New Developments in Complex Analysis and Function Theory

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Book of abstracts

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Co-organized by:

Περιφέρεια Κρήτης
Περιφερειακή Ενότητα
Ηρακλείου

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Plenary talks

Universality and boundary behavior of polynomial approximants

Catherine Bénéteau
University of South Florida

In this talk, I will discuss certain polynomials that approximate, in some optimal way, inverses of functions in analytic function spaces of the unit disk. These polynomials are closely related to classical objects in function theory such as orthogonal polynomials and reproducing kernels in weighted spaces. I will examine the universality properties of these polynomials on the unit circle and describe a related double approximation property for non-vanishing analytic functions.

Semigroups of holomorphic functions on the unit disk

Dimitrios Betsakos
Aristotle University of Thessaloniki

A one-parameter family of holomorphic functions $\phi_t : \mathbb{D} \to \mathbb{D},\ t \geq 0$, is called a *semigroup* if
(a) $\phi_0 =$identity, (b) $\phi_{t+s} = \phi_t \circ \phi_s$, (c) $\lim_{t\to s} \phi_t = \phi_s$.
For every $z \in \mathbb{D}$, the *orbit* starting from z is the path $\gamma_z : [0, +\infty) \to \mathbb{D}$ with $\gamma_z(t) = \phi_t(z)$.

We will review some basic facts about semigroups and their orbits:
(i) Representation of semigroups (Koenigs function),
(ii) Classification of semigroups (elliptic, hyperbolic, parabolic),
(iii) Behavior as $t \to \infty$: If (ϕ_t) is hyperbolic or parabolic, there exists a unique attractive point $\tau \in \partial\mathbb{D}$ such that for every $z \in \mathbb{D}$, $\phi_t(z) \to \tau$, as $t \to \infty$.

We will present some recent results regarding the asymptotic behavior of the orbits as $t \to \infty$.

Trees in dynamics and probability

Mario Bonk
University of California, Los Angeles

Trees (often called dendrites) appear in many areas of mathematics, for example as Julia sets of some postcritically-finite polynomials or as samples of the continuum random tree (CRT). In my talk I will report on some recent results on the topology and quasiconformal geometry of trees. This is joint work with Huy Tran and with Daniel Meyer.

Periodic cycles and singular values of entire transcendental functions

Núria Fagella
Universitat de Barcelona

Location and local dynamics of periodic points of a dynamical system is a classical problem. Among the non-repelling periodic points we find the equilibria of the system. When the iterated functions is entire (polynomial or transcendental) the Separation Theorem describes the distribution of the non-repelling periodic points with respect to the "external rays", an invariant set of points in the escaping set. In this talk we shall relate these objects also to the singular values of the function, i.e. points where the map fails to be a local homeomorphisms. These results give an alternative proof of the well known Fatou-Shishikura inequality which bounds the number of non-repelling cycles in terms of the number of singular values of the map.

Inequalities for the analytic content, and the Bergman analytic content, of domains in Euclidean space

Stephen J. Gardiner
University College Dublin

The analytic content of a bounded planar domain Ω is defined by

$$\lambda(\Omega) = \inf\{\|\overline{z} - \phi\|_{\overline{\Omega}} : \phi \in C(\overline{\Omega}) \cap \mathrm{Hol}(\Omega)\},$$

where $\|\cdot\|_{\overline{\Omega}}$ denotes the usual sup norm. It has a natural extension to all dimensions which is formulated in terms of harmonic vector fields. This talk will describe the verification of a conjecture of Gustafsson and Khavinson, relating the analytic content of a smoothly bounded domain in $\mathbb{R}^N$ to the classical isoperimetric inequality. It will then discuss an analogous notion of analytic content for Bergman spaces, and associated isoperimetric-type inequalities involving the St Venant functional for torsional rigidity.

This is joint work with Marius Ghergu and Tomas Sjödin.

Order isomorphisms of countable dense real sets which are universal entire functions

Paul Gauthier
Université de Montréal

An entire function can have surprising properties. It can be universal in the sense that its translates approximate all entire functions. Given two countable dense real sets A and B, there exists an entire function which restricts to an order isomorphism of A onto B. An entire function can have both of these properties simultaneously. An entire function can have either of these properties, yet have finite order of growth.

The numerical range of compressions of the shift operator

Pamela Gorkin
Bucknell University

After a brief introduction to the numerical range of a matrix and some applications, we discuss some standard techniques used to study it. We then apply these to obtain properties of the numerical ranges of compressions of the shift operator in various settings.

Singularities and Wandering domains

Xavier Jarque
Universitat de Barcelona

The general framework will be iteration of transcendental maps on the complex plane. The celebrated Sullivan non wandering domains Theorem asserts that for rational iteration all Fatou components are eventually periodic. Later it was shown that quasi-conformal surgery, Sullivan's main ingredient on his proof, could be used to show that, for instance, critically finite transcendental entire maps have the same property. However it was already known that wandering domains are possible in transcendental dynamics. We will present first some previous results and examples on the (non-) existence of wandering domains. Secondly, we will focus on the relation between wandering domains and the post singular set for transcendental entire or meromorphic maps. Such relation is well understood for attracting and parabolic basins and partially understood for Siegel discs and Baker domains, but there are few results relating wandering domains and the postsingular set. We will present new results (joint work with K. Baranski, N. Fagella and B. Karpinska) on this direction. For instance, we will show that if the iterates of such a domain do not intersect the postsingular set, and the postsingular set lies at a positive distance from the Julia set (in the complex plane) then any sequence of iterates of wandering domains must contain arbitrarily large disks. This allows to exclude the existence of wandering domains for some meromorphic maps with infinitely many poles and unbounded set of singular values.

Algebra and PDE: stronger together than apart

Dmitry Khavinson
University of South Florida

Do you find the following questions appealing?

- Let $F(u, v)$ be a rational function of two variables that has no linear factors and a meromorphic function $u(x, y)$ solves the PDE $F(\operatorname{grad} u) = 0$ near the origin, say. Then u is a linear function, *i.e.*, $u = ax + by + c$. Why? Is it true in three variables?

- Let u be a harmonic polynomial in $\mathbb{R}^n$ and P is a non-negative polynomial that divides u. Then u vanishes identically. Is it true?

- Let $P(D)[u^k] = 0$, where $P(D)$ is a partial differential operator with entire coefficients and k runs over an arithmetic progression of positive integers, *e.g.*, $k = 2n + 3, n = 1, 2, ...$ Then the hessian, $\operatorname{Hess} u$, vanishes identically, so the mapping $\operatorname{grad} u : \mathbb{C}^n \to \mathbb{C}^n$ is degenerate. Why?

- Does the principal ideal generated by a harmonic polynomial $x^2 + y^2 - 2z^2$ contain infinitely many harmonic polynomials?

We shall discuss some common grounds for these and other similar questions.

Localized Hardy spaces and generic results

Vassili Nestoridis
University of Athens

It is well known that the derivative of the Riemann map of a Jordan domain with rectifiable boundary belongs to the Hardy space H^1 on the unit disc. In collaboration with V. Liontou we extended this result to Jordan domains with a rectifiable arc in their boundary. Thus, we are led to localised Hardy spaces on the disc. In such function spaces, in collaboration with A. Stavrianidi and S. Vlachos, we prove generic results of non-extendability or totally unboundedness extending results of M. Siskaki and T. Hatziafratis, K. Kioulafa and V. Nestoridis.

A positivity conjecture related to the Riemann zeta function

Thomas Ransford
Université Laval

The celebrated Riemann hypothesis can be reformulated as a simply-stated criterion concerning least-squares approximation. While carrying out computations related to this criterion, we have observed a curious phenomenon: for no apparent reason, at least the first billion entries of a certain infinite triangular matrix associated to the Riemann zeta function are all positive. In this talk, I shall explain the background leading to this observation, and make a conjecture. (Joint work with Hugues Bellemare et Yves Langlois.)

Baker's conjecture in complex dynamics

Phil Rippon
The Open University

In the iteration of an analytic function, the Fatou set (or stable set) is the open set where the iterates of the function form a normal family, and its complement is the Julia set (or chaotic set). Baker's conjecture is that for transcendental entire functions of order less than 1/2, the Fatou set has no unbounded components. We describe recent progress on this conjecture, and the way in which the conjecture has led to new results in classical complex analysis of wider interest.

This is joint work with Gwyneth Stallard and Dan Nicks.

On complex and imaginary multiplicative chaos

Eero Saksman
University of Helsinki

We consider the existence of random complex multiplicative chaos "$e^{\beta X}$" for general log-normal Gaussian fields and $\beta \in \mathbb{C}$. In particular, we will describe analytical properties of "$\cos(\beta X)$". The talk is based on joint work with Janne Junnila (University of Helsinki) and Christian Webb (Aalto University).

2d-shape Analysis using Complex Analysis

Alexander Yu. Solynin
Texas Tech University

We will discuss several approaches to the problem of recognition of two-dimensional images or "shapes". One particular approach to this problem, based on Complex Analysis, uses compositions of conformal mappings restricted to circles, the so-called "fingerprints". An idea to use fingerprints to study two-dimensional shapes goes back to a paper "*Kähler structure on the K-orbits of a group of diffeomorphisms of the circle*" of Alexander Kirillov published in 1987. But it were Eiten Sharon and David Mumford who turned this idea (in their 2004 paper "*2d-shape analysis using conformal mapping*") into a tool, which can be applied for recognition of planar shapes, such as shapes on TV screens and in pictures. After that this theory became quite a popular topic in recent publications on applications of complex analysis to problems in pattern recognition.

An interesting approach to fingerprint problem was suggested by Peter Ebenfelt, Dima Khavinson and Harold Shapiro in their paper "*Two-dimensional shapes and lemniscates*" published in 2011. In this paper, the authors have shown, in particular, that fingerprints of polynomial lemniscates (which, by a classical result due to David Hilbert, are dense in the space of all two-dimensional shapes) are generated by solutions of functional equations, which involve Blaschke products. A simpler proof of the main result of Ebenfelt, Khavinson and Shapiro and its generalization to the case of rational lemniscates were presented in a nice short paper "*Shapes, fingerprints and rational lemniscates*" by Malik Younsi published in 2016.

The first goal of this talk is to discuss how methods of Complex Analysis can be applied to the problems of pattern recognition. In particular, I will discuss the main results on fingerprints obtained by Ebenfelt, Khavinson and Shapiro and by Younsi. In addition, I will also mention a different approach to fingerprints via circle packing which was used by Brock Williams.

My second goal here is to present my recent results, which include as special cases Ebenfelt-Khavinson-Shapiro characterization of fingerprints of polynomial lemniscates as well as Younsi characterization of rational lemniscates. My main intention here is to emphasize the role of *quadratic differentials* in this developing theory.

Eremenko's conjecture in complex dynamics

Gwyneth Stallard
The Open University

This talk is concerned with the iteration of transcendental entire functions, in particular with the set of points which escape to infinity under iteration, known as the escaping set. This set plays a key role in transcendental dynamics with much recent work motivated by Eremenko's conjecture that all the components of the escaping set are unbounded. We describe how this has led us to show that, for many functions, the escaping set has the structure of an infinite spider's web, using and proving results on the properties of the maximum modulus and the minimum modulus.

This is joint work with Phil Rippon and Dan Nicks.

On an extremal problem in geometric function theory

Dragan Vukotić
Universidad Autónoma de Madrid

Consider a non-vanishing analytic function bounded by one in modulus in the unit disk. Then the largest possible value of any of its Taylor coefficients (other than the constant term) should be exactly $2/e$, and equality should hold only for a specific singular inner function with finitely many atoms. This conjecture, posed around 1968 by a Polish mathematician Jan Krzyż, has been pursued by various complex analysts.

While the problem can be considered from many different points of view and information on the structure of extremal functions has been available for a long time, the conjecture has remained open to this date. So far, it has only been proved for the first five coefficients; also, various partial results have been obtained regarding the properties of extremal functions.

The purpose of this talk is to review the current state of the conjecture and some progress obtained in the recent years, including a collaboration with María J. Martín, Eric T. Sawyer, and Ignacio Uriarte-Tuero. Related problems will be considered if time permits.

Contributed talks

On polynomial inequalities in the complex plane

Vladimir Andrievskii
Kent State University

This is a survey of some recent results concerning the following topics. First, we discuss sharp $L_p, 1 \leq p < \infty$ weighted Remez- and Nikolskii-type inequalities for algebraic polynomials considered on a quasismooth (in the sense of Lavrentiev) curve in the complex plane. Second, we present the exact (up to the constants) double inequality for the Christoffel function for the generalized Jacobi measure supported on a Jordan domain bounded by a quasiconformal curve. Note that the quasiconformality of the boundary cannot be omitted.

Multiply universal Taylor shift operator

Nikolitsa Chatzigiannakidou
University of Patras

Recently, H. Klaja and A. Mouze studied the problem of double universality of the Taylor shift operator acting on the space of real infinitely differentiable functions. Their result is inspired by the notion of doubly universal Taylor series introduced by G. Costakis and N. Tsirivas. In this talk we will present the general case of multiple universality of the Taylor shift operator, combining ideas presented by H. Klaja and A. Mouze, and by V. Vlachou who studied this problem for universal Taylor series.

Weighted harmonic mappings in the unit disk

Xingdi Chen
Huaqiao University

In this talk, we will give several results on weighted harmonic mappings. Corresponding to Euclidean harmonic mappings, we give the integral representation theorem, Rado-Kneser-Choquet theorem, Schwarz Lemma for weighted harmonic mappings. Furthermore, we also obtain equivalent conditions for the Lipschitz continuity of weighted harmonic mappings.

Universal constraints on semigroups of hyperbolic isometries

Argyrios Christodoulou
The Open University

This talk concerns semigroups of isometries of the hyperbolic plane, which are known to arise naturally in various dynamical systems. A central problem in this theory is identifying whether a semigroup is discrete, a property that is well-understood for groups of isometries, namely Fuchsian groups. Our goal is to obtain geometric constraints on finitely-generated semigroups of isometries that imply discreteness. We also compare these conditions with their well-known counterparts in the theory of Fuchsian groups.

Cantor bouquets in spiders' webs

Yannis Dourekas
The Open University

For many transcendental entire functions, the escaping set has the structure of a Cantor bouquet, consisting of uncountably many disjoint curves. Rippon and Stallard showed that there are many functions for which the escaping set has a new connected structure known as an infinite spider's web. We investigate a connection between these two topological structures for a certain class of exponentials.

On computability and computational complexity of Julia sets

Artem Dudko
Institute of Mathematics, Polish Academy of Sciences

Computer generated images of Julia sets play crucial role in establishing new results in complex dynamics. Roughly speaking, a subset of a plane is called computable if there is an algorithm which can produce an approximation of this set with arbitrary high precision. Computational complexity measures how long does it take for such algorithm to produce an approximation with given precision. In this talk I will give a survey on computability and computational complexity of Julia sets and will present some new results.

Bohr's inequality for harmonic mappings

Stavros Evdoridis
Aalto University

In this talk we present improved versions of Bohr's inequality for sense-preserving harmonic mappings with bounded analytic part, defined in the unit disc. The results are obtained along the lines of an earlier work of I. R. Kayumov and S. Ponnusamy and all of them are sharp.

Critical locus for complex Henon maps

Tanya Firsova
Kansas State University

For one dimensional maps, the dynamics of the map is to a large extent determined by the orbits of the critical points. Complex Henon maps are automorphisms, and as such do not have critical points. Critical loci, sets of tangencies between dynamically defined foliations/laminations often serve as a good analog of the critical points. We study the critical loci in the escape region, defined by Bedford, Smillie and Hubbard. The critical locus in this region is a one-dimensional analytic set. We'll discuss the relation between the dynamical properties of the map and topological properties of the critical locus. We will give a description of the critical locus for Henon maps in an HOV region. This is a joint work in progress with Remus Radu and Raluca Tanase.

Hyponormal Toeplitz operators with non-harmonic symbol acting on the Bergman space

Matthew Fleeman
Baylor University

The Toeplitz operator acting on the Bergman space $A^2(\mathbb{D})$, with symbol φ is given by $T_\varphi f = P(\varphi f)$, where P is the projection from $L^2(\mathbb{D})$ onto the Bergman space. We present some history on the study of hyponormal Toeplitz operators acting on $A^2(\mathbb{D})$, as well as give results for when φ is a non-harmonic polynomial. Particular attention is given to unusual hyponormality behavior that arises due to the extension of the class of allowed symbols.

Dynamical moduli spaces and multipliers of periodic points

Lukas Geyer
Montana State University

One of the fundamental questions in complex dynamics is to understand the structure of and coordinates on *moduli space* $\mathcal{M}_d$, i.e., the space of Möbius conjugacy classes of rational maps of some given degree d. Multipliers at fixed points and periodic points are conjugacy invariants, so a natural question is how uniquely they determine conjugacy classes. For square degrees $d = n^2$ there is always a one-dimensional subvariety $\Lambda_d \subset \mathcal{M}_d$ consisting of rational maps which are semi-conjugate to multiplication by n on a torus, with all multipliers constant, the "flexible Lattés locus." However, McMullen showed that for every degree d there exist numbers N_d and K_d such that the multipliers of periodic points up to period N_d determine at most K_d conjugacy classes in $\mathcal{M}_d \setminus \Lambda_d$.

Although not much is known about N_d and K_d for $d \geq 3$, we will find "generic" versions of these, i.e., N'_d and K'_d such that multipliers up to period N'_d determine at most K'_d conjugacy classes in an open dense subset of $\mathcal{M}_d$.

We also consider the same problem in the moduli space $\mathcal{M}_d^P$ of polynomials instead of rational maps, and show that in this case, *fixed point data* (multiplicity and holomorphic indices of all fixed points, equivalent to fixed point multipliers for polynomials without multiple fixed points) determines at most $(d-2)!$ conjugacy classes in $\mathcal{M}_d^P$ for $d \geq 2$.

This is joint work with Adam Epstein (University of Warwick, UK).

Composition operators on Dirichlet-type and Möbius invariant spaces

Gokhan Gogus
Sabanci University

In this talk, norm and essential norm estimates of composition operators acting on Dirichlet-type spaces and Möbius invariant spaces of analytic functions on the unit disk will be presented. The Dirichlet-type spaces were introduced recently for the first time by G. Bao, G. Gogus and S. Pouliasis.

Widom factors in approximation theory

Alexander Goncharov
Bilkent University

We discuss the asymptotic behaviour of Chebyshev polynomials and orthogonal polynomials in terms of *Widom factors.* Our main interest is in the description of the Szegő class for continuous singular measures.

Dual exponential polynomials and linear differential equations

Janne Heittokangas
University of Eastern Finland
and Taiyuan University of Technology

We discuss linear differential equations with exponential polynomial coefficients, where exactly one coefficient is of order greater than all the others. The main result shows that a nontrivial exponential polynomial solution of such an equation has a certain dual relationship with the maximum order coefficient. Several examples illustrate our results and exhibit possibilities that can occur.

This presentation is based on a joint work with Gary Gundersen and Zhi-Tao Wen, published in J. Differential Equations **264** (2018), 98-114.

Marstrand-type projection theorems in normed spaces

Annina Iseli
University of Bern

In 1954, John Marstrand established a theorem that describes to what extent the Hausdorff dimension of Borel sets in Euclidean two-space changes under orthogonal projections onto lines. Namely, he proved that given a Borel set A the dimension of the image of A under the orthogonal projection onto a line L equals the smaller of 1 and dim(A), for almost every line L that contains the origin. This result marked the start of a large series of results in the same spirit to which many mathematicians contributed over the last decades. In particular, there exist Marstrand-type projection theorems for higher dimensional Euclidean space and there are analogs of these results in other metric spaces such as the Heisenberg groups.

In this talk we address the existence of Marstrand-type results for closest-point projections onto linear subspaces of codimension one in finite dimensional normed spaces. In fact, we determine the minimal regularity needed for a norm to support Marstrand-type theorems. Moreover, we present the construction of a norm in Euclidean two-space that barely fails to satisfy the required regularity and does not support Marstrand-type theorems. As it turns out, this is closely related to the study of the set of exceptional directions for the orthogonal projections onto lines in Euclidean two-space.

(The presented results were achieved as part of my PhD thesis supervised by Zoltán Balogh.)

Describing Blaschke products by their critical points

Oleg Ivrii
California Institute of Technology

In this talk, I will discuss a question which originates in complex analysis but is really a problem in non-linear elliptic PDE. It is well known that up to post-composition with a Möbius transformation, a finite Blaschke product may be uniquely described by the set of its critical points. I will discuss an infinite-degree version of this problem posed by Dyakonov. Let J be the set of inner functions whose derivative lies in the Nevanlinna class. I will explain that an inner function in J is uniquely determined by the inner part of its derivative (its critical structure), and describe all possible critical structures of inner functions in J. I will also give a concrete description of the natural topology on J which respects the convergence of critical structures.

Semigroups of hyperbolic isometries

Matthew Jacques
The Open University

Motivated by the theories of Kleinian groups and of continued fractions we explore the dynamics of semigroups generated by hyperbolic isometries of the unit 3-ball. Each Kleinian group G induces a limit set contained in the Riemann sphere. In an analogous fashion each semigroup induces two subsets of the Riemann sphere, a forward limit set and a backward limit set. We describe semigroups for which the identity is not an accumulation point as semidiscrete. We have shown that if S is a finitely-generated nonelementary semidiscrete semigroup of isometries of the unit 2-ball, then S is a group if and only if its two limit sets are equal. In this talk we show an extended version of that result to semigroups acting on the unit 3-ball.

Chebyshev polynomials and typically real functions

Stanislawa Kanas
University of Rzeszow

We discuss the generalized Chebyshev polynomials $U_n(p,q;e^{i\theta})$ of the second kind defined by the generating function

$$\Psi^{(p,q)}(e^{i\theta};z)=\frac{1}{(1-pze^{i\theta})(1-qze^{-i\theta})}=\sum_{n=0}^{\infty}U_n(p,q;e^{i\theta})z^n,\qquad z\in\mathbb{D},$$

where $\theta\in[-\pi,\pi]$ and $-1\leq q\leq p\leq 1$, as well as the class of generalized typically-real functions, defined in [1, 2], that is, the class of functions analytic in the unit disk, and given by

$$f(z)=\frac{1}{2\pi}\int_0^{2\pi}\frac{z\,d\mu(\theta)}{(1-e^{i\theta}pz)(1-e^{-i\theta}qz)},\qquad z\in\mathbb{D},$$

where $\mu(\theta)$ is the probability measure on $[0,2\pi]$ and $-1\leq p,q\leq 1$.

References

[1] S. Kanas, A. Tatarczak, Constrained coefficients problem for generalized typically real functions, *Complex Var. Elliptic Equ.* **61** (2016), no. 8, 1052-1063.
[2] S. Kanas, A. Tatarczak, Generalized Typically Real Functions, *Filomat* **30** (2016), no. 7, 1697-1710.

Complex-analytic and other properties of the generalized hypergeometric functions and their ratios

Dmitrii Karp
Far Eastern Federal University

In the talk we discuss Stieltjes and Nevanlinna representations of the generalized hypergeometric functions and their ratios along with their consequences. We present several new representation formulas and identities used to deduce them. In particular, a formula for the jump of generalized hypergeometric functions when crossing the branch cut and new identities for a sum of products of hypergeometric functions play a key role. We further give a brief survey of the mapping and other complex-analytic properties of the hypergeometric functions that follow from the new and known representations. If time permits we also discuss connections with radial positive definite functions, extended Laguerre inequalities for entire functions, location of zeros and other topics.

Semigroups of holomorphic functions and condenser capacity

Maria Kourou
Aristotle University of Thessaloniki

Suppose $(\phi_t)_{t\geq 0}$ is a one-parameter semigroup of holomorphic self-maps of the unit disk $\mathbb{D}$ with Denjoy-Wolf point $\tau = 1$. The semigroup is called hyperbolic if the angular derivative $\phi_t'(1) < 1$, whereas the semigroup is called parabolic if $\phi_t'(1) = 1$. Suppose K is a compact subset of $\mathbb{D}$. We prove that the capacity of the condenser $\big(\mathbb{D}, \phi_t(K)\big)$ is a decreasing function of t and we study its asymptotic behavior with respect to the type of the semigroup.

This is a joint work with D. Betsakos, G. Kelgiannis and St. Pouliasis funded by the program "Support to researchers emphasizing on young researchers", ΕΣΠΑ 2014-2020.

Prescribing the postsingular dynamics of meromorphic functions

Kirill Lazebnik
California Institute of Technology

We show that any dynamics on any discrete planar sequence S can be realized by the postsingular dynamics of some meromorphic function, provided we allow for small perturbations of S. This work was influenced by an analogous result of DeMarco, Koch and McMullen for finite S in the rational setting. The proof contains a method for constructing meromorphic functions with good control over both the postsingular set of f and the geometry of f, using the Folding Theorem of Bishop and a classical fixpoint theorem. This is joint work with Christopher Bishop.

Quasisymmetric embeddings of slit Sierpínski carpets into the plane

Wenbo Li
City University of New York

The study of quasiconformal geometry of fractal metric spaces has received much attention recently. In particular, the metric spaces homeomorphic to the classical Sierpínski carpet, also known as metric carpets, were studied partly because of problems arising in geometric group theory.

A mapping between metric spaces is called quasisymmetric if it distorts relative distances and sizes of sets by a bounded amount. One of the most important questions in the theory is the problem of quasisymmetrically embedding a metric space into an Euclidean space. In this talk we will define a class of spaces called slit Sierpínski carpets and will completely characterize those slit Sierpínski carpets which can be embedded quasisymetrically into the plane. The main tools are classical and transboundary modulus of families of curves. This is a result proved by Hrant Hakobyan and Wenbo Li.

Finite rank perturbations

Constanze Liaw
University of Delaware

Kato-Rosenblum and Aronszajn-Donoghue provide reasonably good understanding of the subtle theory of rank one perturbations. We will briefly discuss these statements. For higher rank perturbations, the situation is different. While the Kato-Rosenblum theorem still ensures the stability of the absolutely continuous part of the spectrum, the singular parts can behave more complicated. Nonetheless, some results prevail in the finite rank setting.

On the branch set of mappings

Rami Luisto
Charles University in Prague

We call a continuous, open and discrete mapping a branched cover. This class of mappings contains several interesting families of maps, *e.g.* those of holomorphic and quasiregular mappings, and mappings of finite distortion with property (A). The set of points where a given map fails to be a local homeomorphism is called the branch set of the map. There are several classical results describing some aspects of possible branch sets for the aforementioned classes of mappings, but many natural questions remain open. In this talk we present some recent results, joint with Aapo Kauranen and Ville Tengvall, connecting the large scale behaviour of a branched cover with the large scale behaviour of its branch set.

Oscillating wandering domains for entire functions of finite order in the class $\mathcal{B}$

David Martí-Pete
Kyoto University

Recently Bishop constructed the first example of a bounded-type transcendental entire function with a wandering domain using a new technique called quasiconfomal folding. It is easy to check that his method produces a function of infinite order. We construct the first examples of functions in the class $\mathcal{B}$ of finite order with wandering domains. In Bishop's example, as well as in our construction, the wandering domains are of oscillating type, that is, with an unbounded non-escaping orbit. To build such function, we use quasiconformal interpolation instead of quasiconformal folding, which is much more straightforward. Our examples have order $p/2$ for any $p \in \mathbb{N}$ and thus, since functions in the class $\mathcal{B}$ have order at least $1/2$, we can achieve the smallest possible order. This is a joint work with Mitsuhiro Shishikura.

On the solutions of the incompressible Euler equations

Maria Martín
Universidad Autónoma de Madrid

Several publications in the applied mathematics, engineering and physics research literature exploited a remarkable feature shared by some celebrated explicit solutions to the two-dimensional incompressible Euler equations in Lagrangian variables, namely that in all of them the labelling map is harmonic at all times.

Recently, A. Aleman and A. Constantin proposed a complex analysis approach aimed at classifying all such flows. While new explicit solutions were obtained, the exhaustion of all possibilities was reduced to an explicit nonlinear ordinary differential system in $\mathbb{C}^4$. Solving this system in full generality proved elusive so far.

We propose a different approach, based on ideas from the theory of harmonic mappings, that provides a complete solution to the problem of classifying all two-dimensional ideal fluid flows with harmonic Lagrangian labelling maps; thus, we explicitly provide all solutions (with the specified structural property) to the incompressible two-dimensional Euler equations.

Joint work with O. Constantin.

Strong continuity of semigroups of composition operators on Morrey spaces

Noel Merchán
Universidad de Málaga

A semigroup of analytic functions in the disc is a family $(\varphi_t)_{t\geq 0}$ of analytic functions in the unit disc $\mathbb{D}$ with $\varphi_t(\mathbb{D}) \subset \mathbb{D}$ which satisfy the following conditions:

- φ_0 is the identity in $\mathbb{D}$.
- $\varphi_{t+s} = \varphi_t \circ \varphi_s$, for all $t, s \geq 0$.
- $\varphi_t \to \varphi_0$, as $t \to 0$, uniformly on compact subsets of $\mathbb{D}$.

Each such semigroup induces a semigroup (C_t) of composition operators on $\mathcal{H}(\mathbb{D})$, the space of analytic functions in $\mathbb{D}$,

$$C_t(f) = f \circ \varphi_t, \quad f \in \mathcal{H}(\mathbb{D}).$$

Given a Banach space X consisting of functions of $\mathcal{H}(\mathbb{D})$ and a semigroup (φ_t), we say that (φ_t) generates a semigroup of operators on X if (C_t) is a well-defined strongly continuous semigroup of bounded operators in X. This exactly means that for every $f \in X$, we have $C_t(f) \in X$ for all $t \geq 0$ and

$$\lim_{t\to 0^+} \|C_t(f) - f\|_X = 0.$$

Classical choices of X treated in the literature are the Hardy spaces H^p, the disk algebra $\mathcal{A}$, the Bergman spaces A^p, the Dirichlet space $\mathcal{D}$ and the chain of spaces Q_p and $Q_{p,0}$ which include the spaces $BMOA$, Bloch as well as their "little oh" analogues.

In this work we study the action of (C_t) to the class of Morrey spaces

$$\mathcal{L}^{2,\lambda} = \left\{ f \in H^2 \,:\, \sup_{a\in\mathbb{D}} (1-|a|^2)^{1-\lambda} \int_{\mathbb{D}} |f'(z)|^2 (1-|\sigma_a(z)|^2)\, dA(z) < \infty \right\},$$

where $\sigma_a(z) = \frac{a-z}{1-\bar{a}z}$, $a \in \mathbb{D}$ are Möbius maps and $0 < \lambda < 1$.

This work is based on a joint work with professors P. Galanopoulos and A. G. Siskakis from Aristotle University of Thessaloniki, Greece.

References

[1] O. Blasco, M. D. Contreras, S. Díaz-Madrigal, J. Martínez, A. G. Siskakis, Semigroups of Composition Operators in BMOA and the Extension of a Theorem of Sarason, *Integral Equations Operator Theory* **61** (2008), no. 1, 45-62.

[2] O. Blasco, M. D. Contreras, S. Díaz-Madrigal, J. Martínez, M. Papadimitrakis, A.G. Siskakis, Semigroups of Composition Operators and integral operators in spaces of analytic function, *Ann. Acad. Sci. Fenn. Math.* **38** (2013), 67-89.

Carleson measures for the Dirichlet space on the polydisc

Pavel Mozolyako
Università di Bologna

The Dirichlet space on the polydisc $\mathbb{D}^d, d \geq 1$, consists of analytic functions satisfying

$$\|f\|^2_{\mathcal{D}(\mathbb{D}^d)} := \sum_{m_1,\dots,m_d} |\hat{f}(m_1,\dots,m_d)|^2 (m_1+1)\cdot\dots\cdot(m_d+1) < +\infty.$$

In the one-dimensional case ($d = 1$) the Carleson measures were first described by Stegenga ('80) in terms of capacity, further development was achieved in papers by Arcozzi, Rochberg, Sawyer, Wick and others.

Following Arcozzi et al. we consider the equivalent problem in the discrete setting — characterization of trace measures for the Hardy operator on the polytree T^d. For $d = 2$ we present a description of such measures in terms of bilogarithmic capacity (which, in turn, gives the description of Carleson measures for $\mathcal{D}(\mathbb{D}^2)$ in the sense of Stegenga).

This talk is based on joint work with N. Arcozzi, K.-M. Perfekt, G. Sarfatti.

Recent results on polynomial inequalities

Béla Nagy
Hungarian Academy of Sciences, University of Szeged

Recently, there is a growing interest in Bernstein and Turán type inequalities. Our main focus is to establish sharp inequalities and also develop new techniques meanwhile. In this talk I would like to present some new Turán type inequalities on general sets involving the density of the equilibrium measure. This is a work in progress. The results are based on joint works with Olivier Sète and Sergei Kalmykov.

On some properties of a class of analytic functions defined by a generalised differential operator

Timothy Opoola
University of Ilorin

Using a generalised differential operator, we define a class of analytic functions with negative coefficients. For this new class we provide the characterization property. The radii of starlikeness and convexity of functions belonging to the class defined are also established. Our results generalized some well known results.

Key words: Analytic functions, Univalent functions, Opoola differential operator.

Gleason parts for uniform algebras without analytic discs

Dimitrios Papathanasiou
University of Mons-Hainaut

It was once conjectured that whenever the maximal ideal space $\mathcal{M}_A$ of a uniform algebra (A, X) is bigger than X, there exists an analytic disc in $\mathcal{M}_A \setminus X$. Stolzenberg gave an example showing that this is not the case, see [4]. One could still hope though, that some weaker notion of analyticity like nontrivial Gleason parts could be found in $\mathcal{M}_A \setminus X$. Garnett however in [2], proved that every σ-compact, completely regular space can occur as a Gleason part for a uniform algebra which restricted on this part is the algebra of all continuous and bounded functions. Even though Garnett's result showed that Gleason parts need not bear any analyticity, in the maximal ideal spaces of his examples there are still many analytic discs. Later on, examples of nontrivial uniform algebras without analytic discs and with either only trivial Gleason parts or a big Gleason part were found, see [1] and [3]. We will be concerned with the question of characterizing the topological spaces that can occur as Gleason parts for uniform algebras without analytic discs.

References

[1] B. J. Cole, S. N. Ghosh, A. J. Izzo, A hull with no nontrivial Gleason parts, *Indiana Univ. Math. J.* (accepted).
[2] J. Garnett, A topological characterization of Gleason parts, *Pacific J. Math.* **20**, (1967), no.1, 59-63.
[3] A. J. Izzo, Gleason parts and point derivations for uniform algebras with dense invertible group, *Trans. Amer. Math. Soc.* (accepted).
[4] G. Stolzenberg, A hull with no analytic structure, *J. Math. Mech.* **12**, (1963), 103-111.

The polarization with respect to hypersphere and its applications

Elena Prilepkina
Far Eastern Federal University

The methods of symmetrization have a lot of applications in the geometric theory of functions. The first geometric transformation bearing the name symmetrization was introduced by Steiner in 1836. It is now well known that many symmetrizations can be obtained as a limit of the polarizations with respect to hyperplanes [1]. This transformation was introduced for sets by Wolontis in 1952, the term polarization was suggested by Dubinin in 1985. But not enough attention has been paid in the literature to applications of the polarization with respect to hypersphere. We will discuss the basic properties of the polarization with respect to hypersphere. Applications include some isoperimetric inequalities for conformal capacity of condensers, estimates of conformal metric [2] and distortion theorems for quasiregular mappings in the annulus, inequalities for n-harmonic Levitskii radius [3]. For example, let D be a star-shaped domain with respect to zero, $D \subset \mathbb{R}^n$, $a \in D \setminus \{0\}$, $b \in D \setminus \{0\}$ and $a/|a| = b/|b|$, $|a| < |b|$. Then $R_n(D,b)/|b| \leq R_n(D,a)/|a|$, where $R_n(D,a)$ is n-harmonic radius [4]. For a proper subdoman $G \subset \mathbb{R}^n$ and for all $x, y \in G$ define conformal metric $\mu_G(x,y)$,

$$\mu_G(x,y) = \inf_{C_{xy}} M_n(\triangle(C_{xy}, \partial G; G)),$$

where infimum is taken over all continua C_{xy} such that $C_{xy} = \gamma[0,1]$ and γ is a curve with $\gamma(0) = x$ and $\gamma(1) = y$. Here $\triangle(E,F,G)$ is the family of all closed non-constant curves joining E and F in G and $M_n(\triangle(E,F,G))$ is its conformal module. By using the polarization with respect to hypersphere for annulus $K_r = \{r < |x| < 1/r\}$ and $x, y \in K_r$, $|x| = |y| = 1$, we proved that

$$\mu_{K_r}(x,y) = M_n(\triangle(\alpha_{xy}, \partial K_r; K_r)),$$

where α_{xy} joins x with y and is the smallest arc of the unit circle in the 2-dimensional plane Oxy.

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References

[1] A. Yu. Solynin, Continuous symmetrization via polarization, *Algebra i Analiz*, **24** (2012), no. 1, 157-222; *St. Petersburg Math. J.* **24** (2013), no. 1, 117-166.

[2] M. Vuorinen, *Conformal geometry and quasiregular mappings*, Lecture Notes in Mathematics, 1988, Springer-Verlag.

[3] W. Wang, N-Capacity, N-harmonic radius and N-harmonic transplantation, *J. Math. Anal. Appl.* **327** (2007), no. 1, 155-174.

[4] E. G. Prilepkina, On the n-harmonic radius of domains in the n-dimensional Euclidean space, *Dal'nevost. Mat. Zh.* **17** (2017), no. 2, 246-256 (in Russian).

A Bound on the Cohomology of Quasiregularly Elliptic Manifolds

Eden Prywes
University of California, Los Angeles

A classical result gives that if there exists a holomorphic mapping $f\colon \mathbb{C} \to M$, then M is homeomorphic to S^2 or $S^1 \times S^1$, where M is a compact Riemann surface. I will discuss a generalization of this problem to higher dimensions. I will show that if M is a d-dimensional, closed, connected, orientable Riemannian manifold that admits a quasiregular mapping from $\mathbb{R}^d$, then the dimension of the degree l de Rham cohomology of M is bounded above by $\binom{d}{l}$. This is a sharp upper bound that proves a conjencture by Bonk and Heinonen. A corollary of this theorem answers an open problem posed by Gromov. He asked whether there exists a simply connected manifold that does not admit a quasiregular map from $\mathbb{R}^d$. The result gives an affirmative answer to this question.

Approximation of functions and operators, a tentative comparison

Hervé Queffélec
University of Lille

Let f be a continuous, complex *function*, on $K = [-1, 1]$. A fundamental result of S. Bernstein (later extended by Walsh, Widom, and others) establishes a sharp connection between the speed $E_n(f)$ of uniform approximation of f by polynomials of degree n and the analytic extension of f to a domain $\Omega \supset K$, in terms of the relative Green capacity of K inside Ω.

We establish a similar connection for approximation numbers $a_n(T)$ of a (weighted) composition *operator* on the Hardy space of the unit disk, in terms of the Green capacity of its "compositional symbol", with a non-trivial application.

This connection somehow persists in several dimensions, as it is the case (Siciak) for functions. We will yet show the limits of that connection in dimension greater than 1, through a counterexample on the bidisk.

This talk is issued from several joint works, published, submitted, or under progress, with Daniel Li and Luis Rodríguez-Piazza (and also Gandalf Lechner for one of them).

Siegel disks for complex Hénon maps

Remus Radu
University of Toronto

We look at the family of complex Hénon maps which have a semi-indifferent fixed point with eigenvalues w_1 and w_2, where $|w_1| < 1$ and $w_2 = \exp(2\pi it)$ and t is a Brjuno number. These maps have a Siegel disk and we are interested in the regularity properties of its boundary. When t is the golden mean and the Jacobian is small enough, we show, using hyperbolicity of golden mean renormalization of dissipative Hénon-like maps, that the boundary of the Siegel disk is homeomorphic to a circle. This is joint work with D. Gaidashev and M. Yampolsky.

A z^k invariant subspace without the wandering property

Daniel Seco
ICMAT

We present a construction of an invariant subspace for the operator of multiplication by z^k in Dirichlet-type spaces, which does not satisfy the wandering property. This is in relation to a question by Carswell, Duren and Stessin.

Quasiconformal variation of cross-ratios and applications

Mitsuhiro Shishikura
Kyoto University

A quasiconformal mapping $f\colon \mathbb{C} \to \mathbb{C}$ defines a deformation of the conformal structure defined by $ds = |dz + \mu_f d\bar{z}|$. We study the deformation of 2-dimensional torus (elliptic curve) via Grötzsch inequality. This gives an estimate on the variation of cross-ratios of 4 points on the Riemann sphere, through the theory of elliptic functions. As an application, we give a simple proof of Teichmüller-Wittich-Belinskiĭ's and Gutlyanskiĭ-Martio's theorems on the conformality of quasiconformal mappings at a given point. The same estimate is applied to the construction of oscillating wandering domains for an entire function of class B with finite order (with David Martí Pete). As another application, we also give a proof of Ahlfors-Bers's formula on the parametric differentiation of qc-mappings (without going through singular integral operators and Calderón-Zygmund inequality).

Distances to a subspace of the Zygmund Class

Odí Soler i Gibert
Universitat Autònoma de Barcelona

A continuous real valued function on $\mathbb{R}$ with compact support is said to belong to the Zygmund class, $f \in \Lambda_*$, 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 with BMO derivative in the distributional sense 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). We will do so by means of a discretisation similar to another used previously by J. Garnett and P. Jones to study the space BMO.

Hedgehogs in higher dimensions and their applications

Raluca Tanase
University of Toronto

Hedgehogs in dimension one were introduced by Pérez-Marco in the '90s to study linearization properties and dynamics of holomorphic univalent germs of $(\mathbb{C}, 0)$ with a neutral fixed point. In this talk we discuss hedgehogs and their dynamics for germs of holomorphic diffeomorphisms of $(\mathbb{C}^n, 0)$ with a fixed point at the origin with exactly one neutral eigenvalue. We show how to use quasiconformal theory to transport results from one complex dimension to higher dimensions. This is based on joint work with T. Firsova, M. Lyubich, and R. Radu.

Closed range composition operators on $BMOA$

Maria Tjani
University of Arkansas

Let φ be an analytic self-map of the unit disk $\mathbb{D}$. We characterize closed range composition operators C_φ on $BMOA$. An important ingredient is a reverse type Carleson condition due to Luecking. An immediate corollary is that if C_φ is closed range on the Bloch space then it is also closed range on $BMOA$.

This is joint work with Kevser Erdem.

On Julia sets for quasimeromorphic mappings

Luke Warren
University of Nottingham

In studying the dynamics of analytic and meromorphic functions, the Fatou set $\mathcal{F}$ and the Julia set $\mathcal{J} = \mathcal{F}^c$ are very important objects. More recently, the Fatou-Julia theory has been successfully extended to different types of quasiregular mappings, which are higher dimensional analogues of analytic mappings in Euclidean real space. Of key importance, the Julia sets were established and studied independently from the Fatou sets by using the so called 'blowing-up' property. We shall extend the Fatou-Julia theory to quasimeromorphic mappings with an essential singularity at infinity and at least 1 pole by providing a definition of the Julia set for these mappings.

Iteration in tracts

James Waterman
The Open University

By a result of Rippon and Stallard, for a transcendental entire function there exist points in the escaping set whose orbit escapes arbitrarily slowly. We will discuss extending this result to prove the existence of points which escape arbitrarily slowly within a particular type of domain, called a tract.

Weak tangents of visual sphere of expanding Thurston maps

Angela Wu
University of California, Los Angeles

Weak tangents of a metric space are limits of the blow ups of a metric space. We study the geometry of visual spheres generated by expanding Thurston maps. We will discuss what weak tangents can tell us about the geometry of these visual spheres.

Conformal rigidity of circle domains

Malik Younsi
University of Hawaii

A domain in the Riemann sphere is called a circle domain if every connected component of its boundary is either a round circle or a point. The famous Koebe uniformization conjecture states that every planar domain is conformally equivalent to a circle domain. The existence of a Koebe conformal map has been proved only in some special cases, such as domains with at most countably many boundary components, thanks to the major progress of He and Schramm in the 1990's.

In this talk, I will discuss uniqueness of the map, which is closely related to the notion of conformal rigidity. More precisely, we say that a circle domain is (conformally) rigid if every conformal map of the domain onto another circle domain is the restriction of a Möbius transformation. It is well-known that some circle domains are rigid and some are not, but both sufficient and necessary conditions are yet to be found. I will survey recent results on the rigidity of circle domains, and we shall see how all of this is related to conformal removability.

Schwarz lemma and boundary Schwarz lemma for pluriharmonic mappings

Jian-Feng Zhu
Huaqiao University

In this talk, we first improve the boundary Schwarz lemma for holomorphic self-mappings of the unit ball $\mathbb{B}^n$, and then we establish the boundary Schwarz lemma for harmonic self-mappings of the unit disk $\mathbb{D}$ and pluriharmonic self-mappings of $\mathbb{B}^n$. The results are sharp and coincide with the classical boundary Schwarz lemma when $n = 1$.

The closed span of an exponential system in L^p spaces on simple closed rectifiable curves in the complex plane and Pólya singularity results for Taylor-Dirichlet series

Elias Zikkos
Cyprus Ministry of Education

In the spirit of the Fabry-Pólya gap singularity results for power series and Dirichlet series, we investigate similar phenomena for Taylor-Dirichlet series of the form

$$\sum_{n=1}^{\infty}\left(\sum_{k=0}^{\mu_n-1} c_{n,k}z^k\right)e^{\lambda_n z}, \quad c_{n,k}\in\mathbb{C},$$

when associated to a set Λ having multiple positive real numbers

$$\Lambda := \{\underbrace{\lambda_1,\lambda_1,\ldots,\lambda_1}_{\mu_1-times},\underbrace{\lambda_2,\lambda_2,\ldots,\lambda_2}_{\mu_2-times},\ldots,\underbrace{\lambda_k,\lambda_k,\ldots,\lambda_k}_{\mu_k-times},\ldots\}, \quad 0<\lambda_1<\lambda_2<\ldots,$$

$\lambda_n\to\infty$, with Λ satisfying the density condition $\lim_{t\to\infty}\frac{\sum_{\lambda_n\leq t}\mu_n}{t}=d<\infty$ and some other restrictions. We prove that such a series has at least one singularity in every open interval whose length exceeds $2\pi d$ and lies on the boundary of convergence.

We also characterize those functions defined on a simple closed rectifiable curve l_d (a curve that surrounds straight line segments of length $2\pi d$, parallel to the Imaginary Axis) that belong to the closed span of the exponential system

$$E_\Lambda := \{z^k e^{\lambda_n z}:\ n\in\mathbb{N},\ k=0,1,2,\ldots,\mu_n-1\},$$

in the Banach space $L^p(l_d)$ for $p\geq 1$, equipped with the norm $||f||_{L^p(l_d)}=\left(\int_{l_d}|f(z)|^p\,|dz|\right)^{\frac{1}{p}}$. In addition, we characterize the solution space of a convolution equation and a differential equation of infinite order.

References

[1] I. F. Krasichkov-Ternovskii, Invariant subspaces of analytic functions. II. Spectral synthesis on convex domains, *Mat. Sb.* **88** (1972), 3-30; English transl., Math. USSR-Sb. **17** (1972), 1-29.

[2] A. S. Krivosheev, The fundamental principle for invariant subspaces in convex domains, *Izv. Ross. Acad. Nauk Ser. Mat.* **68** no. 2 (2004), 71-136, English transl., *Izv. Math.* **68** no. 2 (2004), 291-353.

[3] O. A. Krivosheeva, Singular points of the sum of a series of exponential monomials on the boundary of the convergence domain, *Algebra i Analiz* **23** no. 2 (2011), 162-205; English transl., *St. Petersburg Math. J.* **23** no. 2 (2012), 321-350.

[4] E. Zikkos, On a theorem of Norman Levinson and a variation of the Fabry Gap theorem, *Complex Var. Theory Appl.* **50** no. 4 (2005), 229-255.

[5] E. Zikkos, Analytic continuation of Taylor-Dirichlet series and non-vanishing solutions of a differential equation of infinite order, *Comput. Methods Funct. Theory* **10** no. 1 (2010), 367-398.

Poster session

1. Dahmane Achour, University of M'sila
   Factorable p-nuclear m-homogeneous polynomials
2. Tomasz Beberok, University of Agriculture in Krakow
   Does Markov inequality imply nonpluripolarity?
3. Tania Gricel Benitez Lopez, University of Liverpool
   Topology of Julia continua
4. Asena Çetinkaya, Istanbul Kültür University
   Convolution properties for Salagean-type analytic functions defined by q-difference operator
5. Firas Ghanim, University of Sharjah
   Subclass of univalent meromorphic functions defined by a linear operator associated with the Hurwitz-Lerch zeta function
6. Mayya Golitsyna, University College Dublin
   Overconvergent properties of polynomial expansions of harmonic functions
7. Juha-Matti Huusko, University of Eastern Finland
   On Becker's univalence criterion
8. Angeliki Kampoukou, University of Athens
   A remark on projective limits of function spaces
9. Christina Karafyllia, Aristotle University of Thessaloniki
   On a relation between harmonic measure and hyperbolic distance on planar domains
10. Seong-A Kim, Dongguk University
    Polynomial expressions of higher Schwarzian derivatives
11. Masashi Kisaka, Kyoto University
    Transcendental entire function of arbitrarily slow growth with prescribed polynomial dynamics
12. Prasanna Kumar, BITS Pilani, K K Birla Goa Campus
    Some results involving zeros of a complex polynomial
13. Mezrag Lahcene, University of M'sila
    New classes of summability for Lipschitz operators
14. Adrián Llinares, Universidad Autónoma de Madrid
    On norms of inclusions between mixed norm spaces
15. Alejandro Mas, Universidad Autónoma de Madrid
    Unitary operators in Hilbert spaces of analytic functions
16. Adesanmi Mogbademu, University of Lagos
    Effectiveness properties of certain interpolator polynomials
17. Dalah Mohamed, Freres Mentouri Constantine University
    Analysis of an antiplane contact problem with friction

18. Parvaneh Najmadi, Payame Noor University
Estimate of logarithmic coefficients of a certain subclass of analytic functions
19. Leticia Pardo Simón, University of Liverpool
Unbounded postsingular sets in transcendental dynamics
20. Monica Rosiu, University of Craiova
Boundary value problems on Klein surfaces
21. Alexandra Stavrianidi, National and Kapodistrian University of Athens
Generic results about totally unbounded functions
22. Timothy Wilson, University of North Texas
Continuity of Hausdorff dimension for Julia sets of hyperbolic and parabolic polynomials
23. Paweł Zaprawa, Lublin University of Technology
On circularly symmetric functions