Advanced Course in Operator Theory and Complex Analysis

Programme & Book of Abstracts

16 – 20 June 2025

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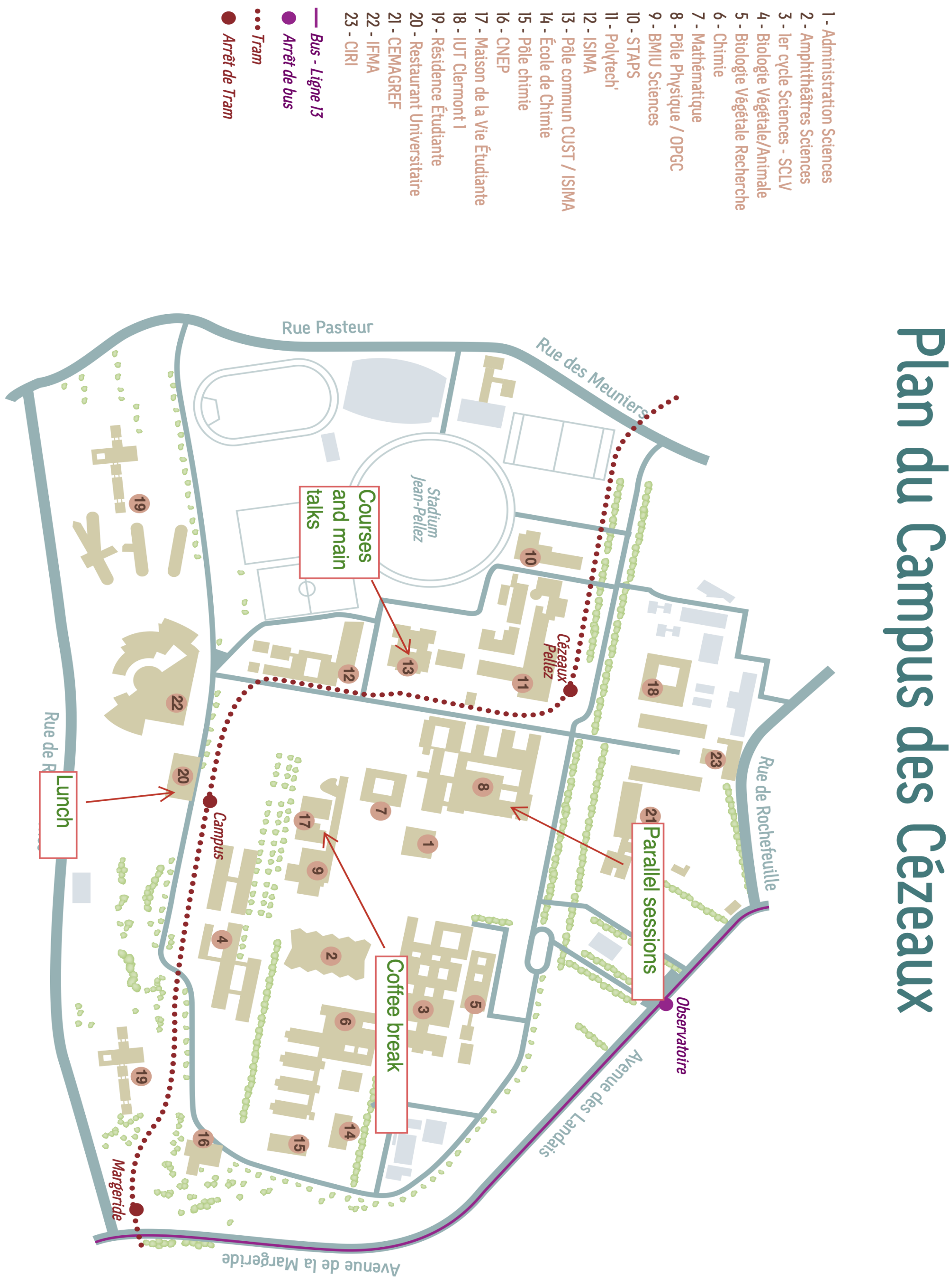
1 Campus Map


Plan du Campus des Cézeaux
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Courses and main talks
Lunch
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2 Practical Information

How to Arrive

- The conference takes place on the Cézeaux Campus of Université Clermont Auvergne. To arrive, take Tram A in the direction of *La Pardieu* and alight at the **Cézeaux Pellez** stop.
- Tram tickets can be bought from vending machines at the tram stops. You can also pay onboard the tram via a contactless payment.

Registration

- Registration takes place in lecture hall **Amphi 2** of the *Pôle Commun* building (Building 13 on the campus map).

Talks

- The talks take place in either the *Pôle Commun* (Building 13 on the campus map), or in the *Pôle Physique* (Building 8 on the campus map).
- Full details of the schedule of talks can be found on Pages 5 and 6.

Breaks

- The coffee breaks take place at the *Maison de la vie Etudiante* building (Building 17 on the campus map).
- Lunch will be served at the university restaurant from Tuesday to Thursday (Building 20 on the campus map).
- On Friday a buffet lunch will be offered at the *Maison de la vie Etudiante* building (Building 17 on the campus map).

3 Schedule

Locations of the talks

- The courses and plenary talks take place in lecture hall **Amphi 2** of the *Pôle Commun* building (Building 13 on the campus map), except on Friday morning when the course is held in lecture hall **9110** of *Pôle Physique* (Building 8 on the campus map).
- The parallel sessions take place in the *Pôle Physique* building (Building 8 on the campus map). Full details of the parallel sessions can be found on the next page.

	Monday			Tuesday			
08:45				Kraus 1			
09:45				Shargorodsky 1			
10:45				Coffee			
11:15				Fricain 2			
12:15				Lunch			
13:00	Registration			Lunch			
14:00	Fricain 1			Lunch			
	Fricain 1			Gorkin 2			14:15
15:00	Gorkin 1			Gorkin 2			
	Gorkin 1			Chalmoukis			15:15
16:00	Coffee			Coffee			
16:30	Gumenyuk	Menet	Mironov	Khavinson	Papathanasiou	Oger	
17:00	Zlotnikov	Sahin	Lamberti	McDougall	Maronikolakis	Zelent	
17:30	Lazebnik	Gomes	Torkinejad Ziarati	Brennan	Gillet	Clemente Delgado	

	Wednesday	Thursday			Friday	
08:45	Fricain 3	Gorkin 3			Shargorodsky 3 (Pôle Physique 9110)	
09:45	Kraus 2	Shargorodsky 2			Pikul	Ostermann
					Santana Rivero	Chen
10:45	Coffee	Coffee			Coffee	
11:15	Ilišević	Manolaki			Yadav	Dorval
					Geleta	Beslikas
12:00	Curto	Rodríguez-Piazza			Moucha	Gebrehana
12:40	Lunch	Lunch			Buffet Lunch (Maison de la vie Etudiante)	
14:00	Excursion (Bus departs Cézeaux Campus 14:00)	Lunch				
14:30		Kraus 3				
15:30		Martín				
16:10		Coffee				
16:40		Maciá Medina	Bellavita	Abbar		
		Pietrzycki	Dellepiane	Kołaczek		
	Conference Dinner (Bus departs Cézeaux Campus 19:30)					

3.1 Detailed Schedule of Contributed Talks

- The parallel sessions take place in three different lecture halls (9109, 9110, 9111) in the *Pôle Physique* building (Building 8 on the campus map).

	Monday		
	Room 9109	Room 9110	Room 9111
16:30	Gumenyuk	Menet	Mironov
17:00	Zlotnikov	Sahin	Lamberti
17:30	Lazebnik	Gomes	Torkinejad Ziarati

	Tuesday		
	Room 9109	Room 9110	Room 9111
16:30	Khavinson	Papathanasiou	Oger
17:00	McDougall	Maronikolakis	Zelent
17:30	Brennan	Gillet	Clemente Delgado

	Thursday		
	Room 9109	Room 9110	Room 9111
16:40	Maciá Medina	Bellavita	Abbar
17:10	Pietrzycki	Dellepiane	Kołaczek

	Friday	
	Room 9109	Room 9110
09:50	Pikul	Ostermann
10:20	Santana Rivero	Chen
	Coffee	
	Room 9109	Room 9110
11:15	Yadav	Dorval
11:45	Geleta	Beslikas
12:15	Moucha	Gebrehana

4 Social Events

Excursion

Wednesday's social activities begin with an afternoon excursion to the UNESCO World Heritage Site of the *Puy de Dôme* volcano.

- A coach will depart from the Cézeaux Campus at **14:00** and transfer participants to the *Panoramique des Dômes* train station.
- Following a scenic train ride to the summit, you can wander and enjoy the views. You also have the possibility to purchase refreshments at the top.
- The coach will depart from the Panoramique des Dômes station car park at **19:00** and take participants to the conference dinner.

Conference Dinner

The conference dinner takes place at *La Hutte Gauloise* restaurant on the Gergovie plateau.

- The coach will take participants directly from the excursion to the restaurant.
- En route, the coach will make a stop at the Cézeaux Campus at **19:30** to collect participants who did not join the excursion.
- The coach will depart the restaurant at **22:00** to transfer participants back to Clermont-Ferrand.

5 Abstracts of Advanced Courses

Introduction to the dynamical properties of Toeplitz operators on the Hardy space of the unit disc.

Emmanuel Fricain

Université de Lille

In this mini-course, we will discuss the hypercyclicity of Toeplitz operators T_φ defined on the Hardy space H^2 of the open unit disk. The first part of the course will provide a brief introduction to the notion of hypercyclicity. In particular, we will prove the Godefroy–Shapiro criterion for hypercyclicity in terms of the density of eigenvectors. We will then present some basic facts about Toeplitz operators on the Hardy space. Finally, we will prove two results concerning the hypercyclicity of Toeplitz operators.

The first result concerns anti-analytic symbols and is due to Godefroy and Shapiro (1991). The second result concerns symbols of the form $\varphi(e^{i\theta}) = ae^{-i\theta} + b + ce^{i\theta}$, with $\theta \in \mathbb{R}$ and $a, b, c \in \mathbb{C}$, and is due to Shkarin (2012). If time permits, I will briefly discuss some more recent results by Baranov–Lishanskii, Abakumov–Baranov–Charpentier–Lishanskii, and Grivaux–Ostermann and myself.

Function theory and geometry in a problem in linear algebra: circular numerical ranges

Pamela Gorkin

Bucknell University

In this series of lectures, we look at the numerical range of an $n \times n$ matrix through the lens of function theory and geometry. The motivation for this talk is a conjecture of Gau, Wang and Wu that was made in 2016. The first lecture provides the background necessary to understand the statement of the conjecture as well as prior work. The second lecture emphasizes visualization of the numerical range, a special class of matrices that represent compressions of the shift operator, and a class of functions associated with these operators. Using this background, a geometric proof of the conjecture in a special case will be presented.

Maximal Blaschke Products

Daniela Kraus

University of Würzburg

By the Riemannian point of view, holomorphic functions are best described by their boundary behavior and their "singularities". The most common choice for the "singularities" are the zeros and the poles. In this course we take a less traveled path by choosing critical points as "singularities". We discuss the basic features of this approach as well as numerous recent developments. Starting point is the connection between uniformization of surfaces and the maximal solution of the Liouville equation

$$\Delta u = 4e^{2u},$$

which goes back to Schwarz, Picard and Poincare in the 1890s. Here, the so called Liouville correspondence plays a key role as it relates solutions of the Liouville equation with bounded, locally univalent maps. Further, solutions to the PDE $\Delta u = 4e^{2u}$ with singularities correspond to bounded holomorphic functions with critical points and lead naturally to a class of Blaschke products, which are called maximal Blaschke products. As we will see maximal Blaschke products have a number of distinguished properties, which indicate that they constitute an appropriate infinite generalization of the class of finite Blaschke products. For instance we obtain Ahlfors–Nehari–Schwarz lemmas, which extend earlier work of Nehari (1947), Heins (1962), Zakeri (1996), and boundary versions in the spirit of Burns–Krantz. Secondly, maximal Blaschke products behave nicely with respect to composition and forward iteration. Thirdly, maximal Blaschke products maximize the derivative at a fixed point over the set of all bounded analytic functions in the unit disk with prescribed critical points, a property which closely relates them to canonical divisors in Bergman spaces and the Ahlfors' map. In recent work, O. Ivrii and O. Ivrii & A. Nicolau connect maximal Blaschke products with the invariant subspace problem for Bergman spaces as well as with work of Garnett and Papadimitriakis from 1991 on almost isometries of the hyperbolic plane.

Introduction to the spectral theory of Toeplitz operators

Eugene Shargorodsky

King's College London

We will consider Toeplitz operators on Hardy spaces over the unit circle and discuss generalisations of several classical results including those by Brown-Halmos, Hartman-Wintner, Widom, Douglas, Coburn, Simonenko, and Gohberg-Krupnik. We will describe the (essential) spectra of Toeplitz operators with continuous and piecewise continuous symbols, and with symbols belonging to the algebra $C + H^\infty$. We will also consider some other classes of symbols with non-jump discontinuities. Some of the above results will be presented in the framework of abstract Hardy spaces built upon Banach function spaces, while other ones will be confined to the classical Hardy spaces H^p or to their weighted analogues $H^p(w)$.

6 Abstracts of Invited Speakers

Sharp L^p bounds for the Hardy-Littlewood maximal operator on Gromov hyperbolic spaces

Nikolaos Chalmoukis

University of Milano-Bicocca

Let (X, d) be a Gromov hyperbolic space equipped with a locally finite Borel measure that is locally doubling and of exponential growth. In this setting, we establish sharp weak type and strong L^p type bounds for the centered Hardy–Littlewood maximal operator. Our results aim to clarify how the mapping properties of the Hardy–Littlewood maximal operator depend on the geometry of a space which is globally negatively curved. In particular, the bounds apply to Cartan-Hadamard manifolds of pinched negative curvature and symmetric spaces of noncompact type and rank one. A key ingredient in the proof is a discretization procedure, which allows us to approximate in a convenient way an arbitrary Gromov hyperbolic space by a class of graphs which we call *spider's webs*.

This is a joint work with S. Meda and F. Santagati.

Mellin Transform and Exponential Polynomial Methods in the Study of the Square Root Problem for Positive Measures

Raul Curto

University of Iowa

For recursively generated shifts, we provide definitive answers to two outstanding problems in the theory of unilateral weighted shifts: the Subnormality Problem (**SP**) (related to the Aluthge transform) and the Square Root Problem (**SRP**) (which deals with Berger measures of subnormal shifts).

In joint work with H. El Azhar, Y. Omari and E.H. Zerouali, we use the Mellin Transform and the theory of exponential polynomials to establish that (**SP**) and (**SRP**) are equivalent if and only if a natural functional equation holds for the canonically associated Mellin transform. For p–atomic measures with $p \leq 6$, our main result provides a new and simple proof of the above-mentioned equivalence.

Subsequently, we obtain an example of a 7–atomic measure for which the equivalence fails. This provides a negative answer to a problem posed by G.R. Exner in 2009, and to a recent conjecture formulated by R.E. Curto et al in 2019.

Keywords. Subnormal weighted shift, Aluthge transform, Square Root Problem, Mellin transform, finitely atomic measure.

References

[1] R.E. Curto, H. El Azhar, Y. Omari and E.H. Zerouali, The Square Root Problem and subnormal Aluthge transforms of recursively generated weighted shifts, *Integral Equations Operator Theory* 96(2024), art. 33; 17 pp.

Spectral properties of periodic isometries

Dijana Ilišević

University of Zagreb

A bounded linear operator T is said to be periodic of period $m \in \mathbb{N}$ if $T^m = I$ and $T^k \neq I$ for every positive integer $k < m$. The spectrum of such an operator consists of (not necessarily all) m-th roots of unity. Isometries with finite spectrum have a spectral decomposition. In this talk, the spectral properties of periodic isometries on a certain class of Banach spaces will be discussed, with special emphasis on isometries on some function spaces, including spaces of continuous functions and spaces of analytic functions.

This talk will be based on the results of joint work with several coauthors, specifically: joint work with Fernanda Botelho, joint work with Chih-Neng Liu, Bui Ngoc Muoi and Ngai-Ching Wong, as well as joint work with Catherine Bénéteau, Fernanda Botelho, María Cueto Avellaneda, Jill E Guerra, and Shiho Oi.

Higher order harmonic Schwarzian derivatives

María José Martín

University of La Laguna

Let Ω be a domain in the complex plane. A *harmonic mapping* in Ω is a complex valued function $f = u+iv$ whose real and imaginary parts are (real) harmonic in Ω. Analytic functions are a special case where the real and imaginary parts are conjugate harmonic functions, satisfying the Cauchy–Riemann equations. In those cases when the domain Ω is simply connected, the harmonic mapping f can be written as $f = h + \overline{g}$, where both h and g are analytic in Ω.

The landmark paper by James Clunie and Terry Sheil-Small in 1984, points out that many of the classical results for conformal functions have clear analogues for univalent harmonic mappings. However, as Peter Duren mentions in his book on harmonic mappings in the plane, "as soon as analyticity is abandoned, serious obstacles arise".

The purpose of this talk is to show a generalization of some particular objects introduced for analytic functions to those cases when the functions considered are merely harmonic. More concretely, we propose a definition of higher order Schwarzian derivatives for locally univalent harmonic mappings. The definition will be based on the relation between the classical formulas of the pre-Schwarzian and Schwarzian derivatives of locally univalent analytic functions and the derivatives of the generating functions of the methods due to Newton and Halley, respectively, for approximating zeros. We will prove that the higher order harmonic Schwarzian derivatives we obtain coincide, in those cases when the functions considered are holomorphic, with the Aharonov invariants, introduced by Don Aharonov in 1969.

This is a joint work with F. Pérez-González and Alexis Quintero-Díaz.

Boundary behaviour of holomorphic functions

Myrto Manolaki

University College Dublin

The study of the boundary behaviour of holomorphic functions is of significant importance in many areas in Analysis. In this talk I will present an overview of my research on this topic, focusing on two theorems that complement and strengthen some classical results. The first one concerns Abel's Limit Theorem, which connects the behaviour of a Taylor series as we approach the boundary from the interior with its behaviour on the boundary itself. The second one strengthens Plessner's and Spencer's theorems about the angular behaviour of holomorphic functions on the unit disc. As we will see, these two theorems find applications to certain classes of holomorphic functions with wild boundary behaviour. (Based on joint works with Stephen Gardiner, Stéphane Charpentier and Konstantinos Maronikolakis.)

Composition operators on weighted Hardy spaces

Luis Rodríguez-Piazza

Dpto. Análisis Matemático & IMUS. Universidad de Sevilla

Given a sequence $\beta = (\beta_n)_{n\geq 0}$ of positive real numbers (the weights) we define *the weighted Hardy space* $H^2(\beta)$ as the space formed by all functions f analytic at 0 and whose power series at 0, $f(z) = \sum_{n\geq 0} a_n z^n$, satisfies

$$\|f\|^2_{H^2(\beta)} := \sum_{n\geq 0} |a_n|^2 \beta_n < +\infty\,.$$

We will always assume that the sequence of weights (β_n) satisfies the condition

$$\liminf_{n\to\infty} \beta_n^{1/n} \geq 1,$$

and so, every function $f \in H^2(\beta)$ is holomorphic on the whole open unit disc $\mathbb{D}$.

Many classical Hilbert spaces of analytic functions appear as weighted Hardy spaces. For instance, this is the case for Hardy, Bergman and Dirichlet spaces.

If $\varphi\colon \mathbb{D} \to \mathbb{D}$ is holomorphic, the composition operator C_φ of symbol φ is simply

$$C_\varphi\colon f \mapsto f\circ\varphi, \qquad \text{for all } f \in Hol(\mathbb{D}).$$

It is known that, for every symbol φ, C_φ defines a bounded operator on Hardy and Bergman spaces; but this is not true on the Dirichlet space.

In this talk I will present some results, included in [1] and [2], obtained in collaboration with P. Lefèvre, D. Li and H. Queffélec. We will deal with some problems around the following question raised by N. Zorboska in the eighties:

> Determine the sequences $\beta = (\beta_n)_{n\geq 0}$ for which every symbol $\varphi\colon \mathbb{D} \to \mathbb{D}$ defines a bounded composition operator $C_\varphi\colon H^2(\beta) \to H^2(\beta)$.

References

[1] P. Lefèvre, D. Li, H. Queffélec, L. Rodríguez-Piazza, *Characterization of weighted Hardy spaces on which all composition operators are bounded.* To appear in Analysis & PDE.

[2] P. Lefèvre, D. Li, H. Queffélec, L. Rodríguez-Piazza, *On some questions about composition operators on weighted Hardy spaces.* To appear in Pure and Applied Functional Analysis.

7 Abstracts of Contributed Talks

On the spectrum of Lipschitz operators

Arafat Abbar

LAMA, Université Gustave Eiffel

Let M be a pointed metric space, and let $\mathrm{Lip}_0(M)$ denote the Banach space of complex-valued Lipschitz functions on M that vanish at the base point. A weighted composition operator on $\mathrm{Lip}_0(M)$ is an operator of the kind $wC_f : g \mapsto w \cdot g \circ f$, where $w : M \to \mathbb{C}$ and $f : M \to M$ are any maps. When such an operator is bounded, it is actually the adjoint operator of a so-called weighted Lipschitz operator $w\widehat{f}$ acting on the Lipschitz-free space $\mathcal{F}(M)$. In this talk, we will be interested on the spectrum of such operators, with a special emphasize when they are compact.

References

[1] A. Abbar, C. Coine and C. Petitjean. A note on the spectrum of Lipschitz operators and composition operators on Lipschitz spaces. *Journal of Operator Theory*, to appear.

[2] H. Kamowitz. Compact endomorphisms of Banach algebras. *Pacific J. Math.*, 89:313–325, 1980.

[3] H. Kamowitz and S. Scheinberg. Some properties of endomorphisms of Lipschitz Algebras. *Studia Math.*, 96:61–67, 1990.

[4] HA. Jiménez-Vargas and M. Villegas-Vallecillos. Compact composition operators on noncompact Lipschitz spaces. *J. Math. Anal. Appl.*, 398:221–229, 2013.

Critical sets of Hardy spaces and some related problems

Carlo Bellavita

Universitat de Barcelona

The result by D. Kraus, which proves the coincidence of the critical sets for the Hardy space H^2 and for the space of bounded analytic functions H^∞ [1, Theorem 1.1], motivates the research of other function spaces with the same property. By observing that every Carleson measures exhibits *a vanishing behavior at almost every point of the unit circle*, we prove the coincidence of the critical sets for H^2 and VMOA. This result leads to other significant implications:

- The non-boundedness from below of the generalized Volterra integral operator T_g acting from $H^\infty \to$ BMOA.
- The generalization to L^p of T. Wolff's result [2, Theorem 1].
- A generalization of W. Cohn factorization for H^p [3, Theorem 1].

This talk is based on an ongoing project in collaboration with Artur Nicolau and Georgios Stylogiannis.

References

[1] Kraus, D. Critical sets of bounded analytic functions, zero sets of Bergman spaces and nonpositive curvature. *Proc. London Math. Soc.*, 106, 2011.

[2] Wolff, T. Two algebras of bounded functions. *Duke Math. J.* 49:321–328, 1982.

[3] Cohn, W. A factorization theorem for the derivative of a function in H^p. *Proc. Am. Math. Soc.* 127: 509–517, 1999.

Composition Operators and Rational Inner Functions on the bidisc

Athanasios Beslikas

Jagiellonian University

In the papers of Bayart [1] and Kosiński [5] respectively, it was proved that if the symbol Φ is $\mathcal{C}^2-$smooth on the closure of the bidisc, the composition operator $C_\Phi : A^2_\beta(\mathbb{D}^2) \to A^2_\beta(\mathbb{D}^2)$ is bounded if and only if the derivative matrix $d_\zeta \Phi$ is invertible for all $\zeta \in \mathbb{T}^2$ such that $\Phi(\zeta) \in \mathbb{T}^2$.
A natural question that emerges is how the situation differs if the symbol Φ does not satisfy a smoothness condition, or even worse, if it has some kind of singularity on the bitorus $\mathbb{T}^2$. Some interesting consequences appear when we consider a holomorphic self map $\Phi = (\varphi, \psi)$ of the bidisc, when φ, ψ are Rational Inner Functions. In the present talk, some recent results obtained in this direction will be presented.
Some references which are intimately connected to the main topic of this talk are [3] [4] and [6]. The talk is planned to be accessible for everyone who has a decent background into complex analysis (one dimensional setting is still fine) and basic notions of operator theory.

References

[1] F.Bayart, *Composition operators on the polydisk induced by affine maps* Journal of Functional Analysis Volume 260, Issue 7, 1 April 2011, Pages 1969-2003.

[2] K.Bickel, *Fundamental Agler Decompositions*, Integral Equations and Operator Theory, Published: 11 September 2012 Volume 74, pages 233–257, (2012). , 1 December 2013, Pages 2753-2790

[3] K.Bickel, J.E. Pascoe, A.Sola, *Derivatives of Rational Inner Functions and integrability at the boundary,* Proceedings of the London Mathematical Society, Vol. 116, Issue 2, pp.281-329

[4] G.Knese, *Rational Inner Functions in the Schur-Agler class of the polydisc*, Publicacions Matemàtiques, Vol. 55, No. 2 (2011), pp. 343-357

[5] Ł. Kosiński, *Composition operators on the polydisc*, Journal of Functional Analysis, Volume 284, Issue 5, 1 March 2023, 109801.

[6] H.Koo, M.Stessin, K.Zhu, *Composition operators on the polydisc induced by smooth symbols*, Journal of Functional Analysis 254 (2008) 2911–2925

The Property of Unique Continuation in Certain Spaces Spanned by Rational Functions on Compact Nowhere Dense Sets

J. E. Brennan

University of Kentucky

It has been known for over a century that certain large classes of functions defined on a compact nowhere dense subset X of the complex plane, and obtained as limits of analytic functions in various metrics, can sometimes inherit the property of *unique continuation* characteristic of the approximating family. I shall discuss the subject from an historical point of view, beginning with Émile Borel's confrontation with Poincaré at his thesis defense in 1892, adding along the way some new results on the existence of boundary values for certain L^2-spaces defined on sets without interior points. My remarks are also intended to make clear the full import of Borel's early nascent ideas for the continued development of approximation theory during the succeeding century.

Recent progress on hypercyclic holomorphic mappings with slow growth

Zhangchi Chen

East China Normal University

A holomorphic map $h : X \to Y$ is called *hypercyclic* with respect to a generalised translation $T \in \mathsf{Aut}(X)$ if the orbit $\{h \circ T^n\}_{n \geqslant 1}$ is dense in the space $\mathcal{O}(X, Y)$ equipped with compact-open topology. Dinh-Sibony asked what is the slowest growth rate of the Nevanlinna characteristic functions of hypercyclic entire curves $\mathbb{C} \to \mathbb{P}^1$.

We construct holomorphic entire curves $h : \mathbb{C} \to \mathbb{P}^m$ hypercyclic with respect to countably many translations with optimal slow growth rate. This result answers Dinh-Sibony's question.

An entire curve $h : \mathbb{C} \to Y$ is called *frequently hypercyclic* with respect to some translation T_a for some $a \in \mathbb{C}^*$ if for any non-empty open subset $U \subset \mathcal{O}(\mathbb{C}, Y)$, the set of positive integers $k \geqslant 1$ with $h(\cdot + k\,a) \in U$ has positive lower density. Any frequently hypercyclic entire curve into projective spaces $h : \mathbb{C} \to \mathbb{P}^m$ has order at least 1.

We construct order 1 entire curves $h : \mathbb{C} \to \mathbb{P}^m$ frequently hypercyclic with respect to translations in countably many directions. This result on the slow growth rate is optimal.

References

[1] Chen, Z. and Huynh, D. and Xie S-Y. Universal Entire Curves in Projective Spaces with Slow Growth. *J. Geom. Anal.*, 33, 308, 2023.

[2] Chen, Z. and Guo, B. and Xie S-Y. Frequently hypercyclic meromorphic curves with slow growth. arXiv:2409.08048.

Reducing subspaces of operators with compact imaginary part

Norberto Clemente Delgado

Universidad Complutense de Madrid

In this talk, we will analyse the existence of non-trivial reducing subspaces for bounded operators T on infinite-dimensional, separable, complex Hilbert spaces with compact imaginary part ImT. We will address a question posed by Foias, Hamid, Onica and Pearcy regarding the assumption of ImT being positive. (Joint work with E. A. Gallardo-Gutiérrez)

$H(b)$ spaces that are $\mathcal{D}_\mu$ spaces with infinitely many atoms

Eugenio Dellepiane

Politecnico di Torino

In this talk, we discuss when de Branges-Rovnyak spaces $H(b)$ are also harmonically weighted Dirichlet spaces $\mathcal{D}_\mu$. In particular, we focus on the case where μ is an atomic measure with infinitely many atoms, i.e., it has the form

$$\mu = \sum_{n=0}^{\infty} \alpha_n \delta_{\zeta_n},$$

with $\zeta_n \in \partial\mathbb{D}$ and $\alpha_n > 0$ such that $\sum_{n\in\mathbb{N}} \alpha_n < \infty$. We present interesting new results and examples. This is based on an ongoing project with Carlo Bellavita, Andreas Hartmann and Javad Mashreghi.

Composition operators on the polydisc

Anne Dorval

Université Clermont Auvergne

Let $\mathcal{U}$ be a domain in $\mathbb{C}^d$, let X be a Banach space of holomorphic functions on $\mathcal{U}$ and let $\phi : \mathcal{U} \to \mathcal{U}$ be holomorphic. The composition operator with symbol ϕ is defined by $C_\phi(f) = f \circ \phi$, $f \in X$. The first question to solve is about the continuity of the operator. When X is the Hardy space or a weighted Bergman space of the unit disc it is easy : by the Littlewood principle it is always the case. However, as the dimension grows, the problem gets trickier. Our focus will be on negative weighted Bergman spaces of the tridisc.

References

[1] Bayart, F. Composition operators on the Hardy space of the tridisc *Indiana U. Math. J.*, arXiv:2312.02565

[2] Kosiński, L. Composition operators on the polydisc *J. Funct. Anal.*, 284:109801, 2023

Bounded Composition Operators on Hilbert Space of Complex-Valued Harmonic Functions

Tseganesh Getachew Gebrehana and **Hunduma Legesse Geleta**

Addis Ababa University

In this paper, we study composition operators on Hilbert space of complex-valued harmonic functions. In particular, we explore isometries, the type of self-map that generate bounded composition operator, and characterize the boundedness of composition operator in terms of Poisson integral. Furthermore, we establish the relation between reproducing kernels and composition operators on Hilbert space of complex-valued harmonic functions.

A VARIANT OF THE FRACTIONAL GAMMA-REGULARIZED ZETAKERNEL

HUNDUMA LEGESSE GELETA

Addis Ababa University

In this talk, we introduce and study a special function, referred to as a variant of the fractional gamma-regularized zeta kernel, in which the lower incomplete gamma function appears in the numerator, contrasting with the fractional hypergeometric zeta function, where it appears in the denominator. We investigate its analytic properties, convergence behavior, and its connection to the Riemann zeta function. A representation is derived in terms of a multiplicative modification of the Riemann zeta function, and comparisons are made with known zero-free regions and deformation phenomena. We demonstrate that this function defines a deformation of the Riemann zeta function, which interpolates to the alternating zeta function in a specific limit. Additionally, a Dirichlet-type series representation is provided. Potential extensions, including a functional equation and asymptotic analysis, are proposed for future work.

Typical properties of positive contractions and the invariant subspace problem

Valentin Gillet

Université de Lille

The invariant subspace problem for positive operators, still open to this day, can be stated as follows: given an infinite dimensional complex Banach space X with a basis, does every positive operator on X have a nontrivial invariant subspace? One of the fundamental results on this subject, due to Abramovich, Aliprantis and Burkinshaw, shows the existence of a nontrivial invariant subspace for any positive operator on a Banach space X having a basis that commutes with a nonzero positive operator that is quasinilpotent at a nonzero positive vector.

The aim of this talk is to study the invariant subspace problem for positive operators from the point of view of typicality, for different operator topologies. In particular, we will determine, for the topologies SOT and SOT*, if the set of positive contractions on a Banach space with a basis that satisfy the hypotheses of the Abramovich, Aliprantis and Burkinshaw theorem is comeager in the set of positive contractions. Finally, we will determine, for the topologies WOT, SOT and SOT*, the point spectrum of a typical positive contraction on ℓ_2.

References

[1] Y. A. Abramovich, C. D. Aliprantis, and O. Burkinshaw, Invariant Subspaces for Positive Operators Acting on a Banach Space with Basis, Proceedings of the American Mathematical Society 123 (1995), no. 6

[2] T. Eisner, A "typical" contraction is unitary, Enseign. Math. (2) 56 (2010), no. 3-4

[3] T. Eisner and T. Mátrai, On typical properties of Hilbert space operators, Israel J. Math. 195 (2013), no. 1

[4] V. Gillet, Typical properties of positive contractions and the invariant subspace problem, preprint available at https://arxiv.org/abs/2409.14481 (2024)

[5] V. Gillet, Similar operator topologies on the space of positive contractions, available at https://arxiv.org/abs/2412.11587 (2024), to appear in Illinois Journal of Mathematics

[6] S. Grivaux, É. Matheron, and Q. Menet, Does a typical ℓ_p-space contraction have a non-trivial invariant subspace?, Trans. Amer. Math. Soc. 374 (2021), no. 10

[7] S. Grivaux, É. Matheron, and Q. Menet, Generic properties of ℓ_p-contractions and similar operator topologies, preprint available at https://arxiv.org/abs/2207.07938 (2022), to appear in Israel J. Math.

[8] G. Sirotkin, Infinite matrices with "few" non-zero entries and without non-trivial invariant subspaces, Journal of Functional Analysis 256(6):1865-1874

Mixing and Kitai's Criterion for Composition Operators

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The question regarding whether every mixing operator satisfies Kitai's Criterion, raised by Shapiro, was solved by Grivaux in [3]. By studying dynamical properties of composition operators on spaces of measurable functions that generalize L^p, introduced by Bayart, Darji and Pires in [1], we are able to construct new examples of mixing operators not satisfying Kitai's Criterion [2]. (This is a joint work with Karl-G. Grosse-Erdmann, from Université de Mons, Belgium).

References

[1] Bayart, F. and Darji, U. B. and Pires, B. Topological transitivity and mixing of composition operators. *J. Math. Anal. Appl.*, 465:125–139, 2018.

[2] Gomes, D. and Grosse-Erdmann, K-G. Kitai's Criterion for Composition Operators. *J. Math. Anal. Appl.*, 547:129347, 2025.

[3] Grivaux, S. Hypercyclic operators, mixing operators and the Bounded Steps Problem. *J. Oper. Theory*, 54:147–168, 2005.

Commuting holomorphic self-maps of the unit disk and pseudo-iterates

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This talk is based on the joint works with M.D. Contreras and S. Díaz-Madrigal (Universidad de Sevilla, SPAIN): [1, 2] and a work in progress.

We study the unital semigroup w.r.t. composition $\mathcal{Z}(\varphi)$ that consists of all holomorphic self-maps $\psi \in \mathsf{Hol}(\mathbb{D}, \mathbb{D})$ of the unit disk $\mathbb{D} := \{z : |z| < 1\}$ commuting with a given holomorphic self-map φ. Following general algebraic terminology, we call $\mathcal{Z}(\varphi)$ the *centralizer* of φ.

The main emphasis is made on the most interesting and complicated case of parabolic self-maps. In particular, we solve a problem going back to the seminal paper by Cowen [3], who proved that if $\varphi, \psi \in \mathsf{Hol}(\mathbb{D}, \mathbb{D}) \setminus \mathsf{Aut}(\mathbb{D})$ commute and if they are elliptic or hyperbolic, then ψ belongs to the so-called pseudo-iteration semigroup of φ. For *parabolic* self-maps he obtained a weaker conclusion that ψ belongs to the pseudo-iteration semigroup of the *composition* $\varphi \circ \psi$.

Later, in [4, 5], Cowen's result for elliptic and hyperbolic self-maps was extended, under a certain additional condition (concerning the way the orbits converge to the Denjoy – Wolff point) to the parabolic case, and the question whether this additional condition can be eliminated was raised. We answer this question affirmatively for the parabolic self-maps φ of *zero hyperbolic step*. Namely, for such φ's, we show that *ψ belongs to $\mathcal{Z}(\varphi)$ if and only if it is a pseudo-iterate of φ and has the same Denjoy – Wolff as φ*. Moreover, in this case, *the centralizer of φ is abelian.*

The hypothesis of zero hyperbolic step is essential. If φ is parabolic of *positive hyperbolic step*, then the centralizer $\mathcal{Z}(\varphi)$ does not have to be abelian and can be much wider than the pseudo-iteration semigroup. For this more complicated case, using simultaneous linearization of commuting self-maps, we are able to identify maximal abelian subsets of the centralizer.

References

[1] Contreras, M. D., Díaz-Madrigal, S., Gumenyuk P. Centralizers of non-elliptic univalent self-maps and the embeddability problem in the unit disc. ArXiv:2311.04134, 2023. https://doi.org/10.48550/arXiv.2311.04134

[2] Contreras, M. D., Díaz-Madrigal, S., Gumenyuk P. Criteria for extension of commutativity to fractional iterates of holomorphic self-maps in the unit disc. *J. London Math. Soc. (2)* 111: e70077, 2025. https://doi.org/10.1112/jlms.70077

[3] Cowen, C. C. Commuting analytic functions. *Trans. Amer. Math. Soc.*, 283: 685–695, 1984.

[4] Vlacci, F. On commuting holomorphic maps in the unit disc of $\mathbb{C}$. *Complex Variables Theory Appl.* 30: 301–313, 1996.

[5] Bisi, C. and Gentili, G. Commuting holomorphic maps and linear fractional models. *Complex Variables Theory Appl.* 45: 47–71, 2001.

Algebra and PDE

Dmitry Khavinson

University of South Florida

We shall discuss Hesse's conjecture for homogeneous polynomials and Korenblum's conjecture on algebras of harmonic functions from the standpoint of nonlinear first-order PDE. Also, we show how to extend a recent theorem of McKinley and Shekhtman for homogeneous polynomial partial differential operators to a much wider class of linear PDE with entire coefficients by putting it into a general frame work of analytic continuation of solutions of linear holomorphic PDE.

Numerical ranges of antilinear operators

Damian Kołaczek

University of Agriculture in Krakow

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 is showing that the numerical range of an antilinear operator on at least two-dimensional space is always a disc, which improve previously known results [1, 2] stating that such numerical range on Hilbert and Banach spaces is always an annulus. We also introduce the concept of an *antilinear numerical index* of the space and compare it with an ordinary numerical index whose definition involves linear operators.

The talk is based on recent joint work with Vladimir Müller (Institute of Mathematics, Czech Academy of Sciences) [3].

References

[1] Hur, I. and Lee, J.-E. Numerical ranges of conjugations and antilinear operators. *Linear Multilinear A.*, 69:2990–2997, 2021.

[2] Chø, M. and Hur, I. and Lee, J.-E. Numerical ranges of conjugations and antilinear operators on Banach spaces. *Filomat*, 35:2715–2720, 2021.

[3] Kołaczek, D. and Müller, V. Numerical ranges of antilinear operators. *Integr. Equat. Oper. Th.*, 96:Paper No. 17, 2024.

Determinantal point processes and generalized Fock spaces

Giuseppe Lamberti

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Consider a subharmonic function ϕ whose Laplacian $\Delta\phi$ is a doubling measure. We can define the *generalized Fock space* $\mathcal{F}^2_\phi$ as the space of entire functions such that

$$\int_{\mathbb{C}} |f(z)|^2 e^{-2\phi(z)} \Delta\phi(z) < \infty.$$

In this situation it is possible to define the *determinantal point process* Λ_ϕ associated to $\mathcal{F}^2_\phi$, where the probability distribution of the process is determined by the reproducing kernel of $\mathcal{F}^2_\phi$.

We provide a complete characterization of when the processes Λ_ϕ are almost surely separated with respect to the Euclidean distance on the plane. As a consequence, we also obtain a characterization of when these processes are almost surely interpolating for the classical Fock spaces. Furthermore, we emphasize the role of intrinsic repulsion in determinantal processes by comparing Λ_ϕ with the Poisson process of the same first intensity. Additionally, we demonstrated that, with probability one, the point process Λ_ϕ fails to be separated with respect to the distance induced by the reproducing kernel K_ϕ.

This is a joint work with X. Massaneda.

On the Shapes of Rational Lemniscates

Kirill Lazebnik

University of Texas at Dallas

A rational lemniscate is a level set of $|r|$ where $r : \hat{\mathbb{C}} \to \hat{\mathbb{C}}$ is rational. We prove that any planar Euler graph can be approximated, in a strong sense, by a homeomorphic rational lemniscate. This generalizes Hilbert's lemniscate theorem; he proved that any Jordan curve can be approximated (in the same strong sense) by a polynomial lemniscate that is also a Jordan curve. As consequences, we obtain a sharp quantitative version of the classical Runge's theorem on rational approximation, and we give a new result on the approximation of planar continua by Julia sets of rational maps. This talk is based on joint work with Christopher J. Bishop and Alexandre Eremenko.

References

[1] Bishop, Christopher J. and Eremenko, Alexandre and Lazebnik, Kirill On the shapes of rational lemniscates *Geom. Funct. Anal.*, 35:359–407, 2025.

Some Gaussianity criteria for Khinchin families

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Generating functions lie at the crossroads of combinatorics, complex analysis, and probability. Given a power series $f(z) = \sum_{n\geq 0} a_n z^n$ with non–negative coefficients and positive radius of convergence $R > 0$, we can turn the coefficients into a *Khinchin family* by declaring, for each $t \in [0, R)$, the mass function

$$\mathbb{P}\big(X_t = n\big) = \frac{a_n\, t^n}{f(t)}, \qquad \text{for any } n \geq 1.$$

This simple prescription simultaneously encodes three objects: the combinatorial numbers a_n, the analytic function f, and a one-parameter family of probability laws $(X_t)_{t\in[0,R)}$. This prompts natural questions: *How do analytic properties of f influence the probabilistic behaviour of X_t?* and, conversely, *what can the probabilistic properties of X_t tell us about the coefficients?*

This talk will focus primarily on analytic criteria for Gaussianity in Khinchin families. Starting from the general framework that assigns to any power series with nonnegative coefficients a family of probability laws $(X_t)_{t\in[0,R)}$, we investigate when the normalized variables converge in distribution to a standard Gaussian. In particular, we present explicit and verifiable analytical conditions, expressed in terms of derivatives of the fulcrum function associated with f, that ensure this convergence. These results allow us to deduce Gaussian behavior using only the behavior of the analytic function along the positive real axis, yielding a flexible toolkit applicable to a wide range of settings; from classical partition functions to canonical products and exponentials of entire functions of finite order.

References

[1] Maciá, V. J.: Some Gaussianity criteria for Khinchin families. *arXiv preprint* arXiv:2501.04375 (2025).

Incomplete polynomial approximation and frequent universality

Konstantinos Maronikolakis

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Generally speaking, an object is called universal if it can approximate, through some specific process, every element of a given space. Moreover, the frequency by which we achieve the universal approximation has been studied intensively since the work of Bayart and Grivaux in 2006, leading to the study of the so-called frequent universality. A main tool that helps us construct universal objects (in particular universal holomorphic functions) is polynomial approximation. In this talk, we will discuss results of approximation by incomplete polynomials and give applications to the frequent universality of Taylor series providing solutions to two problems posed by Mouze and Munnier. This is joint work with Stéphane Charpentier.

Generalized Rosette Harmonic Mappings, and their lifts to Minimal Surfaces

Jane McDougall. Joint work with Conor Wellman and Sohair Abdullah

Colorado College

A harmonic mapping is a complex valued univalent harmonic function defined on a region in the complex plane. **Rosette harmonic mappings** are generalizations of the polynomial harmonic mappings $z + \overline{z}^{n-1}/n - 1$ through modifying the canonical decomposition with hypergeometric ${}_2F_1$ factors. The analytic part of the mapping is closely related to the Schwarz-Christoffel mapping onto a regular 2n-gon, but with parameter $q = 1/n$ replaced by $q = 1/2$. This leads to corners of the boundary of the analytic part equal to $\pi/2$ rather than π/n. By varying the parameter q from 1/2 to a value in $(0, 1/2)$ we obtain a **Generalized Rosette Harmonic Mapping**. When $n \geq 4$ is even, we also obtain an embedded minimal surface that lifts from the harmonic mapping, and with $n = 4$ and $q = 1/2$ the minimal surface is a triply periodic minimal surface (TPMS) for an appropriate relative rotation of the analytic and co-analytic parts. We observe that when q approaches 0 the minimal surface approaches Enneper's surface, thereby providing a continuous deformation to the TPMS. For q in the range $(1/2, 1)$, the harmonic function is not univalent, although for even n it is still the projection of what appears to be an embedded minimal surface. For $1 \leq q < 3/2$, the exterior angles of the boundary of the analytic part of the harmonic mapping are greater than π, while both the harmonic map and minimal surface lifts become unbounded; we conjecture that the minimal surfaces are embedded.

Dynamics of shift operators

Quentin Menet

Université de Mons

Weighted shifts are among the most studied operators in Linear Dynamics. Various dynamical properties have been characterized in terms of weights for these operators such as hypercyclicity [1], topological mixing [2], chaos [3] and frequent hypercyclicity [4]. In a joint work with Dimitris Papathanasiou [5], we have replaced the scalar weights by operators and investigated the dynamical properties of this new family. The aim of this talk will be to highlight the differences between scalar weights and operator weights, as well as the links between an operator T and the associated shift.

References

[1] Salas, H. N. Hypercyclic weighted shifts. *Trans. Amer. Math. Soc.*, 347:993–1004, 1995.

[2] Costakis, G. and Sambarino, M. Topologically mixing hypercyclic operators. *Proc. Amer. Math. Soc.*, 132:385–389, 2004.

[3] Grosse-Erdmann, K.-G. Hypercyclic and chaotic weighted shifts. *Studia Math.*, 139:47–68, 2000.

[4] Bayart, F. and Ruzsa, I. Z. Difference sets and frequently hypercyclic weighted shifts. *Ergodic Theory Dynam. Systems*, 35:691–709, 2015.

[5] Menet, Q. and Papathanasiou D. Dynamics of weighted shifts on ℓ^p-sums and c_0-sums. *Adv. Math.*, 470, 2025.

Sampling and Interpolation in Small Fock Spaces

Mikhail Mironov

Gustave Eiffel University

In this talk, we explore a class of analytic function spaces known as small Fock spaces. We trace their origins and discuss their relevance, along with their connections to the classical Bargmann-Fock space. Our focus will be on sampling and interpolation problems, which play a central role in the structure and applications of these spaces. We present recent results that address these problems and examine their implications.

Forward iteration preserves indestructible and maximal Blaschke products

Annika Moucha

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Let $\mathbb{D} := \{z \in \mathbb{C} : |z| < 1\}$. Given a family of holomorphic functions $f_1, f_2, \cdots : \mathbb{D} \to \mathbb{D}$ its sequence of *forward compositions* is defined by $F_n := f_n \circ \cdots \circ f_1$, $n \geq 1$. By Ferreira's extension of a result by Benini, Evdoridou, Fagella, Rippon and Stallard, see also Abate and Short, there is a necessary and sufficient condition on the family $f_1, f_2, \ldots$ such that the sequence $(F_n)_n$ converges locally uniformly on $\mathbb{D}$ to a *non-constant* limit function $F : \mathbb{D} \to \mathbb{D}$. Furthermore, in this case, Ferreira showed that the limit function F is inner if all functions $f_1, f_2 \ldots$ are chosen to be inner.

This talk deals with forward iteration of two special composition-invariant subclasses of inner functions, namely of indestructible and maximal Blaschke products. We present two sharpenings of Ferreira's result: the limit function F is an indestructible resp. a maximal Blaschke product if and only if all functions $f_1, f_2 \ldots$ are chosen to be indestructible resp. maximal Blaschke products. This is joint work with

A property about seminorms and distances on Fréchet space

Lucas Oger

Université Gustave Eiffel

Following the complete description of linear isometries on the space $\mathrm{Hol}(\Omega)$ of all holomorphic functions on $\Omega = \mathbb{D}$ (the unit disc) or $\mathbb{A}$ (an annulus), with respect to the family of seminorms defined by

$$||f||_{\mathbb{D},\infty,r} = \sup_{|z|\leq r} |f(z)|, \qquad ||f||_{\mathbb{A},\infty,r} = \sup_{1/r\leq |z|\leq r} |f(z)|,$$

a natural question arises. Let E be a Fréchet space, endowed with a family of seminorms $(||\cdot||_n)_{n\geq 0}$. We search for functions $\theta : [0, +\infty) \to [0, 1]$ and positive summable sequences $(s_n)_{n\geq 0}$ such that for all $T \in \mathcal{L}(E)$ and $x \in E$,

$$\sum_{n\geq 0} s_n \theta(||Tx||_n) = \sum_{n\geq 0} s_n \theta(||x||_n) \iff (\forall n \geq 0,\ ||Tx||_n = ||x||_n).$$

We obtain a sufficient condition that covers a wide class of functions θ, so that all sequences (s_n) satisfy the wanted property. After that, we give some examples of Fréchet space for which the linear isometries (with respect to all the seminorms) can be completely described.

This is a joint work with Robert Eymard, Isabelle Chalendar and Jonathan R. Partington.

References

[1] Chalendar, I. and Oger, L. and Partington, J. R. Linear isometries of $\mathrm{Hol}(\mathbb{D})$. *J. Math. Anal. Appl.*, 540.1 (2024), p.19. Id/No 128619.

[2] Chalendar, I. and Oger, L. and Partington, J. R. "Linear isometries on the annulus: description and spectral properties". *Banach J. Math. Anal.*, 19.2 (2025), p.18. Id/No 23.

Hypercyclicity of Toeplitz operators

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The study of Toeplitz operators from the point of view of linear dynamics began with a seminal work by Godefroy and Shapiro, in which they characterized when a Toeplitz operator on the Hardy space with anti-analytic symbol is hypercyclic (i.e., has a dense orbit). Shkarin later characterized the hypercyclicity of tridiagonal Toeplitz operators, and his result was extended first by Baranov and Lishanskii, and later by Abakumov, Baranov, Charpentier, and Lishanskii.
In this talk, I will discuss a new characterization of the hypercyclicity of Toeplitz operators that we obtained using a model theory developed by Yakubovich in the 1990s. This is a joint work with E. Fricain and S. Grivaux.

References

[1] Fricain, E. and Grivaux, S. and Ostermann, M. Hypercyclicity of Toeplitz operators with smooth symbols. *Submitted*, 2025.

Weighted shifts on directed graphs

Dimitris Papathanasiou

Sabanci University

Weighted shifts constitute an important class of operators and their dynamical behavior has been well understood [5]. Recently, this class was broadened by allowing the indexing set of the sequences on which the operator is acting, take the form of a directed tree [2, 3]. In [4], a further generalization was achieved by considering shifts whose weights are operators. In thıs talk, we will discuss examples of weighted shifts acting on sequence spaces indexed by a directed graph and we will attempt to understand their dynamics. We will see how this generalization can be used to create operators outside of the aforementioned classes as well, as to realize already studied operators from a different viewpoint. This is a joint work with A. Baranov and A. Lishanskii.

References

[1] A. Baranov, A. Lishanskii, D. Papathanasiou, *Hypercyclic shifts on lattice graphs*, arXiv:2312.13934 (preprint).

[2] K.-G. Grosse-Erdmann, D. Papathanasiou, *Dynamics of weighted shifts on directed trees*, Indiana Univ. Math. J. **72** (2023), 1, 263–299.

[3] A. López-Martínez, D. Papathanasiou, *Shifts on trees versus classical shifts in chain recurrence*, J. Differ. Equ., **433**, (2025), 113230.

[4] Q. Menet, D. Papathanasiou, *Dynamics of weighted shifts on ℓ^p-sums and c_0-sums*, Adv. Math. **470**, (2025), 110250.

[5] H.N. Salas, *Hypercyclic weighted shifts*, Trans. Amer. Math. Soc. **347** (1995), 993–1004.

Hyperrigidity as a form of 'noncommutative' approximation that captures many important operator-algebraic phenomena

Paweł Pietrzycki

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Motivated both by the fundamental role of the Choquet boundary in classical approximation theory, and by the importance of approximation in the contemporary theory of operator algebras, Arveson introduced hyperrigidity as a form of 'noncommutative' approximation that captures many important operator-algebraic phenomena.

We show that the concept of hyperrigidity can be expressed in many ways. We provide four main approaches to this issue. The first one is via semispectral measures in the spirit of the characterizations of spectral measures. The second approach is based on dilation theory and is written in terms of the Stone-von Neumann calculus for normal operators. The third is inspired by Brown's theorem and deals with the weak and strong convergence of sequences of subnormal (or normal) operators. Finally, the fourth approach concerns multiplicativity of UCP maps on C^*-subalgebras generated by normal elements. This is inspired by Petz's theorem and its generalizations established first by Arveson in the finite-dimensional case and then by Brown in general.

References

[1] Pietrzycki, P. and Stochel, J. Hyperrigidity I: singly generated commutative C^*-algebras, arXiv:2405.20814

The Szász inequalities for matrix polynomials

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Szász inequality is a classical result providing a bound for polynomials with zeros in the upper half of the complex plane in terms of its low-order coefficients. Some generalisations of this result to multivariable polynomials were done by Borcea, Brändén and Knese. In the talk there will be presented inequalities of this kind for matrix polynomials in scalar variable and scalar polynomials in one and multiple matrix variables.

Joint work with Michał Wojtylak nad Oskar J. Szymański.

References

[1] Pikul, P. and Szymański, O. J. and Wojtylak, M. The Szász inequality for matrix polynomials and functional calculus. preprint arXiv:2406.08965, 2024.

[2] Knese, G. Global bounds on stable polynomials. *Complex Anal. Oper. Theory*, 13:1895–1915, 2019.

Size of Parameter Set and The Set of Disjoint Hypercyclic Vectors

Sibel Şahin. Joint work with Frédéric Bayart

Mimar Sinan Fine Arts University

In this talk we will consider the relation between the set of common disjoint-hypercyclic (d-HC) vectors for families of linear operators acting on a Banach space X and the size of parameter set that parametrizes these operators. When the parameter set is uncountable, the non emptiness of the set of common d-HC vectors is a non trivial question and the literature about the hypercyclic counterpart of this question shows us that there are strict restrictions on the size of parameter set. Throughout the talk will examine this general framework over different examples of commonly encountered linear operators namely weighted shifts, translations, composition and differential operators.

References

[1] Bayart F. Common Hypercyclic Vectors for Composition Operators, Journal of Operator Theory, **52**, No:2, (2004), 353–370.

[2] Bayart F. Common Hypercyclic Vectors for High-Dimensional Families of Operators, International Mathematics Research Notices, **21** (2016), 6512–6552.

[3] Bayart F. Costa Jr.F. Menet Q. Common Hypercyclic Vectors and Dimension of the Parameter Set, Indiana Univ.Math J. **71** (2022),no:4, 1763-1795.

[4] Tsirivas N. Common Hypercyclic Vectors for Certain Families of Differential Operators, Illinois Journal of Mathematics Volume 60, Numbers 3–4, Fall and Winter (2016), 625-640.

Generalized spaces of constant curvature in almost contact metric geometry

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In this work, metric contact geometry is studied in depth, introducing different manifolds in this area, from almost contact metric manifolds to Sasakian manifolds. The properties of the latter are investigated through the concept of ϕ-sectional curvature, the expression of the curvature tensor is obtained and from there they are generalized. It is worked in these new spaces, looking for characteristics of them both similar to those of the previous ones and new ones and finally they are provided with different structures to extract more information. At last, we illustrate with examples of general cases different from the previous ones with the help of complex manifolds.

References

[1] D. E. Blair. *Riemannian Geometry of Contact and Symplectic Manifolds.* Second Edition. Progress in Mathematics 203. Birkhaüser. 2010.

[2] P. Alegre, D. E. Blair, A. Carriazo. Generalized Sasakian-space-forms. *Israel Journal of Mathematics* **141** (2004), 157-183.

[3] P. Alegre, A. Carriazo. Structures on generalized Sasakian-space-forms. *Differential Geometry and its Applications* **26** (2008), 656-666.

Cyclicity in Poletsky-Stessin Weighted Bergman Spaces

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We study the cyclicity of polynomials in Poletsky-Stessin weighted Bergman spaces [1] on various domains in $\mathbb{C}^2$, including the unit ball, the bidisk, and the complex ellipsoid. To this end, we introduce a natural extension of the parameter range for Poletsky-Stessin weighted Bergman spaces on complete Reinhardt domains, yielding a family of spaces that resemble Dirichlet-type spaces on the unit ball. We highlight the differences in the cyclicity behavior of polynomials in these spaces on the bidisk compared to those studied by Bénéteau et al. [2] Finally, we propose several open problems concerning the structure of cyclic polynomials in these spaces.

References

[1] Poletsky, E. A. and Stessin, M. I. Hardy and Bergman spaces on hyperconvex domains and their composition operators. *Indiana Univ. Math. J.*, 57(5):2153–2201, 2008.

[2] Bénéteau, C., Knese, G., Kosiński, Ł., Liaw, C., Seco, D., and Sola, A. Cyclic polynomials in two variables. *Trans. Amer. Math. Soc.*, 368(12):8737–8754, 2016.

Polynomial-Based Approximation of the Koopman Operator

Rishikesh Yadav

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The Koopman operator approach offers a robust linear framework for describing nonlinear dynamical systems through the evolution of observables. Although the operator is generally infinite-dimensional, it is essential to create finite-dimensional approximation methods. Additionally, it is important to characterize the associated approximation errors with upper bounds, ideally expressed in the uniform norm. We propose a novel method based on Bernstein polynomial approximation, moving away from the traditional approaches of orthogonal projection or truncation. By utilizing a basis of Bernstein polynomials, we construct a matrix approximation of the Koopman operator in a computationally efficient manner. Building on the principles of approximation theory, we analyze the rates of convergence and establish upper bounds for the error in various contexts, including continuous and differentiable observables. The derived bounds are expressed in the uniform norm and relate to the modulus of continuity of the observables. Additionally, we extend this method to a data-driven framework through a suitable change of coordinates.

Concentration in the Fourier Symmetric Sobolev space

Denis Zelent

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We define the Fourier symmetric Sobolev space $\mathcal{H}$ to be the space consisting of functions $f \in L^2(\mathbb{R})$ such that

$$\|f\|_{\mathcal{H}}^2 = \int_{\mathbb{R}} |f(x)|^2(1+x^2)dx + \int_{\mathbb{R}} |\hat{f}(\xi)|^2(1+\xi^2)d\xi < \infty.$$

It is a reproducing kernel Hilbert space, and we will begin the talk by deriving the formula for the reproducing kernel $K_t(x)$. We base it on the discovery that the Bargmann transform is a unitary operator from $\mathcal{H}$ to a weighted Fock space. Then we will use it to study the concentration problem in $\mathcal{H}$, namely that of maximizing the ratio

$$\frac{\int_I (1+x^2)|f(x)|^2dx + \int_J (1+\xi^2)|\hat{f}(\xi)|^2d\xi}{\int_{\mathbb{R}} (1+x^2)|f(x)|^2dx + \int_{\mathbb{R}} (1+\xi^2)|\hat{f}(\xi)|^2d\xi},$$

where $I, J \subset \mathbb{R}$ are measurable. We approach it by studying the eigenvalues of the corresponding concentration operator $T_{I,J} : \mathcal{H} \to \mathcal{H}$ defined as

$$T_{I,J}f(t) = \int_I f(x)\overline{K_t(x)}(1+x^2)dx + \int_J \hat{f}(x)\overline{\hat{K_t}(x)}(1+x^2)dx.$$

By calculating the trace of $T_{I,J}$ and the sum of the squares of its eigenvalues, we discover an unexpected phenomenon about the decay of eigenvalues of the concentration operator, i.e. the plunge region is of the same order of magnitude as the region where the eigenvalues are close to 1, contrasting the classical case of Paley–Wiener space.

References

[1] Zelent, Denis. Time frequency localization in the Fourier Symmetric Sobolev space. https://arxiv.org/abs/2505.04286

Sampling in (quasi) shift-invariant spaces generated by ratios of exponential polynomials

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Given a separated set Γ in $\mathbb{R}$ and a generator (function) g. The quasi shift-invariant space $V_\Gamma^p(g)$ generated by the function g is an L^p-span of Γ translates of the function g. This space is called shift-invariant if Γ is a set of integers.

We introduce two families of generators that admit meromorphic extension to the complex plane. Namely, we consider $g(x) = R(e^{\alpha x})$ and $g(x) = R(e^{\alpha x})e^{-\alpha x^2/2}$, where R is a rational function satisfying some natural assumptions and α is positive.

We will discuss sharp sampling theorems for the (quasi) shift-invariant spaces $V_\Gamma^p(g)$. Our results are given in terms of lower and upper densities of the sampling set Λ and the set of translates Γ. As an application, we solve the interpolation problem in the space $V_\Gamma^p(g)$ and obtain new results on the density of semi-regular lattices of Gabor frames $\mathcal{G}(g, \Lambda, \mathbb{Z})$.

The talk is based on joint work with Alexander Ulanovskii.

References

[1] Alexander Ulanovskii and Ilya Zlotnikov, Sampling in quasi shift-invariant spaces and Gabor frames generated by ratios of exponential polynomials,
Mathematische Annalen, 391, 3429–3456, 2025.