Abstracts

ACOTCA 2018 - XV edition

Advanced Course in Operator Theory and Complex Analysis

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Contents

Minicourses

Frédéric Bayart
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A short introduction to the (modern) theory of Dirichlet series.

Ordinary Dirichlet series, $\sum_{n\geq 1} a_n n^{-s}$, have been studied quite intensively for 150 years, especially for their links with analytic number theory. Recently, there has been renewed interest in these series, starting from a seminal paper of Hedenmalm, Lindqvist and Seip which introduced the Hardy space of Dirichlet series with square summable coefficients to solve a problem regarding Riesz bases of $L^2([0,1])$. In my course, I will survey several (old and new) aspects of the theory of Dirichlet series:

1. In my first talk, I plan to expose the basic theory of Dirichlet series, focusing on the different abscissae of convergence and on their links. The Bohr lift will also be exposed.
2. My second lecture will be devoted to the Hardy spaces of Dirichlet series.
3. In my last talk, I will discuss some classes of operators acting on the Hardy spaces of Dirichlet series.

Eugenia Malinnikova
NTNU Trondheim, Norway

Localization operators and uncertainty principles in time-frequency analysis.

Artur Nicolau
Universitat Autònoma de Barcelona, Spain

Differentiability, Square Functions and Dyadic Martingales.

The main goal of the lectures is to describe differentiability properties of measurable functions defined in the euclidean space using square functions which involve their second symmetric divided differences. Classical results of Marcinkiewicz, Stein and Zygmund will be discussed as well as their discrete versions which can be stated in terms of dyadic martingales. Results of Burkholder, Gundy and Stout relating the assymptotic behavior of a dyadic martingale with the size of its quadratic variation will also be discussed. An averaging argument will be used to transfer the Fatou type results and the Law of the Iterated Logarithm which hold in the discrete setting to the continuous one.

Sandra Pott
Lunds Universitet, Sweden

Commutators, matrix weights, and sharp bounds.

Commutators (or to an operator theorist, Hankel operators) and the standard class of operators considered in Harmonic Analysis, Calderón-Zygmund operators, exhibit different behaviours, including differences of the optimal bounds in a weighted setting, which are surprising at a first glance.

We will start the course by introducing the setting of vector-valued functions and matrix-weighted weight and presenting some of the recent progress in the area. We will then show that the matrix-weighted setting offers a unified setting for weighted commutators and weighted Calderón-Zygmund operators, which is even interesting in the scalar case. Moreover, we will show that sharp bounds for weighted commutators imply those for Calderón-Zygmund operators and vice versa.

This is joint work with Joshua Isralowitz, Israel Rivera-Rios, Andrei Stoica, and Sergei Treil.

Invited Talks

Yury Belov
St. Petersburg State University, Russia

The Newman-Shapiro problem and spectral synthesis in Fock space.

In 1966 D. Newman and H. Shapiro posed the following problem. Let G be a function from Fock space $\mathcal{F}$ and such that $e^{zw}G \in \mathcal{F}$ for any $w \in \mathbb{C}$. Is it true that

$$\text{span}\{FG : F \in \mathcal{F}\} = \text{span}\{e^{\overline{w}z}G(z) : w \in \mathbb{C}\}?$$

Recently the author (joint with A. Borichev) has constructed a counterexample to this conjecture. On the other hand, we are able to show that if G satisfies some regularity conditions, then conjecture holds. These results are closely connected to some spectral synthesis problems in Fock space.

Fernanda Botelho
University of Memphis, USA

Contractive projections and Bi-contractive Projections on Spaces of Vector Valued Continuous Functions.

In this talk we present a survey of results on the structure of contractive and bi-contractive projections on spaces of continuous functions. We also give a characterization for the bi-contractive projections on spaces of continuous functions defined on a compact Hausdorff space and with values in a separable Hilbert space.

Andreas Hartmann
Université de Bordeaux, France

From the reachable space of the heat equation to Hilbert spaces of holomorphic functions.

In this talk we consider systems described by the heat equation on the interval $[0, \pi]$ with L^2 boundary controls and study the reachable space at some instant $\tau > 0$. The main results assert that this space is generally sandwiched between two Hilbert spaces of holomorphic functions defined on a square in the complex plane and which has $[0, \pi]$ as one of the diagonals. More precisely, in the case of Dirichlet boundary controls acting at both ends we prove that the reachable space contains the Hardy-Smirnov space and it is contained in the Bergman space associated to the above mentioned square. For this we discuss the (explicit) operator associating with both boundary control functions (the so-called input) the corresponding state of the system. This operator is commonly called the input-to-state map. A key step, based on the Poisson summation formula, is the representation of this operator as a convolution with a sum of Gaussians. As it turns out, only two terms of this sum corresponding to both boundary controls need to be considered. These leading terms give rise to integral transforms associated with the heat kernel (or weighted Laplace transforms on sectors) which have been investigated by Aikawa, Hayashi and Saitoh. Another key ingredient is given by Riesz bases for Hardy-Smirnov spaces in polygons which have been discussed by Levin and Lyubarskii.

This is joint work with Karim Kellay (Bordeaux) and Marius Tucsnak (Bordeaux).

Pascal Lefèvre
Université d'Artois, France

An interpolation problem for abscissae of convergence for Hardy spaces of Dirichlet series..

The Hardy spaces of Dirichlet series $\mathcal{H}^p$ ($p \geq 1$) have been studied by Hedenmalm, Lindqvist and Seip when $p = 2$ and by Bayart for the general values of p. We introduce the Orlicz version of Hardy spaces of Dirichlet series $\mathcal{H}^\psi$. We focus on the case $\psi = \psi_q(t) = \exp(t^q) - 1$ and we compute the abscissa of convergence for these spaces, obtaining values interpolating the ones for $\mathcal{H}^p$ and $\mathcal{H}^\infty$. This solves a problem raised by Hedenmalm in 2002. This talk is a complement to the lectures of F. Bayart.

Joint work with M. Bailleul and L. Rodríguez-Piazza.

Pekka Nieminen
Turun yliopisto, Finland

Rigidity phenomena for composition operators.

We consider analytic composition operators in the unit disc. We show that they exhibit quite strong rigidity of non-compact behaviour on Hardy and other function spaces. In particular, we characterize strictly singular and l^2-singular composition operators on H^p. We also consider generalizations of these results.

Marco Peloso
Università degli Studi di Milano, Italy

Fractional Paley—Wiener spaces.

We study spaces of entire functions of exponential type whose restriction to real line have fractional laplacian which is square integrable. For such spaces, that are a natural generalisation of the classical Paley—Wiener spaces, we determine some of their structural properties and study the characterisation of sampling, interpolating and complete interpolating sequences.
This is report on joint work with A. Monguzzi and S. Salvatori.

Eric Sawyer
McMaster University, Canada

The two weight Tb theorem.

We discuss recent work on the two weight Tb theorem.
This is joint work with Chun-Yen Shen and Ignacio Uriarte-Tuero.

Daniel Seco
ICMat, Spain

Some advances in polynomial approximation with applications to invariant subspaces.

We present recent results with Bénéteau and Manolaki with respect to the invariant subspaces generated by a function f in a function space. The information on such spaces is contained on a family of polynomials that we call optimal approximants. In this work, we provide a method for finding a closed formula for all such approximants for a fixed function f, with some assumptions.

Contributed Talks

Ljiljana Arambasic
University of Zagreb, Croatia

Dual frames compensating for erasures.

Evgueni Abakoumov
University Paris-Est

TBA.

Shahida Bashir
University of Gujrat, Pakistan

Structural rigidity of generalised Volterra operators on Hardy spaces.

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Glenier Bello
ICMAT-UAM

Similarity to contractions via operator inequalities.

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Let $\alpha(t) = \sum_{n=0}^{\infty} \alpha_n t^n$ be a function with real coefficients. We say that α is *admissible* if $\alpha(t) = (1-t)\widetilde{\alpha}(t)$ for some function $\widetilde{\alpha}$ positive on $[0,1]$ such that $\sum_{n=0}^{\infty} |\widetilde{\alpha}_n| < \infty$. For admissible functions α we define the following class of bounded linear operators on a Hilbert space H:

$$\mathcal{C}_\alpha := \{T \in L(H) \,:\, r(T) \leq 1, \sum_{n=0}^{\infty} |\widetilde{\alpha}_n| \|T^n\|^2 < \infty, \alpha[T^*, T] \geq 0\},$$

where $r(T)$ denotes de spectral radius of T and $\alpha[T^*, T] := \sum_{n=0}^{\infty} \alpha_n T^{*n} T^n$. We prove that if $T \in \mathcal{C}_\alpha$ then it is similar to a contraction. For these operators we have an explicit functional model and the corresponding consequences derived from it. We also obtain the convergence of the sequence $\{\|T^n h\|^2\}_{n=0}^{\infty}$ for every $h \in H$ under an extra condition on the function α. A criterion for the inclusion $\mathcal{C}_\alpha \subset \mathcal{C}_\beta$ will be given. A useful result about factorization on the Wiener algebra (analytic functions with summable Taylor coefficients) which seems to be new will be mentioned.
Some results of this kind (even for tuples of commuting operators) have been obtained previously. Our work improves them for the single operator case.
This is a joint work with D. Yakubovich.

TOMISLAV BERIC
University of Zagreb, Croatia

Roberts orthogonality and the Davis–Wielandt shell.

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Let $\mathcal{A}$ be a C^*–algebra with the unit e. We say that $x, y \in \mathcal{A}$ are Roberts orthogonal if

$$\|x + \lambda y\| = \|x - \lambda y\|, \quad \lambda \in \mathbb{C}.$$

We give a characterization of Roberts orthogonality of a and e in terms of the Davis–Wielandt shell and show that for some classes of elements, orthogonality of a and e can be ascertained via the numerical range of a.

This is a joint work with Ljiljana Arambasic (University of Zagreb) and Rajna Rajic (University of Zagreb). This research was supported by the Croatian Science Foundation under the project IP-2016-06-1046.

ROSARIO CORSO
Università degli Studi di Catania

Sesquilinear forms associated to sequences on Hilbert spaces.

We will discuss the possibility of defining sesquilinear forms starting from one or two sequences of elements of a Hilbert space. One can associate operators to

these forms and in particular look for conditions to apply representation theorems of sesquilinear forms, such as Kato's theorems. The associated operators correspond to classic frame operators or multipliers in the bounded context. In general some properties of them, such as the invertibility and the resolvent set, are related to properties of the sesquilinear forms. We will focus on special sequences such as lower semi-frames and weighted Riesz basis.

Ugur Gul
Hacettepe University ANKARA TURKEY

An invertibility criterion in a c*-algebra acting on the hardy space with applications to composition operators.

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In this talk we will deal with an invertibility criterion for certain operators which is given as a linear algebraic combination of Toeplitz operators and Fourier multipliers acting on the Hardy space of the unit disc. Very similar to the case of Toeplitz operators we prove that such operators are invertible if and only if they are Fredholm and their Fredholm index is zero. As an application we prove that for "quasi-parabolic"" composition operators the spectra and the essential spectra are equal.
These results constitute joint work with B.B. Koca of Istanbul University

Rajeev Gupta
IIT Kanpur

The Caratheodory-Fejer Interpolation Problem for the Polydisc.

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We present an algorithm for finding a solution to the Caratheodory-Fejer interpolation problem on the polydisc, whenever it exists. A necessary condition for the existence of a solution becomes apparent from this algorithm.

H. Turgay Kaptanoglu
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Inclusions Among Bergman-Besov And Bloch-Lipschitz Spaces And H^∞ On The Unit Ball Of $\mathbb{C}^N$.

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The Bergman-Besov spaces B_q^p with $q \in \mathbb{R}$ and $p > 0$ consist of holomorphic functions on the unit ball $\mathbb{B}$ of $\mathbb{C}^N$ whose sufficently high-order radial derivatives lie in the Bergman spaces on $\mathbb{B}$ with standard weights $(1-|z|^2)^q$ for which $q > -1$. The Bloch-Lipschitz spaces $\mathcal{B}_\alpha^\infty$ with $\alpha \in \mathbb{R}$ are the $p = \infty$ versions of the B_q^p.
We describe exactly and fully which of the spaces in the title are included in which others. More importantly, we construct explicit functions in each space that make sure that each containment is strict and the best possible, and this is the interesting part of our work. Our constructions involve lacunary series of Ryll-Wojtaszczyk polynomials, Littlewood-Paley inequalities, and atomic decompositions of the spaces among others. Many of the inclusions turn out to be sharper than the Sobolev imbeddings.
This is joint work with A. Ersin Üreyen of Anadolu University, Eskişehir.

Santeri Miihkinen
Åbo Akademi University

Structural rigidity of generalised Volterra operators on Hardy spaces.

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Generalised Volterra operator

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

where f, g are analytic in the unit disc $\mathbb{D}$ of the complex plane, was introduced by Pommerenke in the 1970s in connection to exponentials of BMOA functions. Its properties have been widely studied by several authors in many analytic function spaces since the mid-1990s when its boundedness and compactness were characterized in Hardy and Bergman spaces by Aleman and Siskakis. In this talk, we look into its structural properties, ℓ^2-singularity in particular. An operator is ℓ^2-singular if its restriction to any subspace isomorphic to the sequence space ℓ^2 is not bounded below, i.e. it does not fix an isomorphic copy of ℓ^2. Our main result implies that generalised Volterra operators acting on Hardy spaces H^p are always ℓ^2-singular for $p \neq 2$.

Miguel Monsalve López
UCM-ICMAT

On Bishop-type operators.

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In this talk we will discuss spectral properties of Bishop-type operators, as well as results regarding the behaviour of their iterates.

Waleed Noor
University of Campinas (UNICAMP), Brasil

The Báez-Duarte Theorem for the Hardy-Hilbert space.

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The Báez-Duarte Theorem is a reformulation of the Riemann Hypothesis cast as a completeness problem in a separable Hilbert space. We obtain a version of the Báez-Duarte criterion in terms of the Hardy-Hilbert space of the open unit disk. We shall also consider some interesting approximation problems.

José Àngel Pelàez
University of Màlaga, Spain

Littlewood-Paley formula for weighted Bergman spaces.

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We shall describe the radial weights ω on the unit disc $\mathbb{D}$ such that the Littlewood-Paley formula

$$\|f\|^p_{A^p_\omega} \asymp \int_{\mathbb{D}} |f^{(k)}(z)|^p (1-|z|)^{kp} \omega(z)\, dA(z) + \sum_{j=0}^{k-1} |f^{(j)}(0)|^p, \quad f \in H(\mathbb{D}).$$

holds for any $0 < p < \infty$ and $k \in \mathbb{N}$.

These results are part of an ongoing work together with Jouni Rättyä.

Serap Öztop Kaptanoğlu
Istanbul University

Twisted Orlicz Algebras as Operator Algebras.

Orlicz spaces are known as natural generalizations of L^p-spaces. Let G be a locally compact group, $\Omega : G \times G \to C$ 0 be a 2-cocyle, and φ be a Young function. We consider the twisted convolution coming from Ω over the Orlicz space $L^\varphi(G)$. We try to find out which $L^\varphi(G)$ becomes a Banach algebra with respect to twisted convolution and which is completely isomorphic to an operator algebra. We show that our results could be applied to a variety of cases. This

is a joint work with Ebrahim Samei and Varvara Shepelska of the University of Saskatchewan, Canada.

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Odí Soler
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Distances to a subspace of the Zygmund Class.

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A continuous real valued function f on $\mathbb{R}$ with compact support is said to belong to the Zygmund class Λ_*, if

$$\sup_{x,h\in\mathbb{R}} \frac{|f(x+h)+f(x-h)-2f(x)|}{|h|} < \infty.$$

It is known that the space I(BMO) of functions whose distributional derivatives are BMO functions is a subspace of Λ_*. In this talk, based on a joint work with A. Nicolau, we give an estimate for the distance of a given function $f \in \Lambda_*$ to the subspace I(BMO). It will also be discussed a related result for functions in the Zygmund class which are as well in Sobolev sapces.

Shailesh Trivedi
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Drury-Arveson type spaces associated with Cartesian product of locally finite rooted directed trees.

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Given a directed Cartesian product $\mathscr{T}$ of locally finite, leafless, rooted directed trees $\mathscr{T}_1, \ldots, \mathscr{T}_d$ of finite joint branching index, one may associate with $\mathscr{T}$ the Drury-Arveson-type $\mathbb{C}[z_1, \ldots, z_d]$-Hilbert module $\mathscr{H}_{\mathfrak{c}_a}(\mathscr{T})$ of vector-valued holomorphic functions on the open unit ball $\mathbb{B}^d$ in $\mathbb{C}^d$, where $a > 0$. In case all directed trees under consideration are without branching vertices, $\mathscr{H}_{\mathfrak{c}_a}(\mathscr{T})$ turns out to be the classical Drury-Arveson-type Hilbert module $\mathscr{H}_a$ associated with the reproducing kernel $\frac{1}{(1-\langle z,w\rangle)^a}$ defined on $\mathbb{B}^d$. Unlike the case of $d = 1$, the above association does not yield a reproducing kernel Hilbert module if we relax the assumption that $\mathscr{T}$ has finite joint branching index. We classify all directed Cartesian product $\mathscr{T}$ for which the Hilbert modules $\mathscr{H}_{\mathfrak{c}_a}(\mathscr{T})$ are isomorphic

in case a is a positive integer. This is a joint work with Sameer Chavan and Deepak Kumar Pradhan.

ARENDT WOLFGANG
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Asymptotic behavior of composition semigroups.

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The spectrum of composition opreators has been investigated thouroughly. In the talk we will establish relations of spectral properties and the asymptotical behaviour of the powers of an operator. A particular role is played by the poles of the resolvent. We will also consider holomorphic flows and the associated composition semigroups on diverse Banach spaces of holomorphic functions. The results on asymptotics reflect different properties of the spaces.
The talk is based on two papers joint with I.Chalandar, M. Kumar and S. Srivastava.

HANAA ZAYED
Menofia University, Egypt

Some Properties of Uniformly Starlike and Convex Hypergeometric Functions.

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The purpose of this paper is to introduce some properties of (Gaussian) hypergeometric function to be in various subclasses of uniformly starlike and uniformly convex functions. Operators related to hypergeometric functions are also considered. Some of our results correct previously known results.

Nina Zorboska
University of Manitoba

Unitary weighted composition operators on reproducing kernel Hilbert spaces of holomorphic functions.

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Weighted composition operators play an important role when determining the surjective isometries on some Banach spaces of functions. In this talk I will present a characterization of the class of unitary weighted composition operators acting on a special family of Hilbert spaces of holomorphic functions. I will also mention some general geometric aspects of these types of investigations that are closely related to the problems on classification of reproducing kernel Hilbert spaces.