Past talks at the Functional Analysis Seminar (Jagiellonian University)

3 XI 2026

Paweł Pietrzycki

A solution to Crouzeix's conjecture

Abstract. Formulated in 2004, Crouzeix's conjecture states that for every matrix $A \in M_n(\mathbb{C})$ and every polynomial p with complex coefficients,

$$\|p(A)\| \leqslant 2 \max_{z \in W(A)} |p(z)|,$$

where $W(A)$ denotes the numerical range of A. In July 2026, a solution to the conjecture was published by Shanmu Jin, a neurosurgery resident and researcher at Peking Union Medical College Hospital who studies mathematics as an autodidact. Jin adapted to this problem a prompt previously used by OpenAI in work on the Cycle Double Cover Conjecture. He then ran the GPT-5.6 Sol model, which, during approximately sixteen hours of autonomous work and without further intervention from Jin, generated the key argument of the proof. A few days later, Michael Hartz from Saarland University reduced the 24-page preprint, written in an "AI slop" style, to just two pages. Subsequently, a preprint by Emiel Lorist and Felix Schwenninger appeared, also providing a solution to Crouzeix's conjecture; the authors likewise disclosed using AI to explore proof strategies. In this talk, I will present Jin's proof in Hartz's simplified formulation and then discuss the equivalence between its key arguments and those appearing in the proof of Lorist and Schwenninger.

[1] S. Jin, The Numerical Range Is a 2-Spectral Set, Preprints.org, manuscript 202607.1919, 2026. Preprints

[2] M. Hartz, Notes on the Solution of Crouzeix's Conjecture, unpublished notes, July 31, 2026 (not intended for publication).

[3] E. Lorist and F. Schwenninger, A Solution to Crouzeix's Conjecture, arXiv:2608.03841, 2026. arXiv

[4] A. Townsend and A. Greenbaum, The Neurosurgery Resident Who Proved Crouzeix's Conjecture, SIAM News, August 11, 2026.

27 X 2026

Michał Wojciechowski (IM PAN Warszawa)

Absence of the Dunford–Pettis property for $W^{1,1}$ ***and*** BV ***spaces.***

13 X 2026

Anna Wysoczańska-Kula (Wrocław University)

What does graph algebras have to do with creators?

Abstract. Since the introduction of bosonic and fermionic Fock spaces by V.A. Fock in 1932, many different Fock-type constructions emerged. They always come naturally equipped with creation and annihilation operators, and, in some cases, the C*-algebras generated by these families reveal surprising connections to graph algebras. For instance, in 1980, D. Evans observed that the algebras of creators on the free Fock spaces are tightly related to the Cuntz algebras. More recently, Griseta and Wysoczański showed that a finite number of creators on monotone Fock space generate a quotient of a certain graph algebra. In parallel, Crismale, Vecchio, Rossi, and Wysoczański showed that the algebras of infinitely many creators on the monotone Fock spaces is *-isomorphic to Exel-Laca algebras or their quotients. During the talk, I will discuss an extension of these results to the algebra of creators on the boolean-antimonotone Fock space.
This is joint work with Jack Spielberg and Janusz Wysoczański.

6 X 2026

Piotr M. Hajac (IMPAN - Warsaw - Poland)

The maximal dimensions of path and graph algebras

Abstract. Graph theory is one of the most accessible parts of combinatorics, and one often uses graphs to visualize and study abstract objects in a plethora of mathematical contexts ranging from algebra and functional analysis to K-theory. Better still, the ubiquity of graphs goes beyond mathematics, e.g., Dijkstra's graph-search algorithm is used in Google Maps. This talk will commence with an abridged hitchhiker's guide to the galaxy of applications of directed graphs. Then we will focus on solving a concrete optimization problem concerning the maximal dimension of both the path algebra and the graph algebra of a connected acyclic directed graph with N edges. The former is a broadly studied universal object, like the tensor algebra, and the latter is simply a matrix algebra. Finally, we will pose some reverse optimization problems: Given a dimension, what is the minimal sufficient number of edges? In particular, we will discuss the optimization-gap problem for matrix algebras, and speculate on its relation with the Cunningham chains of the first kind of prime numbers. (Based on joint work with Ł. Kaczmarczyk, M. Lowiel, and E. A. Pacheco.)

9 VI 2026

Piotr M. Hajac (IMPAN - Warsaw - Poland)

The art of moves on graphs and extended covariant functoriality of graph algebras

Abstract. Combinatorics of graphs is a very powerful tool to unravel various properties of graph algebras. In particular, isomorphisms between graph algebras are often implemented by moves between their graphs. In this talk, I will explain how to make these combinatorial methods functorial. In particular, I will show that collapsing an outsplitted graph to the original graph, or transforming a graph to a shifted graph, can be implemented by admissible graph or path homomorphisms, respectively. To include the inverses of such isomorphisms, I will introduce a new category of graphs where morphisms are given as regular homomorphisms of graph inverse semigroups. This new category admits a covariant functor to the category of C^*-algebras and $*$-homomorphisms which extends the known covariant functor from the category of graphs and admissible path homomorphisms. I will demonstrate the new framework by applying it to various graphs that yield the minimal unitization of compact operators (the standard Podleś quantum sphere) and matrices over Cuntz algebras. (Based on joint work with G. G. de Castro, M. Lowiel, and E. Pacheco.)

26 V 2026

Paweł Pietrzycki

The SOT-closure of the set of 2-isometries

Abstract. A classical example of a set of operators that is sequentially SOT-closed but not SOT-closed with respect to nets is due to Halmos: $T \in B(H) : T^2 = 0$. The SOT-closure of this set is, in fact, the whole algebra $B(H)$. Jabloński, Jung and Stochel posed the following problem: is the set of 2-isometries on an infinite-dimensional Hilbert space strongly closed? A negative answer was given by M. Scherer. In fact, he proved that the SOT-closure of this class coincides with the set of all expansive operators. This talk is based on the preprint: M. Scherer, The SOT-closure of the set of 2-isometries, arXiv:2509.05083.

19 V 2026

Sameer Chavan

Subnormality of the quotients of rotation-invariant Hilbert modules

Abstract: In this talk, we investigate rotation-invariant Hilbert modules H over the polynomial ring and their quotients, with primary emphasis on the

classification of subnormal quotient modules of the form H/[p], where p is a homogeneous polynomial in d complex variables. The motivation for this classification arises from the subnormality of the module tensor product of subnormal Hilbert modules, a problem first considered by N. Salinas. We present complete solutions to this problem for the Hardy and Drury-Arveson Hilbert modules in two variables.

12 V 2026

Nitin Tomar

Multivariable dilation theory for q-commuting contractions and the quantum annulus (cont.)

Abstract. We discuss recent results in multivariable dilation theory. For families of q-commuting contractions with $\|q\| = 1$, the existence of a regular q-unitary dilation is proved to be equivalent to Brehmer's positivity condition and to the existence of a regular Q-unitary dilation, extending the classical dilation theorem for commuting contractions. Applications include regular q-unitary dilations for q-commuting isometries, doubly q-commuting contractions and certain countable families together with an analogue of von Neumann's inequality. The talk also discusses dilation theory for operators related to the quantum annulus and an extension of the McCullough-Pascoe dilation theorem to doubly commuting tuples.

28 IV, 5 V 2026

Damian Kołaczek

Numerical ranges of real linear operators in Hilbert and Banach spaces

Abstract. Here we discuss the concept of numerical range for real linear operators in both Hilbert and Banach space cases and its relation to spectra of such operators. We compare various similarities and differences between numerical radii and numerical ranges in complex linear and real linear settings. Our main result is showing that the numerical range of real linear operator on at least two-dimensional complex Hilbert space is always a convex set, which generalize classic Toeplitz-Haussdorff theorem. The talk is based on recent joint work with Vladimir Müller (Institute of Mathematics, Czech Academy of Sciences):
D. Kolaczek and V. Müller, Real linear operators and numerical ranges, preprint: https://arxiv.org/abs/2508.04347

21 IV 2026

Nitin Tomar

Multivariable dilation theory for q-commuting contractions and the quantum annulus

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24,31 III 2026

Marek Skrzypczyk

Resistance Distance

The resistance distance between two vertices of a simple connected graph is defined as the effective resistance between them when each edge is replaced by a unit resistor (1 ohm). In this talk, I will present the properties of resistance distance and resistance matrices.

References:

[1] R.Bapat. I.Gutman, and W.Xiao. A Simple Method for Computing Resistance Distance. Z. Naturforsch (2003)

[2] R.Bapat. Graphs and Matrices. Springer London (2010)

[3] C.Bu, L.Sun, W.Wang, and J.Zhou. Some results on resistance distance and resistance matrices. Linear and Multilinear Algebra (2015)

[4] I.Gutman and W.Xiao. Relations between resistance distance and Laplacian matrices and their applications. MATCH Communications in Mathematical and in Computer Chemistry (2004)

[5] D.Klein and M.Randić. Resistance Distance. Journal of Mathematical Chemistry (1993)

17 III 2026

Jarosław Duda

Hierarchical Correlation Reconstruction: moment problem-like approach for various applications

Abstract: I will talk about various applications of kind of polynomial copulas approach - after normalization of all variables to nearly uniform di-

stribution in [0,1], their joint density is modeled as a linear combination in basis of orthonormal polynomials, with coefficients being moments. It e.g. allows to model joint, conditional distributions, their evolution in time, test sample independence with kernel-like method (alternative to HSIC: Hilbert-Schmidt information criterion), or extend auto/cross-correlation analysis and Granger causality. Finally, it can be extended to biology-inspired neural networks: able to predict and propagate probability densities as vectors of moments, also able to change propagation direction.

3,10 III 2026

Patryk Pagacz

The Taylor spectrum of pairs of isometries

Abstract. We will describe Taylor spectrum of pairs of isometries given by diagrams. In particular, we will show that for each a, b the set $\{(z, w) : |z|^a \leqslant |w| \leqslant |z|^b \leqslant 1\}$ is a spectrum of some pair of isometries.

27 I 2026

Sebastian Foks

Absolute continuity of polynomially bounded tuples

The problem of absolute continuity for tuples of operators is studied. While prior work [4] established the equivalence between absolute continuity and Apostol's condition for tuples of commuting contractions in Hilbert space, satisfying von Neumann's inequality, a generalization to polynomially bounded tuples requires a different approach. Using properties of Henkin measures [2], it was shown in [3] that Apostol's condition is equivalent to absolute continuity in the general case of polynomially bounded tuples of commuting Banach space contractions. This condition is verified for a triple of contractions for which von Neumann's inequality fails. Additionally, possible extensions to the noncommutative case via noncommutative analogues of Henkin measures (introduced in [1]) are discussed.

REFERENCES

[1] R. Clouâtre, E. J. Timko, Non-commutative measure theory: Henkin and analytic functionals on C*-algebras, Math. Annalen 386 (2023), 415-453

[2] J. Eschmeier, Invariant subspaces for commuting contractions, J.Operator Theory 45 (2001), 413-443

[3] S. Foks, Equivalence of Absolute Continuity and Apostol's Condition, (2025), https://arxiv.org/abs/2503.14256

[4] M. Kosiek, A. Octavio, Representations of $H^\infty(D^N)$, and absolute conti-

nuity for N-tuples of contractions, Houston J. of Math. 23, (1997), 529-537

20 I 2026

Konstantinos Konstantos

Orthogonal factors of operators on the Bourgain-Rosenthal-Schechtman R^p_α spaces

Abstract. In 1981, Bourgain, Rosenthal and Schechtman constructed the R^p_α spaces, $\alpha < \omega_1$, [1], yielding uncountably many pairwise non-isomorphic complemented subspaces of L_p, $1 < p < \infty$. Each of them has a Schauder basis given by a 3-valued symmetric martingale difference sequence. In this work, we study factorizing properties of operators on the R^p_α spaces. We say that a bounded linear operator T on a Banach space X is a factor of the identity operator id on X if there exist bounded linear operators $L, R : X \to X$ such that $id = LTR$. Factors of the identity have played a crucial role in Banach space theory, for example, in the study of closed ideals in the Banach algebra $\mathcal{L}(X)$ and in the study of decompositions of classical Banach spaces. This motivates the following definition. We say that a Banach space X with its Schauder basis $(e_n)_{n\in\mathbb{N}}$ has the factorization property if every bounded linear operator $T : X \to X$ with large diagonal, i.e., such that $\inf_{n\in\mathbb{N}} |e^*_n(T(e_n))| \geqslant \delta > 0$, is a factor of the identity. In [3], we prove that, for $1 < p < \infty$, the space R^p_ω with its natural basis has the factorization property. Additionally, in [2], we show that, for $1 < p < \infty$, the limit spaces R^p_α with their standard bases have the factorization property. This is joint work with Pavlos Motakis.

REFERENCES

[1] J. Bourgain, H. P. Rosenthal, and G. Schechtman. An ordinal L^p-index for Banach spaces, with application to complemented subspaces of L^p, *Ann. of Math. (2)*, 114(2):193–228, 1981.

[2] K. Konstantos and P. Motakis. Coordinate systems and distributional embeddings in Bourgain-Rosenthal-Schechtman spaces: a framework for operator reduction, 2025.

[3] K. Konstantos and P. Motakis. Orthogonal factors of operators on the Rosenthal $X_{p,w}$ spaces and the Bourgain-Rosenthal-Schechtman R^p_ω space, *Journal of Functional Analysis*, 288(5):110802, 2025.

13 I 2026

Subhadip Pal (Indian Institute of Technology Bhubaneswar, Odisha-752050, India)

Multidimensional Bohr radii of Banach spaces

Abstract. In 1914, Harald Bohr obtained the following remarkable result: Let $f(z) = \sum_{n=0}^{\infty} a_n z^n$ be a holomorphic function on open unit disk with $|f(z)| < 1$. Then $\sum_{n=0}^{\infty} |a_n z^n| \leqslant 1$ when $|z| \leqslant 1/3$, and moreover the constant $1/3$, called the *Bohr radius* is best possible. Later, several authors have studied the Bohr's power series theorem in higher dimension and introduced the concept of multidimensional Bohr radius. In this talk, our aim is discuss a more general version of multidimensional Bohr radii for the holomorphic functions defined on unit ball of ℓ_q^n $(1 \leqslant q \leqslant \infty)$ spaces with values in arbitrary complex Banach spaces. Further, we discuss arithmetic Bohr radius, which is an interesting variant of multidimensional Bohr radius. More precisely, we study the multidimensional Bohr radii for bounded linear operators between complex Banach spaces. We present asymptotic estimates of multidimensional Bohr radii for both finite and infinite dimensional Banach spaces. Finally, we obtain the asymptotic behavior of Bohr radii of operators between sequence spaces.

16 XII 2025

Radomił Baran

Determinantal representations of multivariable stable polynomials (cont.)

Abstract. In this talk I will discuss determinantal representations of stable polynomials in several variables. I will focus in particular on the two-variable case, where I will present a constructive proof of the existence of a contractive determinantal representations for stable polynomials. This talk will be based on

1. A. Grinshpan, D.S. Kaliuzhnyi-Verbovetskyi, V. Vinnikov, H.J. Woerdeman, Stable and Real-Zero Polynomials in Two Variables, 2014.
2. A. Grinshpan, D.S. Kaliuzhnyi-Verbovetskyi, H.J. Woerdeman, Norm-Constrained Determinantal Representations of Multivariable Polynomials, 2013.

9 XII 2025

Grzegorz Łysik (UJK w Kielcach)

Charakteryzacja funkcji analitycznych w terminach wartości średnich

Abstrakt. Podam charakteryzację funkcji rzeczywisto-analitycznych w terminach wartości średnich po kulach euclidesowych. Uzyskana charakteryzacja motywuje wprowadzenie pojęcia funkcji analitycznej na przestrzeni metrycznej z miarą. Takie funkcje posiadają własność jednoznaczności tzn.

jeśli funkcja u znika na niepustym podzbiorze otwartym zbioru spójnego Ω, to u znika na Ω.

2 XII 2025

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2. A. Grinshpan, D.S. Kaliuzhnyi-Verbovetskyi, H.J. Woerdeman, Norm-Constrained Determinantal Representations of Multivariable Polynomials, 2013.

25 XI 2025

Athanasios Beslikas

Membership of Rational Inner Functions on mixed norm Dirichlet-type spaces on the bidisc (cont.)

Abstract: In the present talk we will discuss the problem of membership of RIFs on a new class of Dirichlet-type spaces with mixed norm. These new spaces are intimately connected with the classical Dirichlet spaces. The main inspiration of this work comes from the paper of A.Sola, J.E.Pascoe and K.Bickel "Derivatives of Rational Inner Functions: Geometry if the songularities and integrability on the boundary" (Proceedings of the London Mathematical Society, 2016). This work is a joint project with prof. Alan Sola from Stockholm University.

4,18 XI 2025

Tomasz Wawrzycki

Banach spaces with arbitrary finite Baire order

Abstract. For a Banach space X the space X_1^{**} of Baire class one functionals is defined as a weak* sequential closure of X in X^{**}. Inductively for a natural number n the space X_n^{**} of Baire class n functionals is defined as a weak* sequential closure of X_{n-1}^{**}. In this talk we will discuss the following result: for every Banach space with a basis X there is a separable

Banach space Y such that for every natural number n: $Y_n^{**} = Y \oplus X_{n-1}^{**}$ (where $X_0^{**} := X$). Using this result we will give an answer to the two open problems concerning Baire functionals posted by Argyros, Rosenthal and Godefroy. The talk is based on a joint work with Anna Pelczar-Barwacz and Zdenek Silber, https://arxiv.org/abs/2509.08906.

28 X 2025

Athanasios Beslikas

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21 X 2025

Michał Buchała

High order isometric liftings and dilations

Abstract. It is evident that the operator, which has m-isometric dilation, must be of polynomial growth of order m-1. In the talk we will show that the aforementioned necessary condition implies existence of (m+2)-isometric dilation. We will also prove that in case of convex operators, the necessary condtion is also sufficient: if powers are of linear growth, then the operator has 2-isometric dilation. The talk is based on: C. Badea, V. Müller, L. Suciu, High order isometric liftings and dilations, Studia Mathematica 258, 2021.

7, 14 X 2025

Michał Buchała

m-isometric weighted shifts with operator weights: an application to dilations of m-concave operators

Abstract. In the talk we are going to present the characterization of m-isometric weighted shifts with operator weights. The question when the weights of such a shift commute will be answered and the solution to the completion problem will be given. The second part of the presentation will

be devoted to applying the aforementioned characterization to dilation theory - we are going to show that every expansive m-concave operator has an m-isometric dilation; the obtained dilation will be proved to be minimal. We will also show that in such a setting minimal dilations may not be unitarily isomorphic. The talk is based on:
1. M. Buchała, m-isometric weighted shifts with operator weights, Bull. Malays. Math. Sci. Soc. 48 (2025).
2. M. Buchała, Every expansive m-concave operator has m-isometric dilation, https://arxiv.org/abs/2507.07252

10 VI 2025
Piotr M. Hajac (IM PAN)
Unital embeddings of C^*-algebras that one can see
Abstract: Cuntz algebras $O_n, n > 1$, are celebrated examples of a separable infinite simple C^*-algebra with a number of fascinating properties. Their K-theory allows an embedding of O_m in O_n whenever $n-1$ divides $m-1$. In 2009, Kawamura provided a simple and explicit formula for all such embeddings. It turns out that his formulas can be easily deduced by viewing Cuntz algebras as graph C^*-algebras, known as operator algebras that one can see. Better still, playing the game of graphs and using both the covariant and contravariant functoriality of assigning graph C^*-algebras to directed graphs, we can show how to embed Cuntz algebras into matrices over Cuntz algebras via straightforward polynomial formulas. Based on joint work with Yang Liu.

3 VI 2025
Łukasz Gorczyca
Analytical and combinatorial approaches to free probability theory
Abstract. In this talk, we will discuss non-commutative probability spaces, which consist of a unital algebra and a unital, linear functional. We will introduce the concept of free independence, which serves as the non-commutative analogue of classical independence, and explore the properties of freely independent non-commutative random variables. Our focus will then shift to the combinatorial aspects of freeness, developed by R. Speicher, as well as to analytical tools such as the Cauchy transform, introduced by D.V. Voiculescu, which are used to determine the distributions of sums of certain non-commutative random variables. (See also P. Biane, Free probability for probabilists)

27 V 2025

Marcel Scherer (University of Saarland, Saarbrücken, Germany)

Arveson's Hyperrigidity Conjecture: Partial Results and a New Counterexample

Abstract. The talk is about the hyperrigidity of operator systems. Despite being disproven by Bilich and Dor-On, Arveson's hyperrigidity conjecture remains open in the case of operator systems in commutative C*-algebras. We will present new results on the hyperrigidity of the operator system given by the continuous affine functions on compact convex subsets in $\mathbb{R}^2$. Additionally, we present a finite-dimensional operator system in a noncommutative C*-algebra that contradicts Arveson's conjecture.

13 V 2025

Sameer Chavan

Von Neumann's inequality in several variables

Abstract. We discuss an abstract version von Neumann's inequality and deduce von Neumann's inequality for a number of domains in $\mathbb{C}^n$, which include (fat) Hartogs triangle, egg domain etc. This is based on joint works with P. Pramanick, S. Jain and S. Bera.

6 V 2025

Rafał Czyż

Infinite-Dimensional Determinants and Pluripotential Theory

Abstract. We shall discuss the notion of the generalized determinants in infinite-dimensional Hilbert spaces. In applications, we will link generalized determinants to plurisubharmonic functions, providing insights into maximality and comparison principle.

15,29 IV 2025

Marek Skrzypczyk

Reflection length with two parameters in the asymptotic representation theory of type B/C and applications (based on the paper by Bożejko, Dołęga, Ejsmont, Gal under the same title, Journal of Functional Analysis, 284 (2023)).

1,8 IV 2025

Mateusz Nowak

Critical almost Mathieu operator: hidden singularity, gap continuity, and the Hausdorff dimension of the spectrum (based on the paper by S. Jitomirskaya, I. Krasovsky under the same title,

https://arxiv.org/pdf/1909.04429)

25 III 2025

Il Bong Jung

Conditionally positive definite unilateral weighted shifts and related topics

Abstract. The concepts of conditional positive definiteness have their origins in stochastic processes that are stationary or which have stationary increments. It seems that the conditional positive definiteness in operator theory has been begun to characterize the subnormality of operators by Jan Stochel in 1991. The definition of conditional positive definite (CPD) operator was introduced by Jablonski-Jung-Stochel in 2022. The class of CPD operators contains subnormal operators, 2-and 3-isometries, complete hypercontractions of order 2 and much more beyond them. Among the various CPD operators, the CPD (unilateral) weighted shift is of great interest as a particular operator model. In this talk, we discuss the description of the representing triplet of the CPD weighted shift, the main object canonically associated with CPD operators. Furthermore, the CPD matrix may generate a bridge between CPD and certain weak hyponormal operators. We investigate the structure of the bridge with constraints - so called "property CP(n)" - and some visible examples. In addition, we discuss the flatness problem of weighted shift with property CP(n) and solve the backward extension problem for conditionally positive definite weighted shifts.

Alicia Roca

Row completion of polynomial and rational matrices

18 III 2025

Hanna Blazhko

Introduction to reproducing kernel Banach spaces

The talk is based on:

H. Zhang, Y. Xu, and J. Zhang, Reproducing kernel Banach spaces for machine learning (2009),
J. R. Giles, Classes of semi-inner-product spaces (1967),
G. Lumer, Semi-inner-product spaces (1961),
Y. Xu, Sparse machine learning in Banach spaces (2023).

4,11 III 2025

Jakub Markowiak

Arveson's hyperrigidity conjecture is false

Abstract: The classical Korovkin's theorem states that if for a sequence of positive, linear operators $\Phi_n : C[0,1] \to C[0,1]$, $\|\Phi_n(f) - f\| \to 0$ holds for $f \in \{1, x, x^2\}$, then it also holds for all $f \in C[0,1]$. Here $\{1, x, x^2\}$ is an example of so-called Korovkin set. Arveson generalized this idea to non-commutative setting and introduced the notion of hyperrigidity. Arveson conjectured that if the non-commutative Choquet boundary of a separable operator system S is equal to the set of irreducible representations of $B = C^*(S)$, then S is hyperrigid in B. Last year, B. Bilich and A. Dor-On provided a counterexample for separable, type I C^*-algebra, and recently, M. Scherer constructed a finite-dimensional counterexample. During the talk, we will investigate those results. All required preliminaries, including basics on Choquet theory and non-commutative boundary theory, will be presented.
Talk is based on the following papers:
1. Bilich, Dor-On, Arveson's hyperrigidity conjecture is false (2024)
2. Scherer, A Finite Dimensional Counterexample for Arveson's Hyperrigidity Conjecture (2025)

21 I 2025
Radomił Baran
Rational dilation problems associated with constrained algebras (cont.)
The talk is based on:
M.A. Dritschel, B. Undrakh, Rational dilation problems associated with constrained algebras, Journal of Mathematical Analysis and Applications, 467 (2018), 95-131
M.A. Dritschel. M.T. Jury, S. McCullough, Dilations and constrained algebras, Operators and Matrices, 10 (2016), 829-861

14 I 2025
Jens de Vries (TU Tweente)
The double-layer potential for spectral constants revisited
Abstract: We thoroughly analyse the double-layer potential's role in approaches to spectral sets in the spirit of Delyon-Delyon, Crouzeix and Crouzeix-Palencia. While the potential is well-studied, we aim to clarify on several of its aspects in light of these references. In particular, we illustrate how the associated integral operators can be used to characterize the convexity of the domain and the inclusion of the numerical range in its closure. We furthermore give a direct proof of a result by Putinar-Sandberg - a generaliza-

tion of Berger-Stampfli's mapping theorem - circumventing dilation theory. Finally, we show for matrices that any smooth domain whose closure contains the numerical range admits a spectral constant only depending on the extremal function and vector. This constant is consistent with the so far best known absolute bound $1 + \sqrt{2}$.
This is joint work with Felix Schwenninger.

7 I 2025
Radomił Baran
Rational dilation problems associated with constrained algebras (cont.)
The talk is based on:
M.A. Dritschel, B. Undrakh, Rational dilation problems associated with constrained algebras, Journal of Mathematical Analysis and Applications, 467 (2018), 95-131
M.A. Dritschel. M.T. Jury, S. McCullough, Dilations and constrained algebras, Operators and Matrices, 10 (2016), 829-861

17 XII 2024
Satyajit Guin (Indian Institute of Technology, Kanpur)
A naive attempt to "Two Subfactors" - few curious and interesting results
Abstract. Jones proposed the study of "two subfactors" of a II_1 factor as a quantization of two closed subspaces in a Hilbert space. In the absence of a general theory for two subfactors, it is imperative that one starts investigating some particular important class of two subfactors to gain insights. Motivated by this goal, we have initiated a systematic study of a special class of two subfactors, namely a pair of "spin model subfactors". In this talk, we discuss a few curious and interesting results in this direction. These are part of a joint work with Keshab Chandra Bakshi.

10 XII 2024
Radomił Baran
Rational dilation problems associated with constrained algebras
The talk is based on:
M.A. Dritschel, B. Undrakh, Rational dilation problems associated with constrained algebras, Journal of Mathematical Analysis and Applications, 467 (2018), 95-131
M.A. Dritschel. M.T. Jury, S. McCullough, Dilations and constrained alge-

bras, Operators and Matrices, 10 (2016), 829-861

3 XII 2024

Athanasios Beslikas

Composition Operators and Rational Inner Functions on the bidisc

Abstract. In the present talk we will study recent advancements in the theory of composition operators acting on the anisotropic Dirichlet-type spaces and the weighted Bergman spaces on the bidisc. Moreover, we will consider symbols induced by Rational Inner Functions and some results regarding composition operators induced by Rational Inner Functions will be presented.

19, 26 XI 2024

Maria Dronka

On the perturbed matrix pencils

Abstract. During the talk, two theorems regarding the Kronecker structure of a perturbed matrix pencil will be presented. We will also characterise the closure of the equivalence orbit of a matrix pencil, that is, the closure of the set of all matrix pencils sharing a given Kronecker structure. The talk will be based on the paper:
A. Pokrzywa, On perturbations and the equivalence orbit of a matrix pencil, Linear Algebra Appl. 82 (1986), 99-121.

12 XI 2024
10:15 - 10:55

Michał Wojtylak

On singular operator pencils, including pH ones

Abstract. We provide a systematic theory of singular pencils lambda E-A, with (possibly unbounded) operator coefficients in a Hilbert space. Apparently, the situation is more complicated than in the finite dimensional case. Several equivalent statements connected to the Kronecker canonical form become essentially different when the dimension is infinite. We show the relation of these concepts to solvability of the corresponding (infinite dimensional) differential-algebraic equations Ex'=Ax. While the general theory is rather complicated, it essentially simplifies for the operator pencils of type $\lambda E - (J - R)$, where E,R are positive semidefinite, J is skew-symmetric. Here the results are analogous to the finite dimensional situation.

Reference:
[1] Christian Mehl, Volker Mehrmann, Michał Wojtylak, Spectral theory of infinite dimensional dissipative Hamiltonian systems, arXiv:2405.11634v2

11:00 - 11:45
Patryk Pagacz
The closure of the bundle of a matrix pencil
Abstract. Bundles of matrix pencils (under strict equivalence) are sets of pencils having the same Kronecker canonical form, up to the eigenvalues (namely, they are an infinite union of orbits under strict equivalence). The notion of a bundle for matrix pencils was introduced in the 1990's, following the same notion for matrices under similarity, introduced by Arnold in 1971, and it has been extensively used since then.
During my talk we will describe the closure of the bundle of a pencil L, denoted by B(L), as the union of B(L) itself with a finite number of other bundles, where the dimension of each of these bundles is strictly smaller than the dimension of B(L). To obtain this result we derive a formula for the (co)dimension of the bundle of a matrix pencil in terms of the Weyr characteristics of the partial multiplicities of the eigenvalues and of the (left and right) minimal indices. Further, we provide a characterization for the inclusion relationship between the closures of two bundles of matrix pencils of the same size.
References:
[1] F. De Teran and F. M. Dopico, On bundles of matrix pencils under strict equivalence, Linear Algebra Appl., 658 (2023), pp. 1–31.
[2] F. De Teran, F. M. Dopico, V. Koval and P.Pagacz, On bundles closures of matrix pencils and matrix polynomials, preprint, 2024.

5 XI 2024
Damian Kołaczek
Numerical ranges of antilinear operators
Abstract. We study numerical ranges of antilinear operators acting on Hilbert and Banach spaces. We discuss various similarities and differences between numerical radii and numerical ranges in linear and antilinear setting. Our main result shows that the numerical ranges of antilinear operators on at least two-dimensional space are always discs, which improve previously known results stating that such numerical ranges on Hilbert and Banach spaces are always annuli. We also introduce the concept of an antilinear numerical index of the space and compare it with ordinary numerical index

based on linear operators.
The talk is based on recent paper with Vladimir Müller (Institute of Mathematics, Czech Academy of Sciences):
D. Kołaczek, V. Müller, Numerical ranges of antilinear operators, Integr. Equat. Oper. Th. 96 (2024), 17, doi:10.1007/s00020-024-02768-5

22,29 X 2024
Anna Pelczar
Refleksywne algebry Calkina
Abstrakt. Zostaną omówione przykłady algebr Calkina przestrzeni Banacha (z ostatnich kilkunastu lat) oraz przedstawiona idea konstrukcji przestrzeni Banacha z algebrami Calkina izomorficznymi z przestrzeniami Banacha z bazą bezwarunkową (i naturalnym mnożeniem) z szerokiej klasy, n.in. ℓ_p, $1 \leqslant p < \infty$, oraz L_p, $1 < p < \infty$.
Na podstawie wspólnej pracy z Pavlosem Motakisem.

8,15 X 2024
Dariusz Piekarz
The von Neumann inequality for 3×3 matrices in the unit Euclidean ball
Abstract. In 2022, Hartz, Richter, and Shalit proved von Neumann's inequality for $n \times n$ row-contractive, commuting $d-$tuples of matrices. Following Kosiński's work, I will show that a constant $c_{d,3}$ remains independent of the size of the $d-$tuple. Furthermore, I will discuss the estimation of this constant, which involves numerical calculations at certain point.

11 VI 2024
Piotr M. Hajac (IMPAN)
Noncommutative topology through operator algebras that one can see
Abstract. This is an introductory talk that will start with unravelling the paradigm of noncommutative topology followed by a step-by-step construction of graph C^*-algebras abundantly instantiated. Due to their tangible combinatorial nature, these C^*-algebras are known as "operator algebras that one can see". The main part of the talk will be devoted to a conceptual explanation (technicalities omitted, motivating examples provided) of how we solved the mixed-functoriality problem of pullbacks of graph C^*-algebras. More precisely, while some pullbacks can be understood as coming from pushouts of directed graphs via a contravariant functor assi-

gning C^*-algebras to graphs, other pullbacks require both covariant and contravariant functors assigning C^*-algebras to graphs considered as objects in two different categories. In the latter case, one cannot explain the pullback structure of a graph C^*-algebra in terms of a commuting diagram of underlying graphs in one category of graphs. We solve this problem by introducing a new category of directed graphs, where morphisms are relations rather than maps, and define a covariant functor from this category to the category of C*-algebras. Now, the new functor generalizes both the covariant and contravariant functors used before. Our main result is a general pullback theorem including both types of the aforementioned pullbacks as special cases. Time permitting, the talk will end by posing a tantalizing problem involving both pullbacks of noncommutative C^*-algebras and the Poincaré conjecture. (Based on recent joint works with Mariusz Tobolski and Gilles Gonçalves de Castro.)

28 V, 4 VI 2024
Filip Kołomyjec
Moment polynomial inequalities
Abstract. The focus of my talk will be monic polynomials which are polynomial expressions involving variables and their formal moments. We will discuss analogues of Hilbert's 17th problem and Positivstellensatz in the context of moment polynomials. The talk will be based on the paper "Sums of squares certificates for polynomial moment inequalities" by I. Klep, V. Margon and J. Volčič.

14,21 V 2024
Karolina Dądela
Przestrzenie Hardy'ego i Drury'ego-Arvesona
Abstrakt. W trakcie referatu zdefiniujemy przestrzenie Hardy'ego oraz Drury'ego-Arvesona, zobaczymy niektóre z ich własności, a także przyjrzymy się zależnościom zachodzącym pomiędzy oboma rodzajami przestrzeni funkcyjnych. Referat opiera się na pracy „An invitation to the Drury'ego-Arveson space" Michaela Hartza z roku 2022.

23, 30 VI 2024
Jakub Woźny
Stinespring theorem
Abstract: In this talk we will formulate and proof the Stinespring dilation theorem. This theorem states that any completely positive linear map from

a C^*-algebra to a space of operators on a Hilbert space may be represented as a composition of a $*$-homomorphism and a suitable operator map. We also comment on the relation between positivity and complete positivity. Talk is based on the paper "Positive functions on C*-algebras" by W. Forrest Stinespring (1955).

16 IV 2024

Jens de Vries

A Drury-type bound for ρ-contractions

Abstract. In this talk we discuss a Drury-type bound for general ρ-contractions. In particular, this interpolates von Neumann's inequality and Drury's classical bound. The latter states: If A is any square matrix whose numerical radius is at most 1, then

$$\|p(A)\| \leqslant 1 - |p(0)|^2 + \sqrt{(1 - |p(0)|^2)^2 + |p(0)|^2}$$

for any polynomial p with $\sup_{|z|\leqslant 1} |p(z)| \leqslant 1$

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Felix Schwenninger

The Weiss conjecture and Pisier's example

Abstract. In this talk we show that Pisier's example satisfies the discrete-time Weiss conjecture, which originates from control theory. This is in line with prior results due to Jacob-Partington for Hilbert space contractions and Le Merdy for Ritt operators, underlining their common feature—the bounded polynomial calculus—despite their seemingly unrelated proof techniques. The approach exploits Hardy space theory and a reductions to reproducing kernel theses.
This is joint work with Eskil Rydhe (Lund).

9 kwietnia 2024

Hanna Blazhko

An introduction to the theory of semi-inner product spaces and how the notion of the numerical range can be extended to them

(based on: G. Lumer, Semi-inner-product spaces)

26 marca 2024

André Ran (VU Amsterdam and North West University, South Africa)

A class of unbounded Toeplitz operators

Abstract. In this talk a class of unbounded Toeplitz operators is discussed, namely Toeplitz operators with a symbol that is rational with one or more poles on the unit circle. A classical Toeplitz operator with a symbol $\phi(z)$ which is continuous on the unit circle is defined by $T_\phi f = \mathbb{P}(\phi f)$ for $f \in H^2$, the Hardy space of analytic functions on the disc with L^2 boundary values. A similar definition for the case where ϕ is not continuous, but rational with a pole on the unit circle requires a lot more care with the domain. The talk will start with an overview of the classical theory for continuous symbols. After that, the talk will present (parts of) the current state of the art regarding our knowledge of such unbounded Toeplitz operators. This is joint work with Gilbert Groenewald (NWU), Sanne ter Horst (NWU) and Jacob Jaftha (UCT). The work is supported by the National Research Foundation, South Africa.

Patryk Pagacz (Jagiellonian University, Kraków)

On four (quasi-)singular classes of linear pencils.

Abstract: During my talk I will discuss the relation between the following four kinds of linear pencils:
(i) singular pencils, i.e. linear pencils with the spectrum equal to the whole complex plane,
(ii) linear pencils with the numerical range equal to the whole complex plane,
(iii) linear pencils such that (0,0) belongs to the Taylor spectrum of their coefficients,
(iv) linear pencils such that (0,0) belongs to the joint numerical range of their coefficients.
The direct motivation for our research was two questions: "Is it true that the class (i) is equal to (iii)?" arise in [1] and "Is it true that the class (ii) is equal to (iv)?" arise in [2]. The answers of these questions differ depending on the specific assumptions. For example there are no equivalences relations between (i)-(iv) for linear pencils of operators. We will also show that linear pencils from class (ii) do not have to belong to (iv), even if matrix coefficients commute. However, for matrix linear pencils with coefficients that have positive semidefinite Hermitian parts conditions (ii) and (iv) means the same. Moreover, we will show that the first question has an affirmative answer also for matrix polynomials. The talk is based on the joint works with Vadym Koval.
[1] S. V. Djordjevic, J. Kim and J. Yoon, Spectra of the spherical Aluthge

transform, the linear pencil, and a commuting pair of operators, Linear and Multilinear Algebra, 70:2533-2550, 2022.
[2] C. Mehl, V. Mehrmann and M. Wojtylak, Matrix pencils with coefficients that have positive semidefinite Hermitian part, SIAM J. Matrix Anal. Appl., 43(3):1186-1212, 2022.

19 III 2024
Michał Buchała
m-isometric composition operators on discrete spaces
Abstract. In this talk we present our results concerning composition operators on L^2-spaces with discrete measures. First, we show how such an operator can be viewed as a weighted shift on a certain graph. Next, we move to characterizing m-isometricity of composition operators for which the underlying graph has one cycle. As a conclusion, we give the solution to the Cauchy dual subnormality problem in the class of 2-isometric composition operators on graphs with one cycle. The talk is based on:
https://arxiv.org/abs/2209.08518

5,12 III 2024
Daniil Homza
Gaussian Regularization of the Pseudospectrum, condition number approximation
Abstract. Define condition number of matrix A as infimum of $\|V\| \cdot \|V^{-}1\|$, where $A = VDV^{-}1$, D is diagonal. Matrices with small condition number enjoy many of properties such as stability of spectrum under small perturbation, as well as used in numerical analysis. The main goal will be proving that every matrix is at most inverse polynomial close to matrix whose condition number is at most polynomial in the dimension. A pleasant consequence will be proof of Davies Conjecture. Even though the result is completely deterministic, the main tool will be regularization by complex Gaussian perturbation and random matrix theory approach. Talk is based on work "Gaussian Regularization of the Pseudospectrum and Davies' Conjecture, J. Banks, A. Kulkarni etc."

23 I, 27 II 2024
Jacek Horecki
Dilation theory of the quantum annulus (cont.)

16 I 2024
Jean-Pierre Gazeau

Quantum circuit complexity for light polarisation or complexity with no complex numbers

Abstract. I will present a form of quantum circuit complexity that extends to open systems. To illustrate the methodology, I focus on a basic model where the Hilbert space of states is represented by the Euclidean plane. Specifically, the investigation is about the dynamics of mixed quantum states as they undergo interactions with a sequence of gates. The approach involves the analysis of sequences of density matrices. Each density matrix evolves within the framework of a Gorini-Kossakowski-Lindblad-Sudarshan (GKLS) process during the time interval between consecutive gates. Notably, when considering an upperlimit for the cost function, the optimal number of gates follows a power-law relationship.

9 I 2024

Jacek Horecki

Dilation theory of the quantum annulus

12,19 XII 2023

Antoni Machowski

Families closed under approximate equivalence

Abstract: In my talk I will present the proof made by J.B. Conway and D.W. Hadwin of a theorem proposed by E. Bishop. The theorem characterizes subnormal operators on a Hilbert space H as strong limits of nets of normal operators on H. I will follow this up by some corollaries about families closed under approximate equivalence of operators on separable Hilbert spaces. I will finish with a discussion of a theorem by D. Voicelescu characterizing approximately equivalent representations of separable C*-algebras along with its generalizations. References:

J.B. Conway, D.W. Hadwin, Strong limits of normal operators, 1981
D. Voiculescu, A non-commutative Weyl - von Neumann theorem, 1976
D.W. Hadwin, Completely positive maps and approximate equivalence, 1987

28 XI 2023

Natalia Maślany Positive definite kernels and Hilbert C*-modules (cont.) The talk is based on two papers by F.H. Szafraniec:

1. Murphy's "Positive definite kernels and Hilbert C*-modules" reorganized
2. Revitalising Pedrick's Approach to Reproducing Kernel Hilbert Spaces

7, 14, 21 XI 2023

Radomił Baran
Finite-dimensional contractive realizations of a rational matrix-valued function (based on Grinshpan et al., Matrix-valued Hermitian Positivstellensatz, lurking contractions, and contractive determinantal representations of stable polynomials)

31 X 2023
Marek Skrzypczyk
Linear algebra concepts for quadratic embedding of graphs

Dariusz Cichoń
Multi-variable Christoffel-Darboux formula

Jan Stochel
Arveson's hyperrigidity

10, 24 X 2023
Piotr Pikul
On (several) joint numerical ranges (based on: V. Müller, "The joint essential numerical range, compact perturbations and the Olsen problem")

3 X 2023
Barbara Lewandowska
On the maximal absolut projection constant
Let $\lambda_{\mathbb{K}}(m)$ denote the maximal absolute projection constant over the subspaces of dimension m. In 1960, B.Grünbaum conjectured that $\lambda_{\mathbb{R}}(2) = \frac{4}{3}$, and only in 2010, B. Chalmers and G. Lewicki proved it and that was the only known nontrivial case. Recently, we have provided exact values of $\lambda_{\mathbb{K}}(m)$ in cases where the maximal equiangular tight frame exists in $\mathbb{K}^m$. In this talk, we will presente an upper bound of the value $\lambda_{\mathbb{K}}(m)$, which allowed to do that.
There are numerous examples of complex maximal ETFs, for example, for $m \in \{1, \ldots, 17, 19, 24, 28, 35, 48\}$. In fact, it is conjectured that there is a complex maximal ETF in every dimension (Zaurner's conjecture). Unlike in the complex case, real maximal ETFs seem to be rare objects. The only known cases are for m equal to 2, 3, 7 and 23. A lot of the community believes that these are all real cases where maximal ETFs exist. In other cases, the determination of the constant $\lambda_{\mathbb{R}}(m)$ seems to be difficult. Numerical experiments conducted by B. L. Chalmers (and unfortunately unpublished) suggest that $\lambda(5) \approx 2.06919$. In this talk, relying on a new construction of certain mutually unbiased equiangular tight frames, we will

provide the lower bound for $\lambda_{\mathbb{R}}(5)$ and present some arguments that it may be its true value.