Complex Analysis and Operator Theory

International Workshop in honor of

Daoud Bshouty, David Shoikhet and Simeon Reich

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Abstracts

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Non-linear resolvents of holomorphically accretive mappings

In this talk I plan to discuss known and new results on holomorphically accretive mappings and their resolvents defined on the open unit ball of a complex Banach space.

Namely, we will present a criterion for a mapping to be holomorphically accretive with given squeezing ratio of the generated semigroup as well estimates on its non-linear resolvents.

Following an idea of Harris–Reich–Shoikhet, we establish an inverse function theorem for mappings that admit so-called one-sided estimates. This allows to obtain distortion and covering results for non-linear resolvents. In their turn, the distortion and covering theorems imply accretivity of resolvents with estimates on squeezing ratio. Furthermore, we prove that a nonlinear resolvent is a starlike mapping of given order subject some mild conditions.

Aviv Gibali

HIT Holon Institute of Technology

Superiorization as an acceleration technique and beyond

In this talk I'll present some results in which we used superiorization and the bounded perturbation resilience of algorithms to speed up convergence of given algorithm in multi and single objective optimization problems. Moreover, show how this methodology can help for treating non-convex objective functions.

Several open question to the auidenace/experts are also given.

Oleg Ivrii

Tel Aviv University

Analytic Mappings of the unit disk which almost preserve hyperbolic area

We give a number of characterizations of analytic self-maps of the unit disk which distort hyperbolic area of large disks by a bounded amount in terms of angular derivatives, Lipschitz extensions, Möbius distortion, the distribution of critical points and Aleksandrov-Clark measures.

A joint talk with Artur Nicolau.

Yochay Jerby

HIT Holon Institute of Technology

Edwards' speculation on the origin of the Riemann Hypothesis and higher-order sections

The Riemann-Siegel formula is the main method for computing values of the Riemann zeta function along the critical line. In his seminal work, Edwards offered a "speculation"—one of the few theoretical explorations into the origins of the Riemann Hypothesis (RH) based on this formula. While providing valuable insights, Edwards' Speculation fails to yield a robust theoretical framework due to the inherent complexities of the Riemann-Siegel formula.

In this talk, we introduce an alternative approach to computing zeta on the critical line through high-order sections. Utilizing our asymptotic results on the accelerated Hasse-Sondow formula, we prove a conjecture by Spira, demonstrating that high-order sections circumvent the main analytical challenges encountered for the classical Riemann-Siegel formula. This advancement allows us to recast Edwards' speculation within our higher-order framework, transforming the study of the RH into a contemporary optimization problem. Our exploration of this variational framework uncovers a novel repulsion property among consecutive zeros, potentially connected to the anticipated repulsion effect in the Montgomery pair correlation conjecture.

Dmitrii Karp

HIT Holon Institute of Technology

Generalization of Meijer's G-function by using Barnes' double gamma function

By replacing the Euler gamma function by the Barnes double gamma function in the definition of the Meijer G-function, we introduce a new family of special functions. It is a quite general family which contains Meijer's G-functions (thus also all classical hypergeometric functions ${}_pF_q$), as well as several new functions that appeared recently in the study of random processes and the fractional Laplacian. Our goal at this first stage is to define the new function, study its analytic and transformation properties and relate it to the functions found in the literature. We further define a generalization of the Kilbas-Saigo function introduced earlier to solve in closed form certain classes of integral and differential equations of fractional order and observe that both the original and generalized Kilbas-Saigo functions are special case of our new function.

The talk is based on a joint work with Alexey Kuznetsov (York University, Toronto, Canada).

Nir Lev

Bar-Ilan University

Schauder frames of translates in $L^p(\mathbb{R})$

Does there exist a basis in the space $L^p(\mathbb{R})$ consisting of translates of a single function? I will survey the known results around this problem and present some recent work joint with Anton Tselishchev.

Thu Hien Nguyen
Julius-Maximilian University of Würzburg

Analytic closure of sets of univariate hyperbolic polynomials

The Laguerre–Pólya class is a special class of entire functions that are locally the limit of sequences of univariate hyperbolic polynomials. We present some necessary and sufficient conditions for entire functions to belong to the Laguerre–Pólya class, or to have no complex roots. These conditions involve only their Taylor coefficients: for an entire function $f(z) = \sum_{k=0}^{\infty} a_k z^k$, we define the second quotients of Taylor coefficients as $q_n(f) := \frac{a_{n-1}^2}{a_{n-2}a_n}$, $n \geq 2$, and formulate the conditions in terms of $q_n(f)$. We also discuss some relations of the Laguerre–Pólya class to hyperbolicity preserving operators, algebraic geometry and combinatorics.

Alon Nishry
Tel Aviv University

Integer-valued polynomials satisfying a growth constraint

Integer-valued polynomials (IVPs) are algebraic polynomials which take integer values on the integers. We consider IVPs that satisfy an exponential growth condition on the natural numbers. Elkies and Speyer, answering a question by Dimitrov on MathOverflow, proved there is a growth threshold, so that there are infinitely many IVPs with growth rate above the threshold and only finitely many IVPs below that threshold. We estimate the number of IVPs with a growth rate above the threshold, for polynomials of large degree. In addition, we consider a more general problem, with a not necessarily symmetric growth condition on the integers.

Based on a joint work in progress with Avner Kiro.

Fedor Pakovich

Ben Gurion University of the Negev

On intersections of orbits of rational functions

Let A be a rational function of degree at least two on $\mathbb{CP}^1$. For a point $z_1 \in \mathbb{CP}^1$ we denote by $O_A(z_1)$ the forward orbit of A, that is, the set $\{z_1, A(z_1), A^{\circ 2}(z_1), \dots\}$. In the talk, we address the following problem: *given two rational functions A and B of degree at least two, under what conditions do there exist orbits $O_A(z_1)$ and $O_B(z_2)$ having an infinite intersection?* We show that under a mild restriction on A and B this happens if and only if A and B have an iterate in common, that is, if and only if $A^{\circ k} = B^{\circ l}$ for some $k, l \geq 1$. Put another way, unless rational functions A and B have the same global dynamics, an orbit of A may intersect an orbit of B at most at finitely many places.

Lakshmi Priya

Tel Aviv University

Almost sharp lower bound for the nodal volume of harmonic functions

In this talk, I will discuss the relation between the growth of harmonic functions and their nodal volume. Let $u : \mathbb{R}^n \to \mathbb{R}$ be a harmonic function, where $n \geq 2$. One way to quantify the growth of u in the ball $B(0,1) \subset \mathbb{R}^n$ is via the *doubling index* N, defined by

$$\sup_{B(0,1)} |u| = 2^N \sup_{B(0,\frac{1}{2})} |u|.$$

I will present a result, obtained jointly with A. Logunov and A. Sartori, where we prove an almost sharp result, namely:

$$\mathcal{H}^{n-1}(\{u = 0\} \cap B(0,2)) \gtrsim_{n,\varepsilon} N^{1-\varepsilon},$$

where $\mathcal{H}^{n-1}$ denotes the $(n-1)$ dimensional Hausdorff measure.

Ami Viselter
University of Haifa

Rieffel deformations of locally compact quantum groups

We give an introduction to the theory of locally compact quantum groups and present an old-new construction called the Rieffel deformation, which allows constructing quantum groups from simple classical objects. If time permits, we show how to construct Lévy processes, i.e. "continuous-time random walks", on Rieffel deformation quantum groups. Based on joint work with Adam Skalski.

Olesia Zavarzina
V.N. Karazin Kharkiv National University

Around the plasticity problem

A metric space (M, d) is called expand-contract plastic (or just plastic) if every bijective non-expansive map $F\colon M \to M$ is an isometry.

The talk concerns plasticity of totally bounded metric spaces as in [4] and introduces some simple results and examples on the real line from [3].

We will also discuss a question about plasticity of the unit ball of an arbitrary Banach space as a metric space with the metric generated by the norm, which was posed in [1]. Observe, that in finite dimensions plasticity problem for the unit ball is solved in positive since in finite dimensions the unit ball is compact. In infinite dimensional case there are only some partial results which will be presented in the talk. As well as some results concerning more general problem: for which pairs (X, Y) of Banach spaces every bijective non-expansive map $F\colon B_X \to B_Y$ is an isometry?

Further, following [2], the definition of plastic metric space and result about totally bounded metric spaces will be generalized to the case of two different spaces.

Finally, we will give some remarks from [5] about plasticity of quasi-metric spaces, i.e. metric spaces without the axiom of symmetry.

References

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[3] Langemann D., Zavarzina O. *Expand-contract plasticity on the real line*, Frontiers in Applied Mathematics and Statistics **10** (2024), 1387012.

[4] Naimpally S. A., Piotrowski Z., Wingler E. J. *Plasticity in metric spaces*, J. Math. Anal. Appl. **313** (2006), 38-48.

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