Kontsevich–Vishik trace for Fourier Integral Operators) is a natural choice to consider for the Feynman path integral, as well. Applying the construction of the generalized Kontsevich–Vishik trace (i.e., operator ζ-functions) to the Feynman path integral will yield a new definition of the Feynman path integral whose predictions coincide with a number of well-known physical examples.

! Helton

\inserttitle

Lorem ipsum dolor sit amet, consectetuer adipiscing elit. Ut purus elit, vestibulum ut, placerat ac, adipiscing vitae, felis. Curabitur dictum gravida mauris. Nam arcu libero, nonummy eget, consectetuer id, vulputate a, magna. Donec vehicula augue eu neque. Pellentesque habitant morbi tristique senectus et netus et malesuada fames ac turpis egestas. Mauris ut leo. Cras viverra metus rhoncus sem. Nulla et lectus vestibulum urna fringilla ultrices. Phasellus eu tellus sit amet tortor gravida placerat. Integer sapien est, iaculis in, pretium quis, viverra ac, nunc. Praesent eget sem vel leo ultrices bibendum. Aenean faucibus. Morbi dolor nulla, malesuada eu, pulvinar at, mollis ac, nulla. Curabitur auctor semper nulla. Donec varius orci eget risus. Duis nibh mi, congue eu, accumsan eleifend, sagittis quis, diam. Duis eget orci sit amet orci dignissim rutrum.

Jacob Jaftha

Analysis of an unbounded Toeplitz-type operator: the scalar case

Define the Toeplitz-type operator T_ω $(H_2^m(\mathbb{T}) \to H_2^m(\mathbb{T}))$ as follows:

$$\mathrm{Dom}(T_\omega) = \{\varphi \in H_2^m(\mathbb{T}) : \omega\varphi = h + r \text{ with } h \in L_2^m(\mathbb{T}), r \in \mathrm{Rat}_0^m(\mathbb{T})\}$$

$$T_\omega \varphi = \mathbb{P}h \qquad \text{for all } \varphi \in \mathrm{Dom}(T_\omega),$$

where $\mathbb{P}$ is the orthogonal projection of $L_2^m(\mathbb{T})$ onto $H_2^m(\mathbb{T})$ and $\mathrm{Rat}_0^m(\mathbb{T})$ is the space of strictly proper rational matrix functions of size $m \times 1$. In this presentation we will focus on the scalar case where ω has poles on $\mathbb{T}$ and wish to analyse the invertibility of this operator and its Fredholm properties. It will be established that the action of the operator on the orthogonal basis of H^2 can be written as an infinite Toeplitz matrix whose entries have a polynomial bound. The operator T_ω is closed and densely defined, and Fredholm only when the numerator has no zeroes on $\mathbb{T}$.

Dawid Janse van Rensburg

A canonical form for H-symplectic matrices

A canonical form is derived for a pair of matrices (A, H), where H is skew-symmetric and A is H-symplectic, that is, $A^T H A = H$, under the transformations $(A, H) \to (S^{-1}AS, S^T HS)$ for invertible matrices S. In the canonical form for the pair, the matrix A is brought in standard (real or complex) Jordan normal form, in contrast to existing canonical forms.

Yong Jiao

Noncommutative harmonic analysis on semigroups

In this talk we obtain some noncommutative multiplier theorems and maximal inequalities on semigroups. As applications, we obtain the corresponding individual ergodic theorems. Our main results extend some classical results of Stein and Cowling on one hand, and simplify the main arguments of Junge–Le Merdy–Xu's related work. This is a joint work with Maofa Wang.

Marinus Kaashoek

Finite rank perturbations of Volterra operators and completeness theorems

The question under what conditions the set of eigenvectors and generalized eigenvectors of a (non-symmetric) compact Hilbert or Banach space operator T is dense in the space involved is usually called a *completeness problem.* Such problems have a long and interesting history involving, e.g., the fundamental work of M.V. Keldysh from the early seventies, and the completeness theorems play an import role in the theory of dynamical systems. In the present talk, the operator T will be a finite rank perturbation of a Volterra operator. A typical example is an integral operator of the form

$$(Tx)(t) = \int_0^t x(s)\, ds + \int_0^1 g(s)x(s)\, ds, \quad 0 \le t \le 1,$$

which we shall consider on $L^2[0,1]$ as well as on $C[0,1]$. The talk consists of two parts. The first part concerns Hilbert space operators, and the results presented are generalizations of the classical results. In the second part we deal with Banach space operators, not necessarily compact, using the notion of a characteristic matrix function. The theory of entire functions, in particularly, those of the Paley–Wiener class, provides the basic tools for proving our main Banach space completeness theorem. The talk is based on joint work with Sjoerd Verduyn Lunel.

Robert Kaiser

A numerical approach for a special crack problem

This contribution deals with the two-dimensional elasticity problem of a crack at a circular cavity surface. The problem can be modeled by a singular integral equation, the solution of which is the crack opening displacement. For the numerical solution of this equation we propose a collocation-quadrature method, which looks for an approximation of the derivative of the crack opening displacement. This derivative is the solution of a Cauchy singular integral equation with additional fixed singularities, which is given by

$$\frac{1}{\pi}\int_{-1}^{1}\left[\frac{1}{y-x}+\mathbf{h}\left(\frac{1+x}{1+y}\right)\frac{1}{1+y}+\mathbf{k}(x,y)\right]v'(y)\,dy=f(x)$$

for $x\in(-1,1)$, where the right hand side $f:[-1,1]\longrightarrow\mathbb{C}$ is smooth, $\mathbf{k}:(-1,1]\times[-1,1]\longrightarrow\mathbb{C}$ is bounded and continuously differentiable and where

$$\mathbf{h}(t)=-\frac{1}{1+t}+\frac{6t}{(1+t)^2}-\frac{4t^2}{(1+t)^3}\,.$$

The investigations considering the collocation-quadrature method are based on an C^*-algebra approach presented in a recent joint paper with Peter Junghanns on the numerical solution of an integral equation for the notched half-plane problem.

Lutz Kämmerer

Multiple rank-1 lattices as spatial discretization for multivariate trigonometric polynomials

We consider multivariate trigonometric polynomials

$$p\colon[0,1)^d\to\mathbb{C},\qquad p=\sum_{k\in I}\hat{p}_k\mathrm{e}^{2\pi\mathrm{i}k\cdot x},$$
$$\text{i.e. } p\in\Pi_I:=\operatorname{span}\left\{\mathrm{e}^{2\pi\mathrm{i}k\circ}\colon k\in I\right\},$$

with arbitrary frequency set $I\subset\mathbb{Z}^d$, i.e., I has finite cardinality and there is not required a specific structure of I. Our aim are spatial discretizations such that all trigonometric polynomials belonging to Π_I can be uniquely reconstructed from their sampling values at the discretization nodes. In the recent years, we used single rank-1 lattices as spatial discretizations and developed a workable component-by-component strategy in order to determine such rank-1 lattices for given frequency

sets I. The structure of rank-1 lattices allows for the efficient computation of the corresponding discrete Fourier transforms. Moreover, the computation is stable in the sense of well-conditioned Fourier matrices. However, detailed investigations on the structure of rank-1 lattices reveal a unsuitable huge oversampling in specific situations. More precise, the number M of necessarily needed rank-1 lattice nodes may be nearly $\frac{1}{4}|I|^2$ in the worst case.
Our new approach joins multiple rank-1 lattices in order to construct a spatial discretization. Some simple constraints allow for a fast Fourier transform algorithm on the sampling values, i.e. the efficient reconstruction of all multivariate trigonometric polynomials in Π_I from their values at specific sampling nodes. We present different straightforward construction methods of spatial discretizations of the new type. In more detail, all methods are based on randomly chosen rank-1 lattices and have a low complexity. Further analysis of these construction methods allows for estimates of the number of needed sampling nodes for a unique spatial discretization of trigonometric polynomials $p \in \Pi_I$. Roughly speaking, the theoretical oversampling factor $\frac{M}{|I|}$ behaves like $\log |I|$ with very high probability. Numerical tests show even considerably better oversampling factors as well as small condition numbers of the Fourier matrices.

David Kapanadze

Relationship between the effective thermal properties of linear and nonlinear doubly periodic composites

We investigated the effective properties of 2D unbounded composite materials with temperature dependent conductivities. We consider a special case of nonlinear composites, when the conductivity coefficients of the matrix and the composite constituencies are proportional. This allows us to transform the problem for the nonlinear composite to a problem for an equivalent linear composite and then to find a solution of the nonlinear type. Analyzing the effective properties of the composites we derive relationships between their average properties. We show that, when computing the effective properties of the representative cell of the nonlinear composite, the result may depend not only on the temperature but also on its gradient. This is a joint work with W. Miszuris and E. Pesetskaya.

Alexei Karlovich

Semi-Fredholm theory for singular integral operators with shifts and slowly oscillating data

Let α, β be orientation-preserving homeomorphisms of $[0, \infty]$ onto itself, which have only two fixed points at 0 and ∞, and whose restrictions to $\mathbb{R}_+ = (0, \infty)$ are diffeomorphisms, and let U_α, U_β be the corresponding isometric shift operators on the space $L^p(\mathbb{R}_+)$, $1 < p < \infty$, given by $U_\mu f = (\mu')^{1/p}(f \circ \mu)$ for $\mu \in \{\alpha, \beta\}$. We will discuss criteria for the left/right Fredholmness and n-normality/d-normality of singular integral operators of the form

$$A_+P_\gamma^+ + A_-P_\gamma^-,$$

where

$$A_+ = \sum_{k\in\mathbb{Z}} a_k U_\alpha^k, \quad A_- = \sum_{k\in\mathbb{Z}} b_k U_\beta^k$$

are operators in the Wiener algebras of functional operators with shifts and the operators $P_\gamma^\pm = (I \pm S_\gamma)/2$ are associated to the weighted Cauchy singular integral operator

$$(S_\gamma f)(t) = \frac{1}{\pi i}\int_{\mathbb{R}_+} \left(\frac{t}{\tau}\right)^\gamma \frac{f(\tau)}{\tau - t}, d\tau,$$

where $\gamma \in \mathbb{C}$ satisfies $0 < 1/p + \operatorname{Re}\gamma < 1$. We assume that the coefficients a_k, b_k for $k \in \mathbb{Z}$ and the derivatives of the shifts α', β' are bounded continuous functions on $\mathbb{R}_+$ which may have slowly oscillating discontinuities at 0 and ∞. This talk is based on the joint work with Yuri Karlovich and Amarino Lebre.

Yuri Karlovich

One-sided invertibility of infinite band-dominated matrices

The two-sided and one-sided invertibility of multiplication operators by infinite band-dominated matrices on the spaces $l^p(\mathbb{Z})$ with $p \in [1, \infty]$ is studied. Criteria of two- and one-sided invertibility of such operators are obtained under the condition of slowly oscillating behavior of diagonal entries $a_{n,n+k}$ of matrices as $n \to \pm\infty$, by applying a specific factorization of symbols of these operators at $\pm\infty$. Criteria of the one-sided invertibility of multiplication operators by infinite two-diagonal matrices whose diagonal entries $a_{n,n+k}$ form elements $a_{n,n+k}{}_{n\in\mathbb{Z}} \in l^\infty(\mathbb{Z})$ are also established. Applications to studying the two- and one-sided invertibility of Wiener type functional operators on Lebesgue spaces are considered.

Yuri Karlovich

Banach algebras of convolution type operators with PSO data on weighted Lebesgue spaces

Let $\mathcal{B}_{p,w}$ be the Banach algebra of all bounded linear operators acting on the weighted Lebesgue space $L^p(\mathbb{R}, w)$, where $p \in (1, \infty)$ and w is a Muckenhoupt weight. We study the Banach subalgebra $\mathfrak{A}_{p,w}$ of $\mathcal{B}_{p,w}$ generated by all multiplication operators aI $(a \in PSO^\diamond)$ and all convolution operators $W^0(b)$ $(b \in PSO^\diamond_{p,w})$, where $PSO^\diamond \subset L^\infty(\mathbb{R})$ and $PSO^\diamond_{p,w} \subset M_{p,w}$ are algebras of piecewise slowly oscillating functions that admit piecewise slowly oscillating discontinuities at arbitrary points of $\mathbb{R} \cup \{\infty\}$, and $M_{p,w}$ is the Banach algebra of Fourier multipliers on $L^p(\mathbb{R}, w)$. For any Muckenhoupt weight w, we study the Fredholmness in the Banach algebra $\mathcal{Z}_{p,w} \subset \mathfrak{A}_{p,w}$ generated by the operators $aW^0(b)$ with slowly oscillating data $a \in SO^\diamond$ and $b \in SO^\diamond_{p,w}$. Then, under some condition on the weight w, we complete constructing a Fredholm symbol calculus for the Banach algebra $\mathfrak{A}_{p,w}$ and establish a Fredholm criterion for the operators $A \in \mathfrak{A}_{p,w}$ in terms of their Fredholm symbols. A new approach to determine local spectra is considered.

Yoshihito Kazashi

Discrete maximal regularity and discrete error estimate of a non-uniform implicit Euler–Maruyama scheme for a class of stochastic evolution equations

We study two discrete properties of an approximation algorithm recently proposed by Müller-Gronbach and Ritter for stochastic heat equations with multiplicative noise over bounded domains. In this talk, we study this scheme in more detail. Our interest is in a discrete analogue of the maximal regularity estimate and a temporally discrete error estimate. The algorithm considered inherits a regularity of the original equation: The spatial smoothness of the solution in terms of the domain of the square root of Laplacian is controlled by essentially the stochastic forcing term. We further see that how the operator for the noise term acts on eigenspaces of Laplacian turns out to be a key for the error analysis.

Rabah Khaldi

Conformable fractional equations with a Nagumo condition

This talk is devoted to the study of the existence and localization of solutions for a conformable fractional derivative with the Dirichlet boundary condition. Our approach is based on the lower and upper solutions method and Schauder fixed point theorem under a Nagumo condition.

Derek Kitson

Infinitesimal rigidity for unitarily invariant matrix norms

In this talk we will consider infinitesimal rigidity in matrix spaces endowed with a unitarily invariant matrix norm. Our primary goal is to obtain necessary combinatorial conditions for graphs which admit an infinitesimally rigid placement in a given matrix space. We will provide analogues of the Maxwell counting criteria for Euclidean space and show that minimally rigid graphs belong to the matroidal class of (k, l)-sparse graphs for suitable values of k and l. This is joint work with Rupert Levene.

Hubert Klaja

K spectral sets for the numerical radius

Recently, Davidson, Paulsen and Woerdeman proved that an open set of the complex plane is completely K spectral for an operator T if and only if it is completely $\frac{1}{2}\left(\frac{1}{K}+K\right)$ spectral with respect to the numerical radius norm. In this talk, we will show that this is also true for spectral sets. It is joint work with Catalin Badea and Michel Crouzeix.

Greg Knese

Moment problems and stable polynomials

We will show how certain constrained moment problems on the two-torus can shed light on the properties of so-called stable polynomials. Stable polynomials are those polynomials with no zeros on some specified region (say the bidisk or the poly-upper half-plane) and they form a fundamental object/tool in a number of areas including function theory, combinatorics, and operator theory. Analyzing them through the lens of moment problems on the two-torus enables one to unearth a number of useful theorems related to sums-of-squares decompositions, Fejér–Riesz factorizations, and determinantal representations. In addition this approach allows us to understand the regularity and integrability of rational functions on the two-torus.

Beyaz Basak Koca

Fredholmness of some Toeplitz operators

In this talk we will consider Fredholmness of Toeplitz operators with continuous symbols in several variables (in the polydisc and unit ball cases) by using C^*-algebraic methods. Then, as an application of our results, we will give some conditions for solvability of a class of integral equations.

! Kozlowska

\inserttitle

Lorem ipsum dolor sit amet, consectetuer adipiscing elit. Ut purus elit, vestibulum ut, placerat ac, adipiscing vitae, felis. Curabitur dictum gravida mauris. Nam arcu libero, nonummy eget, consectetuer id, vulputate a, magna. Donec vehicula augue eu neque. Pellentesque habitant morbi tristique senectus et netus et malesuada fames ac turpis egestas. Mauris ut leo. Cras viverra metus rhoncus sem. Nulla et lectus vestibulum urna fringilla ultrices. Phasellus eu tellus sit amet tortor gravida placerat. Integer sapien est, iaculis in, pretium quis, viverra ac, nunc. Praesent eget sem vel leo ultrices bibendum. Aenean faucibus. Morbi dolor nulla, malesuada eu, pulvinar at, mollis ac, nulla. Curabitur auctor semper nulla. Donec varius orci eget risus. Duis nibh mi, congue eu, accumsan eleifend, sagittis quis, diam. Duis eget orci sit amet orci dignissim rutrum.

Marcel Kreuter

Mapping theorems for Sobolev spaces of vector-valued functions

In this talk we will consider Sobolev spaces of vector-valued functions. In one dimension these occur frequently when dealing with evolution equations but we will also consider higher dimensions. We will determine situations in which Lipschitz continuous functions F mapping a Banach space X into another Banach space Y induce mappings $W^{1,p}(\Omega, X) \to W^{1,p}(\Omega, Y)$ via composition. Frequently occuring examples in applications are the norm of the space X and lattice operations if X is a Banach lattice. This is joint work with Wolfgang Arendt.

Bilel Krichen

Weakly demicompact linear operators and axiomatic measures of weak noncompactness

In this talk, we study the relationship between the class of weakly demicompact linear operators and measures of weak noncompactness of linear operators with respect to an axiomatic one. Moreover, some Fredholm and perturbation results involving the class of weakly demicompact linear operators are investigated.

Christoph Kriegler

Dimension free bounds for the vector valued Hardy–Littlewood maximal operator

At the beginning of the 80's, Stein and Strömberg proved that the standard Hardy–Littlewood maximal operator

$$Mf(x) = \sup_{r>0} \frac{1}{|B(x,r)|} \int_{B(x,r)} |f(y)|dy, \quad (x \in \mathbb{R}^d)$$

is bounded on $L^p(\mathbb{R}^d)$, $1 < p \leq \infty$ with a constant independent of the dimension $d \in \mathbb{N}$. On the other hand, Fefferman and Stein had proved that the obvious extension of M to $L^p(\mathbb{R}^d; \ell^q)$ is bounded with a constant C_d for $1 < p, q < \infty$. Using Fourier multipliers and a Littlewood–Paley decomposition, we show that C_d can also be chosen to be independent of d. We also show variants with UMD lattices in place of ℓ^q. This is joint work with Luc Deléaval.

Mahesh Kumar

Asymptotic behaviour of composition operators on Banach spaces of holomorphic functions

We study the asymptotic behaviour of the powers T^n of a composition operator T on an arbitrary Banach space X of holomorphic functions on the open unit disc $\mathbb{D}$ of $\mathbb{C}$. We show that for composition operators, one has the following dichotomy: either the powers converge uniformly or they do not converge even strongly. We also show that uniform convergence of the powers of an operator $T \in \mathcal{L}(X)$ is very much related to the behaviour of the poles of the resolvent of T on the unit circle $\mathbb{T}$ of $\mathbb{C}$ and that all poles of the resolvent of the composition operator T on X are algebraically simple.

V.B. Kiran Kumar

Infinite-dimensional preconditioners

Consider the equation $Ax = b$ where A is an $n \times n$ matrix with Toeplitz structure. In 1988, Tony Chan invented the optimal circulant preconditioners C for the system and observed that they are useful in getting faster convergence for the iteration process. The preconditioner C is precisely the circulant matrix for which the Frobenius norm $\|A - C\|_F$ is minimum. In 1999, Stefano Serra Capizzano generalized this technique to algebras of matrix sequences M_{U_n} that include algebras associated with fast transforms like Fourier, Trigonometric, Hartley, Wavelet etc. He showed that in this general situation, a sequence of matrices $P_{U_n}(A_n)$ in M_{U_n} is a preconditioner to the Toeplitz matrix sequence A_n provided $P_{U_n}(A_n)$ converges to A_n in the sense of eigenvalue cluster. Hence the search for preconditioners turned out to be the search for an appropriate matrix sequence that converges to A_n in the sense of eigenvalue cluster. In 2013, we generalized these notions to the setting of operators acting on infinite dimensional Hilbert spaces. The connection of preconditioners with the noncommutative Korovkin type theorems is another interesting aspect of this study. Recently, we tried to apply some of these results to the spectral approximation problem for bounded self-adjoint operators. The application of preconditioners in operator equations has to be investigated in detail. I wish to present some of the recent results in this regard here.

Frances Kuo

High-dimensional integration: the Quasi-Monte Carlo (QMC) way

High dimensional computation — that is, numerical computation in which there are very many or even infinitely many continuous variables — is a new frontier in scientific computing, with applications ranging from financial mathematics such as option pricing or risk management, to groundwater flow, heat transport, and wave propagation. Often the difficulties come from uncertainty or randomness in the data, e.g., in groundwater flow from permeability that is rapidly varying and uncertain, or in heat transport from uncertainty in the conductivity. These high dimensional problems present major challenges to computational resources, and requires serious mathematical efforts in devising new and effective methods. This talk will provide a contemporary review of quasi-Monte Carlo (QMC) methods for approximating high dimensional integrals. I will highlight some recent developments on "lattice rules" and “higher order digital nets”. One key element is the “fast component-by-component construction” which yields QMC methods with a prescribed rate of convergence for sufficiently smooth functions. Another key element is the careful selection of parameters called “weights” to ensure that the worst case errors in an appropriately weighted function space are bounded independently of the dimension. Then I will showcase how this modern QMC theory can be tuned for a number of applications, including PDEs with random coefficients.

Holger Langenau

Best constants in Markov-type inequalities with mixed Hermite weights

Markov-type inequalities give upper bounds on the norm of νth derivative of an algebraic polynomial of degree at most n in terms of the norm of the polynomial itself. Such an inequality is

$$\|D^\nu f\|_\beta \le C\|f\|_\alpha,$$

where f is a polynomial of degree at most n, D^ν the differential operator, and $\|\cdot\|_\alpha$ is some norm. We are interested in finding the best (i.e., the smallest) constant C such that the above inequality holds. We find that this is just the operator norm of the differential operator, which depends heavily on the degree n, the order of derivative ν and, of course, the selection of norms on both sides of the inequality.
In this talk, we will consider the Hermite norm

$$\|f\|_\alpha^2 \coloneqq \int_{-\infty}^{\infty} |f(t)|^2 |t|^{2\alpha} \mathrm{e}^{-t^2} \mathrm{d}t$$

and give asymptotic expressions for the constant when n goes to infinity. We will use some ideas already utilized in the Laguerre and Gegenbauer cases and show how they can be employed in this case.

Bartosz Łanucha

Asymmetric truncated Toeplitz operators of rank one

In this talk we present some properties and characterizations of asymmetric truncated Toeplitz operators. We then describe all the asymmetric truncated Toeplitz operators of rank one. We also point out the cases when the given description differs from the one given by D. Sarason for rank-one truncated Toeplitz operators.

Christian Le Merdy

The Ritt property of subordinated operators in the group case

Let G be a locally compact Abelian group, let X be a Banach space and let $\pi\colon G \to B(X)$ be a bounded strongly continuous representation. For any probability measure ν on G, consider the average operator

$$S(\pi,\nu) = \int_G \pi(t)\, d\nu(t) \in B(X),$$

which can be naturally regarded as subordinated to ν. We give conditions implying that $S(\pi,\nu)$ is a Ritt operator (the discrete analogue of 'bounded analytic semigroups') and admits a bounded H^∞-functional calculus with respect to a Stolz domain. Banach space geometry comes into play and we focus on the case when X is a K-convex Banach space. This is joint work with Florence Lancien.

Ji Eun Lee

On binormal Toeplitz operators on the Hardy space

In this talk, we characterize binormal analytic Toeplitz operators on the Hardy space. For a large class of non analytic Toeplitz operators, which includes Toeplitz operators with trigonometric or rational symbols, we prove that those Toeplitz operators are binormal if and only if they are normal. Historically important examples of Toeplitz operators also shows that our problem is subtle and above result is sharp. The talk is based on joint work with Caixing Gu, Dong-O Kang and Eungil Ko.

Mee-Jung Lee

On the iterated operator transforms

Let $T = U|T|$ be the polar decomposition of an operator $T \in \mathcal{L}(\mathcal{H})$. For given $s,t \geq 0$, we say that $\widehat{T}_{s,t} := sU|T| + t|T|U$ is the *weighted mean transform* of T. In this talk, we study properties of the k-th iterated weighted mean transform $\widehat{T}_{s,t}^{(k)}$ of $T = U|T|$ when U is unitary. In particular, we give the polar decomposition of such $\widehat{T}_{s,t}^{(k)}$ and investigate its applications. We also consider almost commuting relations with a compact operator between T and $\widehat{T}_{0,1}^{(k)}$. Finally, we study the invariant subspaces for $\widehat{T}_{0,1}^{(k)}$. The talk is based on joint work with Sungeun Jung and Eungil Ko.

Jürgen Leiterer

On the similarity of holomorphic matrices

In 1988, R. Guralnick proved: If two holomorphic matrices on a non-compact connected Riemann surface are locally holomorphically similar, then they are globally holomorphically similar. Actually, he proved a more general theorem for certain Bezout rings, and then applies this to the ring of global holomorphic functions on a non-compact connected Riemann surface. It seems that this proof cannot be generalized to nonsmooth 1-dimensional Stein spaces, and also not to smooth higher dimensional Stein manifolds, because then the ring of global holomorphic functions is not Bezout. Using other methods, we obtain:

(1) On 1-dimensional Stein spaces, local holomorphic similarity implies global holomorphic similarity. If the space is smooth, then local continuous similarity is sufficient.

(2) On arbitrary Stein spaces, local holomorphic similarity together with global $\mathcal{C}^\infty$ similarity implies global holomorphic similarity.

(3) On contractible 2-dimensional Stein manifolds, local holomorphic similarity implies global holomorphic similarity.

We show by counterexamples:

(1C) For each integer $k \geq 0$, there are irreducible 1-dimensional analytic sets where local $\mathcal{C}^k$-similarity does not imply local holomorphic similarity.

(2C) There exists a Stein domain in $\mathbb{C}^5$ such that, for each integer $k \geq 0$, there is a pair of holomorphic matrices on it, which are locally holomorphically similar, globally $\mathcal{C}^k$-similar, but not globally holomorphically similar.

(3C) There exists a convex domain in $\mathbb{C}^3$ and a pair of holomorphic matrices on it, which are locally holomorphically similar, but not globally holomorphically similar.

! Leoevey

\inserttitle

Lorem ipsum dolor sit amet, consectetuer adipiscing elit. Ut purus elit, vestibulum ut, placerat ac, adipiscing vitae, felis. Curabitur dictum gravida mauris. Nam arcu libero, nonummy eget, consectetuer id, vulputate a, magna. Donec vehicula augue eu neque. Pellentesque habitant morbi tristique senectus et netus et malesuada fames ac turpis egestas. Mauris ut leo. Cras viverra metus rhoncus sem. Nulla et lectus vestibulum urna fringilla ultrices. Phasellus eu tellus sit amet tortor gravida placerat. Integer sapien est, iaculis in, pretium quis, viverra ac, nunc. Praesent eget sem vel leo ultrices bibendum. Aenean faucibus. Morbi dolor nulla, malesuada eu, pulvinar at, mollis ac, nulla. Curabitur auctor semper nulla. Donec varius orci eget risus. Duis nibh mi, congue eu, accumsan eleifend, sagittis quis, diam. Duis eget orci sit amet orci dignissim rutrum.

Marko Lindner

Limit Operators: Getting your hands on the essentials

The essential norm of an operator A says how much of its norm is robust under compact perturbations. If λ is in the essential spectrum of A, it is in the spectrum all compact perturbations of A. One can define essential invertibility (Fredholmness), essential pseudospectra, the essential numerical range and other essential things. Each time the operator A is considered modulo compact operators — as an element of the Calkin algebra. We review and demonstrate the method of *limit operators* and see how it exactly describes the coset of A modulo compact operators and hence: all the essential things mentioned above. We also recall how the stability of a projection method translates into one of our essential properties before we demonstrate all of this for the Fibonacci Hamiltonian. A major part of this story developed in Chemnitz.

Mikael Lindström

Compactness and weak compactness of weighted composition operators on dual Banach spaces of analytic functions

In this talk I will discuss the norm and the essential norm of weighted composition operators from a large class of (not necessarily reflexive) Banach spaces of analytic functions on the open unit disk into weighted type Banach spaces of analytic functions and Bloch type spaces. I will also show the equivalence of compactness and weak compactness of weighted composition operators from these weighted type spaces into a class of Banach spaces of analytic functions, that includes a large family of conformally invariant spaces. This is joint work with T. Eklund, P. Galindo and I. Nieminen.

Conrad Mädler

On the structure of Hausdorff moment sequences

We consider finite sequences $(s_j)_{j=0}^m$ of complex matrices which arise as power moments $s_j = \int_{[\alpha,\beta]} x^j \sigma(\mathrm{d}x)$ of non-negative Hermitian matrix measures σ on an interval $[\alpha, \beta]$ of the real line. According to the solvability criterion for the truncated matricial Hausdorff moment problem, such sequences can be characterized by non-negative definiteness of certain block Hankel matrices.
We study the extension problem within this class $\mathcal{F}_{q,m,\alpha,\beta}^{\geq}$ of sequences. It turns out that the set of all possible one-step extensions s_{m+1} is a closed matricial interval $[\mathfrak{a}_m, \mathfrak{b}_m]$, the length $\mathfrak{d}_m := \mathfrak{b}_m - \mathfrak{a}_m$ of which can be written as the parallel sum $\mathfrak{d}_m = (\beta - \alpha)(A_m \pm B_m)$ of certain non-negative Hermitian Schur complements A_m and B_m. Thereby, the set of all possible next power moments $\int_{[\alpha,\beta]} x^j \sigma(\mathrm{d}x)$ of matrix measures σ with prescribed first moments $(s_j)_{j=0}^m$ is described. Furthermore, the existence of one-step extensions s_{m+1} is proved in a purely algebraic manner.
As a consequence of a matricial version of the inequality between arithmetic and harmonic mean, we see that the lengths $\mathfrak{d}_m$ decreases as $\mathfrak{d}_{m+1} \leq \frac{\beta-\alpha}{4}\mathfrak{d}_m$ with respect to the Löwner semi-ordering. The maximal possible next length $\hat{\mathfrak{d}}_{m+1} := \frac{\beta-\alpha}{4}\mathfrak{d}_m$ is attained only for the *central* extension $\hat{s}_{m+1} := \frac{1}{2}(\mathfrak{a}_m + \mathfrak{b}_m)$. Since we do not assume regularity of the corresponding matrices, our reasoning heavily relies on the use of the Moore–Penrose inverse. The results are connected to those of Skibinsky and Dette–Studden within the concept of canonical moments. This is joint work with B. Fritzsche and B. Kirstein.

Alejandra Maestripieri

Oblique projections and applications to Procrustes type problems in Hilbert spaces

In approximation problems appearing in many different areas — for example, signal processing and sampling theory, sometimes it is necessary to introduce a weight W, generally a positive (though not necessarily invertible) operator. In this case, the Hilbert space might become a pre-Hilbert space. The notion of *compatibility* is ideally suited to this setting: If H is a Hilbert space, W a bounded positive linear operator in H and $S \subseteq H$ a closed space, then W and S are compatible if there exists a (bounded) projection Q onto S such that Q is W-selfadjoint, i.e. $WQ = Q^*W$. We discuss the existence and properties of such projections, and the relation between the notion of compatibility and that of range additivity, and their role in connection with the minus order for operators. As an application we consider a sort of Procrustes problem with a weight in the Schatten class: Let H be a Hilbert space and $L(H)$ the algebra of bounded linear operators on H. If $W \in L(H)$ is a positive operator such that $W^{1/2}$ is in the Schatten p class for some $1 \leq p < \infty$, and given $A, B, C \in L(H)$, A and B with closed range, find conditions for the existence of

$$\min_{X \in L(H)} \|AXB - C\|_{p,W},$$

where $\| \cdot \|_{p,W} = \|W^{1/2} \cdot \|_p$. Another problem naturally connected to this is to analyse the existence of

$$\min_{X \in L(H)} (AXB - C)^* W (AXB - C),$$

both in the usual operator order as well as the minus order. This is joint work with Maximiliano Contino and Juan Giribet.

Vitalii Marchenko

Xu–Yung–Zwart theorem and C_0-groups generated by operators with non-basis family of eigenvectors

Riesz bases play an important role in infinite-dimensional linear systems theory and signal processing. At the beginning of this century G.Q. Xu & S.P. Yung and H. Zwart established an unexpected relation between the property of operator A on a Hilbert space H to generate a C_0-group and the Riesz basis property of eigenvectors of A if the eigenvalues don't cluster. They also obtained generalizations to the case of non-simple eigenvalues and eigenvalues that may cluster. In this case a vector Riesz basis may not exist but a Riesz basis of A-invariant subspaces may arise.

We study the property to generate the C_0-group for linear unbounded operators with the following properties: operators have purely imaginary eigenvalues, which essentially cluster at $i\infty$, and the corresponding eigenvectors are dense, minimal, but not uniformly minimal, hence do not form a Schauder basis. Thus our joint work with Grigory Sklyar complements the results of Xu–Yung and Zwart on the Riesz basis property for spectral families.

Helena Mascarenhas

Spectral properties of approximation sequences

Algebras of approximation sequences and their spectral properties are studied in which the concepts of rich sequences and fractality are used. Finite sections of a large class of convolution type operators and their properties are presented. Behind the results are local principles and variations of the Lifting theorem. Part of the talk is based on joint work with Pedro Santos and Markus Seidel.

Egor Maximenko

Avram–Parter and Szegő limit theorems: from weak convergence to uniform approximation

This talk is based on joint results with J.M. Bogoya, A. Böttcher, and S. Grudsky. Recently we proved a result on the uniform approximation of the singular values of Toeplitz matrices, which are just the eigenvalues in the case of positive definite Hermitian matrices (*Maximum norm versions of the Szegő and Avram–Parter theorems for Toeplitz matrices*). Here we put the same approach into a more abstract setting, thus extending the range of possible applications. Namely, we present sufficient conditions to pass from the convergence of probability measures in distribution to the uniform convergence of the associated quantile functions. In particular, one can pass from the asymptotic distribution of collections of real numbers (for example, the singular values of a sequence of n-by-n matrices as n goes to infinity) to their uniform approximation by the values of the quantile function at equidistant points. We apply these results to some classes of Toeplitz-like matrices and to other well-known asymptotical distributions: the equidistributed sequences of real numbers and the arcsin law for random walks.

Isaac Michael

On Birman's sequence of Hardy–Rellich-type inequalities

In 1961, Birman proved a sequence of inequalities I_n, for $n \in \mathbb{N}$, valid for functions in $C_0^n((0,\infty)) \subset L^2((0,\infty))$. In particular, I_1 is the classical (integral) Hardy inequality and I_2 is the well-known Rellich inequality. In this talk, we give a proof of this sequence of inequalities valid on a certain Hilbert space $H_n([0,\infty))$ of functions defined on $[0,\infty)$. Moreover, $f \in H_n([0,\infty))$ implies $f' \in H_{n-1}([0,\infty))$; as a consequence of this inclusion, we see that the classical Hardy inequality implies *each* of the inequalites in Birman's sequence. We also show that for any finite $b > 0$, these inequalities hold on the standard Sobolev space $H^n((0,b))$. Furthermore, when $0 < b \leq \infty$, the Birman constants $((2n-1)!!)^2/2^{2n}$ in these inequalities are sharp and the only function that gives equality in any of these inequalities is the trivial function in $L^2((0,\infty))$. We also show that these Birman constants are related to the norm of a generalized Hardy avaraging operator. This is based on joint work with F. Gesztesy, L.L. Littlejohn, and R. Wellman.

Małgorzata Michalska

Truncated Hankel operators and their matrices

Truncated Hankel operators are compressions of classical Hankel operators to model spaces. In this talk we describe matrix representations of truncated Hankel operators on finite-dimensional model spaces. We then show that the obtained descriptions hold also for some infinite-dimensional cases. This is based on joint work with B. Łanucha.

Nazar Miheisi

Spectral asymptotics for Helson matrices

A Helson matrix (also known as a multiplicative Hankel matrix) is an infinite matrix with entries $\{a(jk)\}$ for $j,k \geq 1$. Here the (j,k)'th term depends on the product jk. A particularly important example is the *multiplicative Hilbert matrix*, which corresponds to the choice $a(j) = 1/(\sqrt{j(1+\log j)})$, $\quad j \geq 1$. In this talk we will consider compact modifications of the mutiplicative Hilbert matrix determined by sequences of the form $a(j) = (\sqrt{j}\log j(\log\log j)^{\alpha}))^{-1}$ for sufficiently large j. We will show that their eigenvalues obey the asymptotics $\lambda_n \sim \varkappa(\alpha)/n^{\alpha}$ as $n \to \infty$, with an explicit constant $\varkappa(\alpha)$. In doing so, we will introduce some new transference techniques which allow one to relate the spectral properties of a Helson matrix with those of its continuous analogue (an integral operator on $L^2(1,\infty)$ whose integral kernel $a(s,t)$ depends only on the product st). The talk is based on joint work with Alexander Pushnitski.

Santeri Miihkinen

Strict singularity of a Volterra-type integral operator on H^p

We consider a Volterra-type integral operator

$$T_g f(z) = \int_0^z f(\zeta)g'(\zeta)\,d\zeta, \quad z \in \mathbb{D}$$

acting on the Hardy spaces H^p of the unit disc $\mathbb{D}$. The operator T_g was introduced by Ch. Pommerenke and it has been studied systematically by several people, including A. Aleman, A.G. Siskakis and R. Zhao among others. An interesting notion is the strict singularity of a linear operator between Banach spaces. An operator is strictly singular if its restriction to any infinite-dimensional subspace is not an isomorphism onto its range. We discuss our recent result, which states that a non-compact T_g fixes an isomorphic copy of the sequence space ℓ^p: In particular, the strict singularity of T_g coincides with its compactness on spaces H^p.

Ivica Nakić

Perturbation of eigenvalues of Klein–Gordon operators

We will present perturbation bounds for the abstract Klein–Gordon operator of the form

$$\left(i\frac{\partial}{\partial t} - V\right)^2 \psi = U^2\psi,$$

where V is symmetric and U is a positive selfadjoint operator, and where we perturb the potential V. Included are both inclusion bounds for both, the standard and essential spectrum, as well as two sided bounds for discrete eigenvalues. The method of the proof heavily relies on the fact that the corresponding operator is selfadjoint in an indefinite inner product. This is joint work with K. Veselić.

Dirk Nuyens

Strang splitting for the time-dependent Schrödinger equation and quasi-Monte Carlo methods

We study approximating the solution to the time-dependent Schrödinger equation:

$$\begin{aligned} \mathrm{i}\epsilon\frac{\partial u}{\partial t} &= -\frac{1}{2}\epsilon^2\,\nabla^2 u + vu, \\ u(\boldsymbol{x},0) &= g(\boldsymbol{x}), \end{aligned}$$

where $\boldsymbol{x} \in [0,1]^d$, $t, \epsilon > 0$ and $v(\boldsymbol{x})$ is the potential function. Our numerical method consists of two steps: we first discretize the physical domain and then apply Strang splitting for the time step discretization.

Theoretical results on Strang splitting by using regular grids to discretize the physical domain were obtained by Jahnke & Lubich (2000). The usage of sparse grids instead of regular grids was studied by Gradinaru (2007). We show advantages and improvements by using rank-1 lattice rules for the physical domain. This is joint work with Yuya Suzuki and Gowri Suryanarayana.

Hasen Mekki Öztürk

Indefinite linear matrix pencil and multi-eigenvalue problem

A generalized spectral problem $(A - \lambda B)\, u = 0$ with self-adjoint operator coefficients A, B acting in some Hilbert space, will have a purely real spectrum if any of the operators A, B is sign-definite, i.e. if all of the eigenvalues of A or B have the same sign, either positive or negative. If, however, both coefficients are indefinite, some complex eigenvalues may appear, and the spectral picture is much more complicated.
In this talk, we consider a family of indefinite self-adjoint linear pencil of matrices, $A - \lambda B$, introduced by E. Brian Davies and Michael Levitin. We relate this class to a two-parameter matrix eigenvalue problem in the spirit of Atkinson. We use this approach to establish some estimates on localization of eigenvalues. This is a joint work with Michael Levitin.

Jonathan Partington

Toeplitz kernels, model spaces, and multipliers

We discuss recent progress in the theory of kernels of Toeplitz operators acting on the Hardy–Hilbert space; these kernels include all the model spaces. In particular we focus on the existence of so-called maximal vectors, which determine the kernel in a precise sense. These maximal vectors may easily be parametrised in terms of inner and outer factorizations.
We then discuss multipliers between kernels of Toeplitz operators, following on from work of Crofoot and later Fricain, Hartmann and Ross: these multipliers can be characterised in terms of possible test functions, which turn out to be precisely the maximal vectors. Immediate applications to model spaces are derived.
This is joint work with Cristina Câmara.

Stefanie Petermichl

Characterization of multi-parameter BMO spaces through commutators

The characterisation of symbols that result in bounded Hankel or Toeplitz operators are classical. When passing to real analysis and notably to multi-parameter real analysis, these questions can become very difficult. We discuss the simplicity of the classical base cases as well as the cornerstones extensions to real analysis 'away' from operator theory. In this situation one studies 'commutators' the simplest one of which takes the form $Hb - bH$ where H is the Hilbert transform and b stands for multiplication by a (bmo) function. The real variable one-parameter theory includes a classical article by Coifman, Rochberg, Weiss. The multi-parameter study of related objects was initiated by Cotlar, Ferguson, Sadosky in the late 90s with a deep line by Ferguson, Lacey, Pipher, Wick, myself and others. A recent result by Ou, Strouse and myself solves an endpoint question, bringing the entire multi-parameter commutator theory under one roof. Although the proofs are 'hard analysis' exploiting several recent developments, one recognises the core that lies in elegant arguments stemming from operator theory.

Paweł Pietrzycki

Relations between some system of operator equations and subclass of hypnormal operators

In 1953 A. Brown introduced the class of bounded quasinormal operators. In the case of unbounded operators, two different definitions of unbounded quasinormal operators appeared independently. The first one was given in 1983 by Kaufman, and a few years later, the second one by Stochel and Szafraniec. We will discuss recent results concerning solutions of some system of operator equations which is related with the class of quasinormal operators.

Derk Pik

Generalized solutions of discrete time Riccati inequalities

We present the Riccati inequality for linear discrete time stationary systems with respect to the scattering supply rate. The results are based on earlier work on the Kalman–Yakubovich–Popov inequality from 2006. In the talk we will outline the differences between the finite and infinite dimensional case. The main theorems are closely related to the results of Yu.M. Arlinskii from 2008. The main difference is that we do not assume the original system to be a passive scattering system, and we allow the solutions of the Riccati inequality to satisfy weaker conditions. This talk is based on recent joint work with Marinus Kaashoek and Damir Arov.

Igor Popov

Quantum channel entanglement producing and distance of the channel matrix from the tensor product

Each multi-qubit quantum channel or quantum gate is characterized by the corresponding matrix. If the matrix is a tensor product of the matrices corresponding to separate qubits, then the gate does not create entangled state from a tensor product of states. A distance of the matrix from a subspace of matrices being tensor products shows the ability of the gate to produce entanglement. The way of this distance calculation is described. Examples of the gates are considered.

Alexander Pushnitski

Hankel and Helson matrices

As is well known, a Hankel matrix is the infinite matrix of the form $\{a_{n+m}\}_{n,m=0}^{\infty}$. In my talk, I will review some aspects of the theory of *Helson matrices* (also known as *multiplicative Hankel matrices*). These are infinite matrices of the form $\{a_{nm}\}_{n,m=1}^{\infty}$; here the (n, m)'th entry depends on the product nm rather than on the sum $n + m$.
Hankel matrices play an important role in the theory of Hardy spaces; elements of the Hardy space are functions built from power series. In the same way, Helson matrices are central objects in the theory of functions spaces built from Dirichlet series. While the theory of Hankel matrices is classical and well-studied, the theory of Helson matrices is still in its infancy. I will review some of the basic questions in the theory of Helson matrices: boundedness, finite rank property, positivity and spectral analysis of some concrete Helson matrices. I will compare the current state of knowledge in these questions with the classical case of Hankel matrices.
Some of the results I will discuss are joint work with Karl Mikael Perfekt. Some further related results will be presented in a talk by Nazar Miheisi.

Alexander Pushnitski

Spectral asymptotics for a class of compact Toeplitz operators on Bergman space

I will discuss a class of compact Toeplitz operators in a Bergman space on the unit disk. The symbols of operators in our class are assumed to have a sufficiently “regular” behaviour near the boundary of the disk. This allows us to compute the asymptotics of singular values of this class of Toeplitz operators. This result will be applied to obtain spectral asymptotics of a class of Jacobi matrices.

Andre Ran

Wiener–Hopf factorization of rational matrix functions with symmetries

In this talk several classes of rational matrix functions with symmetries will be considered. The symmetries have implications for the matrices in a minimal realization of the function, mostly this implies certain symmetries in the context of an indefinite inner product space. In turn, this has consequences for factorizations. The classes that will be discussed are: rational matrix functions that have selfadjoint values on the real line, and rational matrix functions that have unitary values on the unit circle. The talk is based on two papers: one from 1985 co-authored with Rien Kaashoek, and one dating from late in 2016, co-authored with Rien Kaashoek and Gilbert Groenewald.

Christian Rebs

An asymptotic lower bound for the norm of the Laplace operator on a space of polynomials

For positive integers n and N we consider the space $\mathcal{P}_n\left([0,1]^N\right)$ of complex polynomials with N variables and highest degree n in each variable. We equip this space with the (unweighted) Laguerre norm $\|\cdot\|$ and consider the Laplace operator $\Delta : \mathcal{P}_n\left([0,1]^N\right) \to \mathcal{P}_n\left([0,1]^N\right)$. Now we ask for the best constant C, depending on n and N, such that the Markov-type inequality $\|\Delta f\| \leq C\|f\|$ holds for all $f \in \mathcal{P}_n\left([0,1]^N\right)$. The best constant with this property is the operator norm $\|\Delta\|$ of the Laplace operator.

We will deduce an asymptotic lower bound for the norm of the operator, more precisely, we prove

$$\|\Delta\| \geq \frac{N}{\omega_0^2}(n+1)^2 + o\left((n+1)^2\right) \quad (n \to \infty).$$

Here we denote by ω_0 the positive solution of the equation $2+2\cosh(\omega)-\omega\sinh(\omega)=0$. Carefully analyzing the structure of the underlying matrices will allow to utilize a result of Bogoya, Böttcher und Grudsky in that process, to get the asymptotic lower bound for $\|\Delta\|$.

Steffen Roch

Beyond fractality

Fractality is a property of algebras of approximation sequences (A_n) which (among other things) implies good convergence properties of spectral quantities related with the A_n (e.g., the convergence of the norms $\|A_n\|$ and of the pseudospectra $\sigma_\varepsilon(A_n)$). Another feature is that they often allow a description in terms of strong limit homomorphisms. In this talk, I consider algebras which are not fractal. Typical examples of non-fractal algebras are the algebra of the *full* finite section discretization of block Toeplitz operators and algebras resulting from the discretization of the algebras $C(X, \mathcal{A})$, the $\mathcal{A}$-valued continuous functions on a Hausdorff compact X. Special attention is paid to the set of all fractal restrictions of the algebra and to the description of these algebras by partial strong limits.

Haripada Sau

Toeplitz operators on the symmetrized bidisc

The symmetrized bidisc has grabbed a great deal of attention of late because of its rich structure both in the context of function theory and in the context of operator theory. We introduce Toeplitz operators on this domain. We show that there is a natural Hilbert space $H^2(\mathbb{G})$ — the Hardy space of the symmetrized bidisc. We describe three isomorphic copies of this space. The L^∞ functions on $b\Gamma$, the distinguished boundary of the symmetrized bidisc, induce Toeplitz operators on this space. We find a Brown–Halmos type characterization of Toeplitz operators, viz.,

T is a Toeplitz operator if and only if $T_s^* T T_p = T T_s$ and $T_p^* T T_p = T$.

We also study asymptotic Toeplitz operators on this domain. This requires us to find a characterization of compact operators on the Hardy space $H^2(\mathbb{G})$.

In the second part of the talk, we generalize the concept of Toeplitz operators by replacing the pair (T_s, T_p) in above criterion by a general

Γ-isometry (S, P) and find a characterization for them. This characterization has a flavour of commutant lifting theorems. We use this result to characterize dual Toeplitz operators. The talk is about a joint work with T. Bhattacharyya and B.K. Das.

Konrad Schmuedgen

Unbounded operators on Hilbert C^*-modules

Let A be a C^*-algebra. A *Hilbert C^*-module* E is a (right) A-module E equipped with an A-valued scalar product which is complete in the corresponding norm. An *operator* is an A-linear and $\mathbb{C}$-linear mapping t of a submodule $\mathcal{D}$ of E into another Hilbert C^*-module F. Operators on Hilbert C^*-modules play an important role in noncommutative geometry, K-theory and quantum group theory. This talk is about operator theory on Hilbert C^*-modules.
If $\mathcal{D}(t)^\perp = \{0\}$, then t has a well-defined adjoint operator t^*. In contrast to "ordinary" Hilbert space operators, self-adjointness is not enough for an interesting theory. In the talk we develop two classes of well-behaved operators. A *regular operator* is a closed densely defined operator such that $(I + t^*t)E$ is dense in E. For instance, Lie algebra generators are regular operators for the C^*-algebra of the Lie group. For the weaker notion of a *graph regular operator* it is required that $(I + t^*t)E$ is dense in E and $(I + tt^*)F$ is dense in F, but t is not necessarily densely defined. Various characterizations (in terms of resolvents, bounded transforms) of these operators are given and a number of examples (continuous functions, Heisenberg group, Toeplitz operators) are discussed.

Carola-Bibiane Schönlieb

Differential operators in image processing: from theory to application

One of the most successful approaches to solve inverse problems in imaging is to cast the problem as a variational model. The key to the success of the variational approach is to define the variational energy such that its minimiser reflects the structural properties of the imaging problem in terms of regularisation and data consistency. Variational models constitute mathematically rigorous inversion models with stability and approximation guarantees as well as a control on qualitative and physical properties of the solution.
In this talk I will focus on the analysis of qualitative properties of solutions to variational models by a closer inspection of the regularisation

term in the energy. Typical regularisers are norms or semi-norms of distributional derivatives of the image. We will discuss generalized eigenfunctions of typically nonlinear operators arising as subgradients of these regularisers and their appearance in associated inverse scale space flows. Eventually, we will show how spectral decomposition of these regularisers can be used to manipulate images to enhance or fuse different scales in images, and how such operators can be learned for sparsifying certain structures in images. This talk includes joint work with Martin Benning, Martin Burger, Daniel Cremers, Guy Gilboa, Joana Grah, Marie Foged Schmidt, Michael Moeller and Raz Nossek.

Felix Schwenninger

On certain optimal constants in semigroup theory

This talk will discuss and review certain questions on the optimal constant-dependence in estimates for operator-semigroups. In particular, this includes the relation between bounds available for sectorial operators and the bound of the corresponding semigroup.

Christian Seifert

On perturbations of positive semigroups

We consider perturbations of positive semigroups acting on (possibly different) L_p-spaces and characterize a Duhamel type estimate in terms of the generators of the semigroups. We apply this result to obtain heat kernel estimates for semigroups induced by forms, showing that the respective (known) estimates for Dirichlet forms are just a consequence of positivity. The talk is based on joint works with Hendrik Vogt, Marcus Waurick and Daniel Wingert.

Jörg Seiler

Bounded H_∞-calculus for closed extensions of cone differential operators

Given a manifold with an isolated singular point, a cone differential operator A is a differential operator that has a specific structure near the singularity. A blow-up procedure leads to the consideration of differential operators defined in the interior of a smooth manifold with boundary that in a collar-neighborhood of the boundary can be written in the form

$$A = t^{-\mu} \sum_{j=0}^{\mu} a_j(t, D_x)(-t\partial_t)^j, \qquad \mu = \operatorname{ord} A,$$

where $a_j(t, D_x)$ represents a differential operator of order $\mu - j$ on the boundary, depending smoothly on $t \in [0, \epsilon)$, the variable orthogonal to the boundary. We shall explain how the closed extensions of elliptic cone differential operators in natural weighted Sobolev spaces look like and describe conditions which assure the existence of a bounded H_∞-calculus for such extensions. This is a joint work with Elmar Schrohe.

Peter Šemrl

Order isomorphisms of operator intervals

A general theory of order isomorphisms of operator intervals will be presented. It unifies and extends several known results, among others Ludwig's famous description of ortho-order automorphisms of effect algebras and Molnár's characterization of bijective order preserving maps on bounded observables. The optimality of the presented theorems can be demonstrated by using Löwner's theory of operator monotone functions.

Ali Shukur

The estimates of powers of operators generated by irrational rotation

In this talk we consider the weighted shift operators generated by irrational rotations. We give an estimate of the norms of the powers of those operators which essentially depends on the arithmetical properties of the irrational number h in the angle $2\pi h$ of rotation on the unit circle. The proof is based on some facts of number theory. The result is joint work with Anatolij Antonevich.

Uaday Singh

Trigonometric approximation of functions in the generalized Lipschitz class with Muckenhoupt weights

Ali Guven (2009, 2012) defined a weighted Lipschitz class $Lip\,(\alpha, p, w)$, where $w(x)$ is a Muckenhoupt weight [Benjamin Muckenhoupt, 1972], of 2π-periodic functions and determined their degree of approximation through matrix means of trigonometric Fourier series associated with them. We generalize the definition of $Lip\,(\alpha, p, w)$ to the weighted Lipschitz class $Lip(\xi(t), p, w)$, where $\xi(t)$ is a positive non-decreasing function and determine the degree of approximation of $f \in Lip(\xi(t), p, w)$ through matrix means of its trigonometric Fourier series. Our results generalize the theorems of Guven (2009, 2012).

Bernd Silbermann

On the spectrum of the Hilbert matrix operator

For each $\lambda \in \mathbb{C}\, \lambda \neq 0, -1, -2, \ldots$ the (generalized) Hilbert matrix $\mathcal{H}_\lambda$ is given by

$$\mathcal{H}_\lambda := \left(\frac{1}{n+m+\lambda} \right)_{n,m \geq 0} .$$

If $\lambda = 1$ then $\mathcal{H}_1$ is the classical Hilbert matrix introduced by D. Hilbert about 125 years ago. These matrices have been the subject of numerous investigation. The talk mainly concerns the description of spectral properties of Hankel operators generated by these matrices on the Hardy spaces H^p and $l^p\,(1 < p < \infty)$. Special attention will be paid to the description of the essential and point spectra of these operators.

Frank-Olme Speck

On the symmetrization of general Wiener–Hopf operators

This talk focuses on general Wiener–Hopf operators given as $W = P_2 A|_{P_1 X}$ where X, Y are Banach spaces, $P_1 \in \mathcal{L}(X)$, $P_2 \in \mathcal{L}(Y)$ are any projectors and $A \in \mathcal{L}(X, Y)$ is boundedly invertible. It presents conditions for W to be equivalently reducible to a Wiener–Hopf operator in a symmetric space setting where $X = Y$ and $P_1 = P_2$. The results and methods are related to the so-called Wiener–Hopf factorization through an intermediate space and the construction of generalized inverses of W in terms of factorizations of A. The talk is based upon joint work with Albrecht Böttcher.

Ilya Spitkovsky

A tale of two projections — A never ending story?

A canonical representation of a pair of orthogonal projections was obtained by Halmos in his “Two subspace” paper as early as 1969. I will discuss several results, both relatively old and rather recent, which either were obtained by using this representation or can be sharpened with its help.

Reinhard Stahn

Fine scales of decay of operator semigroups and an application to decay of waves in a viscoelastic boundary damping model

Let T be a bounded C_0-semigroup on a Hilbert space with generator $-A$. We assume (for simplicity) that the whole imaginary axis is in the resolvent set of A and let $M : [0, \infty) \to (0, \infty)$ be a non-decreasing function with $cM(s) \leq \sup_{-s<\sigma<s} \left\|(i\sigma + A)^{-1}\right\| \leq CM(s)$. It is well-known (Batty–Duyckaerts, 2008) that orbits of classical initial data cannot decay strictly faster than $1/M^{-1}(ct)$. Therefore we call M *admissible* if

$$\left\|T(t)A^{-1}\right\| \leq C/M^{-1}(ct) \quad (t \geq 0)$$

for all bounded C_0-semigroups whose resolvent on the imaginary axis is bounded from above and below by a multiple of M. It is well-known that $M(s) = 1+s^\alpha$ (with $\alpha > 0$) is admissible (Borichev–Tomilov, 2010) and that, more generally, certain so-called regularly varying functions are admissible too (Batty–Chill–Tomilov, 2016).
In the first part of the talk we give a characterization of all M which are admissible, that is, we give a sufficient condition on M for the inequality to hold which is also necessary for a large class of C_0-semigroups including normal semigroups. Our work is based on the mentioned pioneering work of Batty–Chill–Tomilov on fine scales of decay. We give a shorter proof and extend some of their results. In particular we prove that all (non-decreasing) regularly varying functions of positive index are admissible. In the second part of the talk we give an application to a model for the evolution of sound waves. Under mild restrictions on the domain and the acoustic impedance of the boundary we can prove an upper bound on the resolvent on the imaginary axis, given by one over the real part of the acoustic impedance of the boundary. In certain special cases (in 1D and on a disk) we can show that the upper bound is sharp (i.e., is also a lower bound up to a constant). We note that the real part of the acoustic impedance can be (almost) any regularly varying function. Therefore the results from part one of the talk provide a strong tool to prove optimal decay rates. This is joint work with Jan Rozendaal and David Seifert.

Kotaro Tanahashi

Furuta's inequality and p-$wA(s,t)$ operators

Furuta's inequality is a good extension of the Löwner–Heinz inequality, and by using this inequality several new classes of operators were considered by many authors. The first class is the p-hyponormal operators by Aluthge. We define p-$wA(s,t)$ operators and show that a p-$wA(s,t)$

operator T with $0 < p \leq 1$ and $0 < s, t, s + t \leq 1$ has good properties, e.g., T is normaloid, isoloid and subscalar. This is joint work with M. Cho, T. Prasad, M. Rashid, and A. Uchiyama.

Jari Taskinen

Recent developments on boundedness of Toeplitz operators in Bergman spaces

We review some recent results on the boundedness of Toeplitz operators in Bergman spaces A^p on the unit disc. In the case $1 < p < \infty$ we present improvements of earlier results with J. Virtanen, and in the case $p = \infty$ we report on recent works with J. Bonet concerning so-called solid hulls of analytic function spaces, which may be applied to study the basic properties of Toeplitz operators.

Sanne ter Horst

The coupling method and operator relations

The coupling method was introduces in the 1980s as a tool to analyse various integral operators and solve integral equations. One of the main techniques involves showing that the integral operator is matricially coupled (MC) to an operator on a finite dimensional space, from which one deduces that the two operators also satisfy other operator relations such as equivalence after extension (EAE) and Schur coupling (SC). This in turn enables one to determine the Fredholm properties of the integral operator and describe its kernel and co-kernel. In the 1990s the question was raised whether these three operator relations may coincide for general Banach space operators and it was shown that MC and EAE indeed coincide and that these operator relations are implied by SC. The remaining implication, whether EAE = MC implies SC, remained open. Recently, the question was answered affirmatively for various classes of Banach space operators. In particular, it was shown that EAE = MC implies SC for operators acting on Hilbert spaces. In the case of Banach space operators, the underlying geometry of the Banach spaces plays an essential role, in particular for compact operators, for which the question can now also be answered affirmatively. In this talk we discuss some of these recent developments. It is joint work with M. Messerschmidt, A.C.M. Ran, M. Roelands and M. Wortel

Sanne ter Horst

Bounded and unbounded solutions to the discrete-time KYP inequality

The discrete-time Kalman–Yakubovich–Popov (KYP) inequality provides a LMI characterization for when a discrete-time input/state/output linear system satisfies a dissipation inequality, equivalently, when it's transfer function has supremum norm bounded by one. Although initial results go back to work of Yakubovich, it has been since the last decade or so that a good understanding was established of the role of the KYP-inequality for input/state/output linear systems with an infinite dimensional state space. Sometimes unbounded solutions appear, while in other instances the solutions are bounded operators, depending on strictness being assumed in the norm constraint, or not, as well as the minimality and stability conditions that are assumed. In this talk we attempt to provide a unified approach to the diverse results in the literature. The talk is based on joint work with J.A. Ball and G.J. Goenewald.

Nicola Thorn

Properties of multiplicative Toeplitz operators

We shall be discussing a class of operators known as multiplicative Toeplitz operators; for $f : \mathbb{Q}_+ \to \mathbb{C}$, $\mathcal{M}_f$ is the mapping from the sequence space $\mathcal{A} \to \mathcal{A}$, which maps $x = (x_n) \mapsto y = (y_n)$ defined by

$$y_n = \sum_{k=1}^{\infty} f\left(\frac{n}{k}\right) x_k.$$

There has been little study of these operators, at least in comparison to the classical Toeplitz operators. The many open questions and interesting connections to number theory and the Riemann zeta function have fueled recent research.
The aim of this talk is to give an overview of these operators, why we want to study them, some known results and a few open questions. In particular, we give a partial criteria for when these operators are bounded between ℓ^p to ℓ^q and discuss potential improvement upon this criteria. The interplay with number theory is again prevalent, specifically with the set of multiplicative sequences in ℓ^p, denoted as M_p. We give some improvements of the criteria on these subsets, and discuss whether or not we can generalise these results to ℓ^p. Furthermore, we will discuss the spectral properties of $\mathcal{M}_f$. Specifically considering the

equivalent operator $\mathcal{M}_F : B^2_{\mathbb{N}} \to B^2_{\mathbb{N}}$, defined by

$$X \mapsto P(XF)$$

where $F \in B^2_{\mathbb{Q}}$, $B^2_{\mathbb{N}}$ and $B^2_{\mathbb{Q}}$ are Besicovitch spaces with natural and rational exponents respectively and P is the projection between them. The spectrum of $\mathcal{M}_F$ for a certain class of symbols is described and we also show how Coburn's lemma fails in this multiplicative setting.

Tamás Titkos

Lebesgue decomposition and order structure

Our main purpose is to investigate some natural problems regarding the order structure of representable functionals on $*$-algebras. We describe the extreme points of order intervals, and give a nontrivial sufficient condition to decide whether or not the infimum of two representable functionals exists. To this aim we offer a suitable approach to the Lebesgue decomposition theory, which is in complete analogy with the one developed by Ando in the context of bounded positive operators. This tight analogy allows us to invoke Ando's results to characterize uniqueness of the decomposition and to solve the infimum problem over certain operator algebras. The talk is based on joint work with Zs. Tarcsay.

Yuri Tomilov

On the approximation theory of C_0-semigroups

We develop further a functional calculus approach to the theory of approximation of operator semigroups that we initiated with A. Gomilko in 2014. It appears that a number of well-known approximation formulas can be written in the framework of bounded completely monotone functions of semigroup generators. This way our approach allows one to unify and extend the existing approximation formulas, to find several new ones, and to equip them with optimal convergence rates. The results become especially attractive for (sectorially bounded) holomorphic semigroups. The techniques depend on various estimates for completely monotone functions. This is joint work with A. Gomilko and S. Kosowicz.

Yuri Tomilov

On lower bounds for C_0-semigroups

We will examine lower bounds for the norms of orbits of C_0-semigroups under various spectral assumptions. The following result is typical.
Let $(T(t))_{t\geq 0}$ be a C_0-semigroup on a Banach space X, with generator A. Let f be a positive function on $[0,\infty)$ satisfying $\lim_{t\to\infty} f(t) = 0$. If the resolvent of A is bounded in $\{\lambda \in \mathbb{C} : \operatorname{Re}\lambda \geq \epsilon\}$ for each $\epsilon > 0$, then there exist $x \in X$, $x^* \in X^*$ and a set $B \subset [0,\infty)$ of the upper density one such that $|\langle T(t)x, x^*\rangle| \geq f(t)$ for every $t \in B$.
An interplay of such results with harmonic analysis will also be discussed, and some related open problems will be mentioned. This is joint work with V. Müller.

Christiane Tretter

Challenges in non-selfadjoint spectral problems

In this talk different techniques to address the challenges arising in spectral problems for non-selfadjoint operators will be presented. The methods and results will be illustrated by several applications from mathematical physics.

Sascha Trostorff

A Note on differential-algebraic equations in infinite dimensions

We consider a class of (ordinary) differential-algebraic equations on an infinite dimensional state space. We discuss two different initial value problems and the asymptotic behavior of their corresponding solutions.

Carsten Trunk

Rank one perturbations of linear relations with applications to DAE's

We elaborate on the deviation of the Jordan structures of two linear relations that are finite-dimensional perturbations of each other. In a way, we compare the number of Jordan blocks of size at least n corresponding to some eigenvalue to each other. In the operator case, it was recently proved that the maximally possible difference of these numbers is independent of n and coincides with the defect between the operators. One of our main results shows that this number has to be multiplied by $n+1$ for linear relations. Each differential-algebraic equation (DAE) of the form

$$E\dot{x} = Ax$$

with (in general not invertible matrices or operators A and E) can be written in a natural way as a linear relation (via $E^{-1}A$). Using the above result, we obtain a description of the Jordan chains of the operator pencil $\lambda E - A$ associated to the above equation. This is new even in the case of matrices. The above results are still valid even for the case of singular pencils. The talk is based on joint work with L. Leben, H. Gernandt, H. Winkler, F. Martínez Pería and F. Philipp.

Batzorig Undrakh

Rational dilation problems on some distinguished varieties

If a set Ω is a spectral set for an operator T, is it necessarily a complete spectral set? That is, if the spectrum of T is contained in Ω, and von Neumann's inequality holds for T and rational functions with poles off of $\overline{\Omega}$, does it still hold for all such matrix valued rational functions? Equivalently, if Ω is a spectral set for T, does T have a dilation to a normal operator with spectrum in the boundary of Ω? This is true if Ω is the disk or the annulus, but has been shown to fail in many other cases.
There are also multivariable versions of this problem. For example, it is known that rational dilation holds for the bidisk, though it has been recently shown to fail for a distinguished variety in the bidisk called the Neil parabola. The Neil parabola is naturally associated to a constrained subalgebra of the disk algebra, as are many other distinguished varieties. We show that with a handful of exceptions, it is generically the case that rational dilation fails on distinguished varieties associated to constrained subalgebras of the disk algebra. This is joint work with Michael A. Dritschel.

Frederik van Schagen

The discrete twofold Ellis–Gohberg inverse problem

The talk deals with a twofold inverse problem for orthogonal matrix functions in the Wiener class. The scalar-valued version of this problem was solved by Ellis and Gohberg in 1992. Under reasonable conditions, the problem is reduced to an invertibility condition on two operators that are defined using the Hankel and Toeplitz operators associated to the Wiener class functions that comprise the data set of the inverse problem. It is also shown that in this case the solution is unique. The talk is based on joint work with S. ter Horst and M.A. Kaashoek.

Dániel Virosztek

Connections between centrality and local monotonicity of certain functions on C^*-algebras

Connections between the commutativity of a C^*-algebra $\mathcal{A}$ and the monotonicity of some functions defined on some subsets of $\mathcal{A}$ have been investigated widely. The first result related to this topic is due to *Ogasawara* who showed in 1955 that a C^*-algebra $\mathcal{A}$ is commutative if and only if the square function is monotone on the positive cone of $\mathcal{A}$. It was observed later by *Pedersen* that the above statement remains true for any power function with exponent greater than one. *Wu* proved a similar result for the exponential function in 2001. *Ji* and *Tomiyama* showed in 2003 that for any function f which is monotone but not matrix monotone of order 2, a C^*-algebra $\mathcal{A}$ is commutative if and only if f is monotone on the positive cone of $\mathcal{A}$.
Very recently, *Molnár* proved a local theorem, namely, that a self-adjoint element a of a C^*-algebra $\mathcal{A}$ is central if and only if $a \leq b$ implies $\exp a \leq \exp b$.
Motivated by the work of Molnár, we show the following. If $I = (\gamma, \infty)$ is a real interval and f is a continuously differentiable function on I such that the derivative of f is positive, strictly monotone increasing and logarithmically concave, then a self-adjoint element a of a C^*-algebra $\mathcal{A}$ with spectrum in I is central if and only if $a \leq b$ implies $f(a) \leq f(b)$, that is, f is locally monotone at the point a. This result easily implies the results of Ogasawara, Pedersen, Wu, and Molnár.

Jani Virtanen

Szegő, Fisher–Hartwig and transition asymptotics of Toeplitz determinants

This talk is a selective survey of the developments surrounding Toeplitz determinants

$$D_n(f) = \det T_n(f) = \det(f_{j-k})_{j,k\geq 0}^{n-1}$$

with emphasis on two types of symbols f and transitions between them in the context of various applications in mathematical physics and random matrix theory.
We start with Szegő type symbols (sufficiently smooth functions of no winding) and recall the strong Szegő limit theorem, which is important in the theory of two-dimensional Ising model. By contrast, Fisher–

Hartwig symbols may possess zeros, (integrable) singularities, discontinuities and nonzero winding numbers, and have further applications in statistical mechanics. By transition asymptotics we mean asymptotic expansions of Toeplitz determinants $D_n(f_t)$ as $n \to \infty$ which are uniformly valid for $0 \leq t \leq t_0$, where t_0 is sufficiently small. Of particular interest are the symbols f_t for which the number of Fisher–Hartwig singularities changes as $t \to 0$. I discuss the recent results on transition asymptotics, their applications (such as XY spin chains) and the use of Riemann–Hilbert analysis to treat them.

Toni Volkmer

Sparse high-dimensional FFT using rank-1 lattices

We consider the approximate reconstruction of a high-dimensional (e.g. $d = 10$) function from samples using a trigonometric polynomial $p_I \colon \mathbb{T}^d \simeq [0,1)^d \to \mathbb{C}$,

$$p_I(\boldsymbol{x}) := \sum_{\boldsymbol{k} \in I} \hat{p}_{\boldsymbol{k}} \, \mathrm{e}^{2\pi \mathrm{i} \boldsymbol{k} \cdot \boldsymbol{x}}, \quad \hat{p}_{\boldsymbol{k}} \in \mathbb{C},$$

where $I \subset \mathbb{Z}^d$ is a suitable and unknown frequency index set. For this setting, we present a method which adaptively constructs the index set I of frequencies belonging to the approximately largest Fourier coefficients in a dimension incremental way. This method computes projected Fourier coefficients from samples along suitable rank-1 lattices $\Lambda(\boldsymbol{z}, M) := \{\frac{j}{M}\boldsymbol{z} \mod \boldsymbol{1} \colon j = 0, \ldots, M-1\} \subset \mathbb{T}^t$, $\boldsymbol{z} \in \mathbb{Z}^t$, $t \in \{1, \ldots, d\}$, and then determines the frequency locations. For the computation, only one-dimensional fast Fourier transforms (FFTs) and simple index transforms are used. We discuss an extension of this method which uses so-called reconstructing multiple rank-1 lattices such that the number of required samples and arithmetic operations is distinctly reduced. We demonstrate the high performance of the proposed method in several numerical examples.
This is joint work with Lutz Kämmerer and Daniel Potts.

Julia Volmer

Improving Monte Carlo integration by symmetrization

The error scaling for Markov Chain-Monte Carlo (MCMC) techniques with N samples behaves like $1/\sqrt{N}$. This scaling makes it often very time intensive to reduce the error of calculated observables, in particular for applications in 4-dimensional lattice quantum chromodynamics as our theory of the interaction between quarks and gluons. Even more, for certain cases, where the infamous sign problem appears, MCMC methods fail to provide results with a reliable error estimate. It is therefore highly desirable to have alternative methods at hand which show an improved error scaling and have the potential to overcome the sign problem. One candidate for such an alternative integration technique we used is based on a new class of polynomially exact integration rules on $U(N)$ and $SU(N)$ which are derived from polynomially exact rules on spheres. We applied these rules successfully to a non-trivial, zero-dimensional model with a sign problem and obtained arbitrary precision results. In the talk we test a possible way to apply the integration rules for spheres for the case of a one-dimensional $U(1)$ model, the topological rotor, which already leads to a problem of very high dimensionality.

Marcus Waurick

Fibre homogenisation

We present the method of so-called fibre homogenisation. The presented (abstract) method is then used to derive order-sharp operator-norm estimates for the asymptotic analysis of divergence form problems in $\mathbb{R}^d$ with rapidly oscillating coefficients. The method particularly applies to Maxwell's equations. This is joint work with Shane Cooper.

Elias Wegert

Blaschke products, equilibria of electric charges, Stieltjes polynomials, and moment problems

For any prescribed set of $n-1$ points in the complex unit disc there is an (essentially unique) Blaschke product of degree n with these points as critical points. Though this result has been proven by several authors, it has a number of reformulations that still allow new insights and a simple and natural proof. In particular we show that the problem is equivalent to finding certain Stieltjes and Van Vleck polynomials, which in turn permits a physical interpretation as an equilibrium condition for movable unit charges in the presence of an electrical field generated by fixed charges. A second reformulation involves a moment problem for the canonical representation of power moments on the real axis or, equivalently, the Vandermonde factorization of a Hankel matrix. These equivalences are not only of theoretical interest, but also open up new perspectives for the design of algorithms. The talk is based on joint work with Gunter Semmler.

Jens Wintermayr

Positivity on extrapolation spaces for semigroups

We state a perturbation result for a type of Desch–Schappacher perturbation on AM-spaces, which is closely related to a famous Miyadera–Voigt type perturbation on AL-spaces from Desch and developed by Voigt. Then we will transfer these results to admissibility for observation and control systems (resp. operators) and have a closer look on the so-called degree of unboundedness using interpolation theory. Finally, we will apply these results to Weiss–Staffan perturbations. The talk is based on joint work with B. Jacob and A. Bátkai.

Dmitry Yakubovich

Pseudospectra and norms of functions of Hilbert space operators: examples and counterexamples

Given a Hilbert space operator T, the level sets of function $\Psi_T(z) = \|(T-z)^{-1}\|^{-1}$ determine the so-called pseudospectra of T. We prove that for any operator T, there is a sequence $\{T_n\}$ of finite matrices such that the corresponding functions $\Psi_{T_n}(z)$ tend to $\Psi_T(z)$ uniformly on $\mathbb{C}$. This proof is based on some elementary properties of Ψ_T and an application of quasitriangular operators. We show how to use infinite-dimensional operator models in order to produce examples and counterexamples in the set of finite matrices of large order. We prove that, in a certain sense, the pseudospectrum of a nilpotent matrix can be anything one can imagine. These are our joint results with Avijit Pal. In the last part of the talk, we briefly discuss the relationship between pseudospectra and tests for K-spectrality, which were given in a joint paper of the speaker with M. Dritschel and D. Estévez. Some questions will be posed.