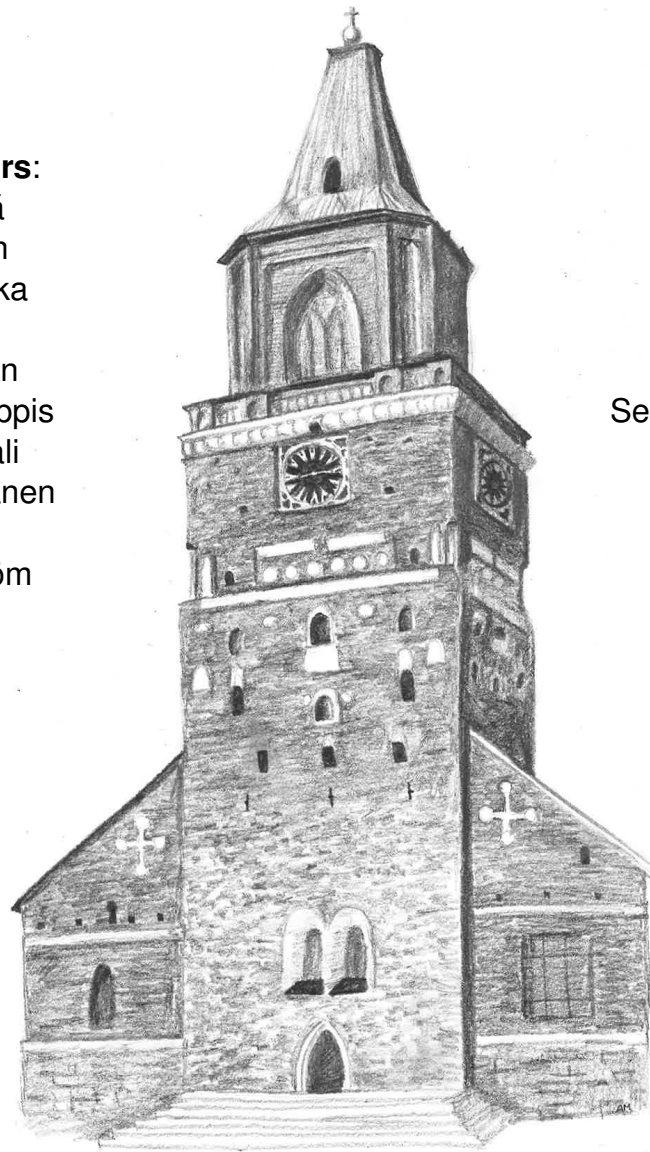


15th Romanian-Finnish Analysis Seminar
10th Function Spaces, Differential Operators and Nonlinear Analysis

Invited speakers:

Daniel Belitiță
Sun-Sig Byun
Iwona Chlebicka
Yumi Cho
Iulian Cîmpean
Cristiana De Filippis
Mahmoud Filali
Ritva Hurri-Syrjänen
Cezar Joița
Mikael Lindström



Mihai Mihăilescu
Aldo Pratelli
Humberto Rafeiro
Cornelia Schneider
Sebastian Schwarzacher
Lenka Slavíková
Dan Timotin
Mark Veraar
Dachun Yang

RomFin & FSDONA
June 10–15, 2019, Turku, Finland



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 5th Romanian-Finnish Seminar 1981 Bucharest (Romania)
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| | RomFin and FSDONA conference | | | | | |
|-------|------------------------------|-------------------|----------------------|-------------------|-------------------|-----------------------|
| | Monday 10th | Tuesday 11th | Wednesday 12th | Thursday 13th | Friday 14th | Saturday 15th |
| 9:00 | Registration | | Registration | | | |
| 9:15 | | | | | | |
| 9:30 | | | | | | |
| 9:45 | | | | | | |
| 10:00 | Cezar Joita | Iulian Cimpean | Ritva Hurri-Syrjänen | Aldo Pratelli | Dachun Yang | Lenka Slavíková |
| 10:15 | Coffee | Coffee | Mihai Mihailescu | Coffee | Coffee | Cornelia Schneider |
| 10:30 | | | | | | |
| 10:45 | | | | | | |
| 11:00 | | | | | | |
| 11:15 | Daniel Beltita | Dan Timotin | Coffee | Yumi Cho | Iwona Chlebicka | Coffee |
| 11:30 | | | | | | |
| 11:45 | | | | | | |
| 12:00 | | | | | | |
| 12:15 | Lunch | Lunch | Mark Veraar | Lunch | Lunch | Cristiana De Filippis |
| 12:30 | | | | | | |
| 12:45 | | | | | | |
| 13:00 | | | | | | |
| 13:15 | | | | | | |
| 13:30 | | | | | | |
| 13:45 | | | Registration | | | Sun-Sig Byun |
| 14:00 | | | | | | |
| 14:15 | | | | | | |
| 14:30 | | | | | | |
| 14:45 | | | | | | |
| 15:00 | | | | | | |
| 15:15 | Contributed talks | Contributed talks | | Contributed talks | Contributed talks | |
| 15:30 | | | | | | |
| 15:45 | | | | | | |
| 16:00 | | | | | | |
| 16:15 | | | | | | |
| 16:30 | | | | | | |
| 16:45 | Coffee | Coffee | | Contributed talks | Contributed talks | |
| 17:00 | | | | | | |
| 17:15 | | | | | | |
| 17:30 | | | | | | |
| 17:45 | Mahmoud Filali | Mikael Lindström | | Coffee | Coffee | |
| 18:00 | | | | | | |
| 18:15 | | | | | | |
| 18:30 | | | | | | |
| 18:45 | | | Excursion | | | |
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Monday 10th

| | | |
|-------|--|---|
| 09:00 | Registration | |
| 09:15 | | |
| 09:30 | | |
| 09:45 | | |
| 10:00 | Local triviality of analytic mappings | |
| 10:15 | Cezar Joita, lecture hall XXII | |
| 10:30 | | |
| 10:45 | Coffee | |
| 11:00 | | |
| 11:15 | Nonlinear oblique projections in Lie groups | |
| 11:30 | Daniel Beltita, lecture hall XXII | |
| 11:45 | | |
| 12:00 | Lunch | |
| 12:15 | | |
| 12:30 | | |
| 12:45 | | |
| 13:00 | | |
| 13:15 | | |
| 13:30 | | |
| 13:45 | | |
| 14:00 | Connections between the Dirichlet and the Neumann problem for integrable boundary data | Schur parameters and the space of finite Blaschke products |
| 14:15 | Lucian Beznea; M2 | Toshiyuki Sugawa; M3 |
| 14:30 | On new means generated by generalized trigonometric functions with two parameters | Kaehler and locally conformally Kaehler metrics on complex spaces with singularities |
| 14:45 | Barkat Bhayo; M2 | Ovidiu Preda; M3 |
| 15:00 | Exceptional sets for the definition of quasiregularity | Weighted Bergman type spaces for the iterated parabolic operators of fractional order |
| 15:15 | Mihai Cristea; M2 | Masaharu Nishio; M3 |
| 15:30 | On symmetric and smooth properties of the p-integrable Teichmüller spaces | |
| 15:45 | Melkana Brakalova-Trevithick; M2 | |
| 16:00 | Coffee | |
| 16:15 | | |
| 16:30 | \ell_1-bases in Banach algebras and Arens irregularities in harmonic analysis | |
| 16:45 | | |
| 17:00 | Mahmoud Filali; lecture hall XXII | |

Invited talks on Monday

Local triviality of analytic mappings

Cezar Joița (Romanian Academy)

Monday 10:00 Agora XXII

Suppose that $f : \mathbb{K}^n \rightarrow \mathbb{K}^p$ is an analytic mapping where $\mathbb{K} = \mathbb{C}$ or \mathbb{R} and $n > p > 0$. We will discuss whether it is possible to impose topological conditions on the fibers of f which will insure that f is a locally trivial fibration. Based on joint works with Mihai Tibăr.

Nonlinear oblique projections in Lie groups

Daniel Beltita (Romanian Academy)

Monday 11:15 Agora XXII

The familiar notion of oblique projection from linear algebra is extended to the nonlinear framework of Lie groups. The nonlinear oblique projections turn out to be rational mappings on Schubert cells of suitable Grassmann manifolds. We also explore the impact of these constructions on the study of the C^* -algebras of solvable Lie groups. This talk is based on joint work with Ingrid Beltita.

ℓ_1 -bases in Banach algebras and Arens irregularities in harmonic analysis

Mahmoud Filali (University of Oulu)

Monday 16:30 Agora XXII

Arens irregularity of a Banach algebra \mathcal{A} is due to elements in its Banach dual \mathcal{A}^* which are not weakly almost periodic. Unlike C^* -algebras, the usual algebras in harmonic analysis (such as the group algebra or the Fourier algebra, when known) turned out to be all Arens irregular (even in an extreme way as we shall see in the talk). At the very beginning, about seventy years ago, Richard Arens himself proved that ℓ^1 is irregular, and was followed by Mahlon Day proving the same result for many discrete groups including the abelian ones. A long exciting story followed. The talk is an attempt to tell you this story and to explain the combinatorial reason (on the group or its dual) making such irregularity. If time permits, we will see some recent developments on the subject.

Contributed talks on Monday

Connections between the Dirichlet and the Neumann problem for integrable boundary data

Lucian Beznea (Simion Stoilow Institute of Mathematics of the Romanian Academy and University of Bucharest)

Monday 14:00 Quantum M2

We provide an explicit solution of the generalized solution of the Neumann problem for the Laplace operator, based on a representation of the solution on the unit ball in \mathbb{R}^n , $n \geq 1$, in terms of the solution of an associated Dirichlet problem, in the case of integrable boundary data. We also provide a new approach to Brosamler's formula which gives a probabilistic representation of the solution of the Neumann problem for the Laplacian in terms of the reflecting Brownian motion. The talk is based on joint works with Mihai N. Pascu (Braşov, Romania) and Nicoale R. Pascu (Kennesaw State University, USA).

Schur parameters and the space of finite Blaschke products

Toshiyuki Sugawa (Tohoku University, Japan)

Monday 14:00 Quantum M3

We show that the set of finite Blaschke products of degree at most d , equipped with the topology of uniform convergence on compact subsets of the open unit disk, is homeomorphic to the $(2d+1)$ -dimensional sphere. We provide a concrete homeomorphism by using the Schur parameters.

On new means generated by generalized trigonometric functions with two parameters

Barkat Bhayo (Sukkur IBA University, Pakistan)

Monday 14:30 Quantum M2

In 1995, P. Lindqvist (4) studied generalized trigonometric functions depending on a parameter $p > 1$ which for the case $p = 2$ reduce to the familiar functions. These functions were utilized to establish a new

form of complete p -elliptic integrals of the first and the second kind by Takeuchi (6). As an application of generalized trigonometric and hyperbolic functions with two parameters (1), (2), (4),(6), here author generalizes logarithmic mean L , Neuman-Sándor M , two Seiffert means P and T , see (5). Moreover, several two-sided inequalities involving these generalized means are established.

- (1) Á. Baricz, B. A. Bhayo, T. K. Pogány *Functional inequalities for generalized inverse trigonometric and hyperbolic functions*, J. Math. Anal. Appl. 417 (2014), 244–259.
- (2) B. A. Bhayo and M. Vuorinen. *Inequalities of eigenfunctions of p -laplacian*, Issues of Analysis. Vol. 2(20), 1(2013), 14–37.
- (3) B. A. Bhayo and J. sándor *On certain new means generated by p -functions*, <https://arxiv.org/abs/1805.06762>.
- (4) P. Lindqvist *Some remarkable sine and cosine functions*, Ricerche di Matematica Vol. XLIV (1995) 269–290.
- (5) E. Neuman and J. sándor *On the Schwab-Borchardt mean*, Math. Pannon., 14, 2 (2003), 253–266.
- (6) S. Takeuchi, *Generalized Jacobian elliptic functions and their application to bifurcation problems associated with p -Laplacian*, J. Math. Anal. Appl. 385 (2012), no. 1, 24–35.

Kaehler and locally conformally Kaehler metrics on complex spaces with singularities

Ovidiu Preda (Institute of Mathematics of the Romanian Academy)

Monday 14:30 Quantum M3

We introduce a generalization of locally conformally Kähler metrics from complex manifolds to complex analytic spaces with singularities and prove that if a complex analytic space has only quotient singularities, then it admits a locally conformally Kähler metric if and only if its universal cover admits a Kähler metric such that the deck automorphisms act by homotheties of the Kähler metric. This theorem is a generalization of a well-known result from the non-singular case.

Exceptional sets for the definition of quasiregularity

Mihai Cristea (University of Bucharest, Romania)

Monday 15:00 Quantum M2

We establish some quasiregularity conditions in terms of the local boundedness of the inferior linear dilatation outside some exceptional sets E .

Weighted Bergman type spaces for the iterated parabolic operators of fractional order

Masaharu Nishio (Osaka City University, Japan)

Monday 15:00 Quantum M3

We consider parabolic operators of fractional order

$$L^{(\alpha)} := \partial_t + (-\Delta)^\alpha$$

for $0 < \alpha \leq 1$. In this talk, after explaining general theory, we shall discuss the Bergman type spaces on the upper half space in the Euclidean space.

On symmetric and smooth properties of the p -integrable Teichmüller spaces

Melkana Brakalova-Trevithick (Fordham University, USA)

Monday 15:30 Quantum M2

We study symmetric and smooth properties of the p -integrable subspaces T_p of the universal Teichmüller space T , for $p > 0$. The elements of T_p are quasisymmetric automorphisms of the real line, which have a q.c. extension with p -integrable complex dilatation with respect to the Poincaré metric. Our approach is based on applying properties of quasiconformal maps and their boundary behavior.

Tuesday 11th

| | | |
|-------|---|--|
| 10:00 | Dealing with not allowed starting points for solutions to singular SDEs in Hilbert spaces: a potential theoretical Iulian Cîmpean, lecture hall XXII | |
| 10:15 | | |
| 10:30 | | |
| 10:45 | Coffee | |
| 11:00 | | |
| 11:15 | Truncated Toeplitz operators and beyond Dan Timotin, lecture hall XXII | |
| 11:30 | | |
| 11:45 | | |
| 12:00 | Lunch | |
| 12:15 | | |
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| 13:45 | | |
| 14:00 | | |
| 14:15 | Reflection principle... Mika Koskenoja; M2 | On the space of homogeneous... Eleutherius Symeonidis; M3 |
| 14:30 | Nonlocal m-Dissipative... Alina Lazu; M2 | Compactness of the branch set of branched covers Ville Tengvall; M3 |
| 14:45 | | |
| 15:00 | Stochastic differential equations... Oana Lupascu-Stamate; M2 | Network Controllability... Ion Petre; M3 |
| 15:15 | | |
| 15:30 | Encodings for the calculation... Flavia-Corina Mitroi-Symeonidis; M2 | |
| 15:45 | | |
| 16:00 | Coffee | |
| 16:15 | | |
| 16:30 | On the norm of the Hilbert matrix operator on weighted Bergman spaces Mikael Lindström; lecture hall XXII | |
| 16:45 | | |
| 17:00 | | |

Invited talks on Tuesday

Dealing with not allowed starting points for solutions to singular SDEs in Hilbert spaces: a potential theoretical approach

Iulian Cîmpean (Romanian Academy)

Tuesday 10:00 Agora XXII

In studying SDEs with singular coefficients on an infinite dimensional state space (e.g. SPDEs of evolutionary type), a typical issue is that one can not find a solution for every starting point. The same can happen when constructing solutions of martingale problems or Markov processes from (generalized) Dirichlet forms. The aim of this talk is to present a general method to construct extended solutions for all starting points in such a way that e.g. in the case of an SDE, they are solutions at least after any strictly positive time, or in case of a given strong Feller resolvent, the so constructed Markov process is defined for every starting point. This is joint work with L. Beznea and M. Röckner.

Truncated Toeplitz operators and beyond

Dan Timotin (Romanian Academy)

Tuesday 11:15 Agora XXII

Truncated Toeplitz operators are compression of multiplication operators to subspaces of H^2 which are invariant for the backward shift. They represent an area of research in operator theory that has seen much progress in the last decade. After a short presentation of these operators, we will discuss some recent developments, mostly concerning extensions of truncated Toeplitz operators in different directions.

On the norm of the Hilbert matrix operator on weighted Bergman spaces

Mikael Lindström (Åbo akademi, Finland)

Tuesday 16:30 Agora XXII

The Hilbert matrix is a classical (one-sided) infinite matrix introduced by Hilbert in 1900's. Historically, its properties have been studied in the sequence spaces l^p by Hardy and Riesz. It can also be defined on spaces of analytic functions by its action on their Taylor coefficients and it is one of the central linear operators investigated in operator theory. In recent years, there has been active research on determination of the exact value of its operator norm on different analytic function spaces. We will discuss these results on Hardy and Bergman spaces and our contribution regarding the exact value of the norm of the Hilbert matrix operator on weighted Bergman spaces. The talk is partly based on a joint work with Santeri Miihkinen and Niklas Wikman (Åbo Akademi University).

Contributed talks on Tuesday

Reflection principle for the complex Monge-Ampère equation and plurisubharmonic functions

Mika Koskenoja (University of Helsinki, Finland)

Tuesday 14:00 Quantum M2

We study reflection principle for several central objects in pluripotential theory. First we show that the odd reflected function gives an extension for pluriharmonic functions over a flat boundary. Then we show that the even reflected function gives an extension for nonnegative plurisubharmonic functions. In particular cases odd and/or even reflected functions give extensions for classical solutions of the homogeneous complex Monge-Ampère equation. Finally, we state reflection principle for the generalized complex Monge-Ampère equation and maximal plurisubharmonic functions.

On the space of homogeneous modified harmonic polynomials in four dimensions

Eleutherius Symeonidis (Katholische Universitaet Eichstaett-Ingolstadt, Germany)

Tuesday 14:00 Quantum M3

The solutions $u : \Omega \rightarrow \mathbb{R}$ (Ω a domain in \mathbb{R}^4) of the equation

$$x_4 \cdot \left(\frac{\partial^2 u}{\partial x_1^2} + \frac{\partial^2 u}{\partial x_2^2} + \frac{\partial^2 u}{\partial x_3^2} + \frac{\partial^2 u}{\partial x_4^2} \right) + 2 \cdot \frac{\partial u}{\partial x_4} = 0$$

are called *modified harmonic functions*. Let $r := \sqrt{x_1^2 + x_2^2 + x_3^2 + x_4^2}$. In his article entitled "Modified Spherical Harmonics in Four Dimensions" (Adv. Appl. Clifford Algebras, 28 (2018)), Heinz Leutwiler conjectures that the set

$$\left\{ r^{2n+4} \cdot \frac{\partial^n r^{-4}}{\partial x_1^\alpha \partial x_2^\beta \partial x_3^\gamma} \mid 0 \leq \alpha, \beta, \gamma \leq n; \alpha + \beta + \gamma = n \right\}$$

is linearly independent, thus forming a basis of the space of homogeneous modified harmonic polynomials of degree n on \mathbb{R}^4 . In our talk we present a proof of this conjecture.

Nonlocal m-Dissipative Evolution Inclusions in General Banach Spaces

Alina Lazu (Gh. Asachi Technical University of Iasi, Romania)

Tuesday 14:30 Quantum M2

We deal with multivalued perturbations of m-dissipative evolution inclusions with nonlocal initial conditions in arbitrary Banach spaces. We prove the existence of solutions when the multivalued right hand side is Lipschitz and has nonempty closed bounded values. Moreover, we show that the closure of the solution set of the nonlocal differential inclusion is dense in the solution set of the corresponding relaxed differential inclusion.

Compactness of the branch set of branched covers

Ville Tengvall (University of Helsinki, Finland)

Tuesday 14:30 Quantum M3

We study the compactness of the branch set (i.e. the set of points where a mapping is not a local homeomorphism) of branched covers (i.e. continuous, discrete and open mappings) in Euclidean spaces. Also quasiregular mappings and mappings of finite distortion are considered in the talk. The talk is based on joint works with Aapo Kauranen and Rami Luisto.

Stochastic differential equations of fragmentation and applications

Oana Lupascu-Stamate ("Institute of Gheorghe Mihoc-Caius Iacob" Institute of Mathematical Statistics and Applied Mathematics of Romanian Academy)

Tuesday 15:00 Quantum M2

We consider a stochastic fragmentation process of an infinite particle system. We introduce a stochastic differential equation of fragmentation with either a continuous or a discontinuous fragmentation kernel and we give several examples. The results are obtained by combining analytic and probabilistic tools, as the associated martingale problem. As an application, we consider a stochastic model for the fragmentation phase of an avalanche, involving a physical fractal property. Finally, we complete the theoretical approach with a numerical simulation. These results were obtained jointly with Lucian Beznea (Bucharest) and Madalina Deaconu (Nancy).

*Network Controllability: Algorithmics for precision cancer medicine***Ion Petre** (University of Turku, Finland)

Tuesday 15:00 Quantum M3

The intrinsic robustness of living systems against perturbations is a key factor that explains why many single-target drugs have been found to provide poor efficacy or to lead to significant side effects. Rather than trying to design selective ligands that target individual receptors only, network polypharmacology aims to modify multiple cellular targets to tackle the compensatory mechanisms and robustness of disease-associated cellular systems, as well as to control unwanted off-target side effects that often limit the clinical utility of many conventional drug treatments. However, the exponentially increasing number of potential drug target combinations makes the pure experimental approach quickly unfeasible, and translates into a need for algorithmic design principles to determine the most promising target combinations to effectively control complex disease systems, without causing drastic toxicity or other side-effects. Building on the increased availability of disease-specific essential genes, we concentrate on the target structural controllability problem, where the aim is to select a minimal set of driver/driven nodes which can control a given target within a network. That is, for every initial configuration of the system and any desired final configuration of the target nodes, there exists a finite sequence of input functions for the driver nodes such that the target nodes can be driven to the desired final configuration. We investigated this approach in some pilot studies linking FDA-approved drugs with cancer cell-line-specific essential genes, with some very promising results.

*Encodings for the calculation of the permutation entropy and their applications on full-scale compartment fire data***Flavia-Corina Mitroi-Symeonidis** (Police Academy "Alexandru Ioan Cuza", Romania)

Tuesday 15:30 Quantum M2

Based on the data collected during a full-scale experiment, the order/disorder characteristics of the compartment fire are researched. We discuss methods, algorithms and the novelty of our entropic approach. From our analysis, we claim that the permutation type entropies can be successfully used to detect unusual data and to perform relevant analysis of fire experiments.

Wednesday 12th

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|-------|---|
| 09:00 | Registration |
| 09:15 | |
| 09:30 | |
| 09:45 | |
| 10:00 | On pointwise estimates |
| 10:15 | Ritva Hurri-Syrjänen, lecture hall XXII |
| 10:30 | The Monotonicity of the Principal Eigenvalue of the p -Laplace Operator |
| 10:45 | |
| 11:00 | |
| 11:15 | Mihai Mihailescu, lecture hall XXII |
| 11:30 | Coffee |
| 11:45 | |
| 12:00 | |
| 12:15 | |
| 12:30 | On the optimal Besov regularity of solutions to stochastic differential equations |
| 12:45 | Mark Veraar, lecture hall XXII |
| 13:00 | Registration |
| 13:15 | |
| 13:30 | |
| 13:45 | |
| 13:00 | |
| 18:40 | Excursion |

Invited talks in the joint session

On pointwise estimates

Ritva Hurri-Syrjänen (University of Helsinki, Finland)

Wednesday 10:00 Agora XXII

I will discuss the validity of some pointwise estimates for functions defined in irregular domains in the Euclidean n -space. As an application we will show that there exist embeddings into suitable Orlicz spaces from the L_p^1 -space such that the corresponding Orlicz norm depends on the geometry of the given domain. The results are sharp for L_1^1 -functions.

My talk is based on joint work with Petteri Harjulehto.

The Monotonicity of the Principal Eigenvalue of the p -Laplace Operator

Mihai Mihailescu (University of Craiova)

Wednesday 10:45 Agora XXII

In this talk we deal with the monotonicity with respect to $p \in (1, \infty)$ of the principal eigenvalue of the p -Laplace operator on a bounded, open, convex domain $\Omega \subset \mathbb{R}^D$ ($D \geq 1$) with smooth boundary subject to the homogeneous Dirichlet and Neumann boundary conditions. An application of the monotonicity result is presented in relation with the study of the positivity of a minimization problem involving an inhomogeneous Rayleigh quotient. The results presented in this talk are obtained in collaboration with Marian Bocea and Julio D. Rossi.

On the optimal Besov regularity of solutions to stochastic differential equations

Mark Veraar (Delft University of Technology, The Netherlands)

Wednesday 12:15 Agora XXII

In this talk I will explain a recent result obtained jointly with Martin Ondrejat. It states that the paths of stochastic integrals and solutions to parabolic stochastic differential equations have the same regularity in time as Brownian motion. To obtain the strongest results possible the temporal regularity is considered in a Besov-Orlicz space.

Thursday 13th

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|-------|---|--------------------------------------|---------------------------|
| 10:00 | On the minimization and stability of the Riesz potential | | |
| 10:15 | Aldo Pratelli, lecture hall XXII | | |
| 10:30 | | | |
| 10:45 | Coffee | | |
| 11:00 | | | |
| 11:15 | Global gradient estimates in double obstacle problems with measure data | | |
| 11:30 | Yumi Cho, lecture hall XXII | | |
| 11:45 | | | |
| 12:00 | | | |
| 12:15 | | | |
| 12:30 | Lunch | | |
| 12:45 | | | |
| 13:00 | | | |
| 13:15 | | | |
| 13:30 | Capacities in... | On multiplier sets in BV-type spaces | |
| 13:45 | Azeddine Baalal; M2 | Daria Bugajewska; M3 | |
| 14:00 | New examples... | Weak regularity... | Inequalities for... |
| 14:15 | Anna Kh. Balci; M2 | Stanislav Henc; M3 | Shahroud Azami; XVII |
| 14:30 | BMO estimates for the $p(x)$ -Laplacian | Some Lipschitz... | Approximation of... |
| 14:45 | Jehan Oh; M2 | Elhadj Dahia; M3 | Jan Vybiral; XVII |
| 15:00 | Break | | |
| 15:15 | | | |
| 15:30 | Hölder continuity... | Classical operators... | Composition operators... |
| 15:45 | Mikyoung Lee; M2 | Alexandre Almeida; M3 | Alexander Ukhlov; XVII |
| 16:00 | Global higher... | Compact embeddings... | New function... |
| 16:15 | Arttu Karppinen; M2 | Dorothee Haroske; M3 | Jakub Skrzeczkowski; XVII |
| 16:30 | Harnack inequality... | New characterizations... | Strong well-posedness... |
| 16:45 | Allami Benyaiche; M2 | Wen Yuan; M3 | Morteza Oveisih; XVII |
| 17:00 | Coffee | | |
| 17:15 | | | |
| 17:30 | The p -Laplace system with right-hand side in divergence form: Inner and up to the boundary Campanato estimates | | |
| 17:45 | Sebastian Schwarzacher, lecture Hall XXII | | |
| 18:00 | | | |

Invited talks on Thursday

On the minimization and stability of the Riesz potential

Aldo Pratelli (University of Pisa, Italy)

Thursday 10:00 Agora XXII

The Riesz potential has been intensively studied in the last decades, mainly for its role in physics, since it can be used to estimate the repulsive force between particles. From the mathematical point of view, it is well known (as it directly comes from the Riesz inequality) that it is maximized by balls, and a quantitative version of this inequality has been proved by Burchard and Chambers few years ago. Adding the Riesz potential of a set and its perimeter gives a formula for the energy of a set of particles: the repulsive force would tend to disperse atoms, while the perimeter tends to put them together. By works of Küpfer-Muratov and other authors it is known that this energy is minimized by balls for sufficiently small total mass, while this becomes false for greater total mass. In this talk, we will give an overall view of this problem, and we will describe some classical and some very recent results. Joint work with N. Fusco.

Global gradient estimates in double obstacle problems with measure data

Yumi Cho (Seoul National University, South Korea)

Thursday 11:15 Agora XXII

In this talk, we consider double obstacle problems with measure data involving $p(x)$ -Laplace type. We study the concept for a limit of approximation solutions and give global Calderón–Zygmund type estimates for the gradient under optimal regularity assumptions on the variable exponent, the nonlinearity, and the boundary of a domain. This is a joint work with Sun-Sig Byun and Jung-Tae Park (KIAS).

The p -Laplace system with right-hand side in divergence form: Inner and up to the boundary Campanato estimates

Sebastian Schwarzacher (Charles University, Czech Republic)

Thursday 17:30 Agora XXII

In this talk we collect some very recent estimates for the gradient of solutions, to the p -Laplace system with right-hand side in divergence form. Both estimates inside the domain for local solutions, and global estimates for solutions to boundary value problems are discussed. Their formulation involves sharp maximal operators, whose properties enable us to translate some aspects of the elliptic regularity theory into a merely harmonic analytic framework. As a consequence, a flexible, comprehensive approach to estimates for solutions to the p -Laplace system for a broad class of norms is derived. In particular, global estimates under minimal boundary regularity are presented.

This is a joint work with: D. Breit, A. Cianchi, L. Diening and T. Kuusi.

Contributed talks On Thursday

Capacities in fractional Sobolev spaces with variable exponents

Azeddine Baalal (Université Hassan II de Casablanca, Morocco)

Thursday 13:30 Quantum M2

In this talk we present a capacities theory connected with the fractional Sobolev spaces with variable exponents. Two kinds of capacities are studied: Sobolev capacity and relative capacity. Basic properties of capacities, including monotonicity, outer capacity and several results, are studied. We prove that both capacities is a Choquet capacity and all Borel sets are capacitable.

On multiplier sets in BV-type spaces

Daria Bugajewska (Adam Mickiewicz University, Poland)

Thursday 13:30 Quantum M3

In this talk we focus our attention on multiplier sets in spaces of functions of bounded variation of various types. We give the comprehensive answers to the problems concerning multiplier sets for the spaces BV , ΛBV , WBV_p , and BV_φ . The talk is based on the recent joint papers with Simon Reinwand.

New examples on Lavrentiev gap using fractals

Anna Kh. Balci (Bielefeld University, Germany)

Thursday 14:00 Quantum M2

We construct new examples on Lavrentiev phenomenon using fractal contact sets. Comparing to the well-known examples of Zhikov it is not important that at the saddle point the variable exponent crosses the threshold dimension. As a consequence we give the negative answer to the well-known conjecture that the dimension plays a critical role for the Lavrentiev gap to appear. As an application we present new counterexamples to the density of smooth functions in variable exponent Sobolev spaces and to the regularity of the functional with double-phase potential. The talk is based on joint work with Lars Diening and Mikhail Surnachev.

Weak regularity of the inverse under minimal assumptions

Stanislav Hencl (Charles University, Czech Republic)

Thursday 14:00 Quantum M3

Let $\Omega \subset \mathbb{R}^3$ be a domain and let $f \in BV_{loc}(\Omega, \mathbb{R}^3)$ be a homeomorphism such that its distributional adjoint is a finite Radon measure. We show that its inverse has bounded variation $f^{-1} \in BV_{loc}$. The condition that the distributional adjoint is finite measure is not only sufficient but also necessary for the weak regularity of the inverse. This is a joint result with A. Kauranen and R. Luisto.

Inequalities for eigenvalues of fourth order elliptic operators in divergence form on Riemannian manifolds

Shahroud Azami (Imam Khomeini International University, Iran)

Thursday 14:00 Quantum XVII

In this talk, we study eigenvalue of linear fourth order elliptic operators in divergence form with Dirichlet boundary condition on a bounded domain in a compact Riemannian manifolds with boundary (possibly empty) and find a general inequality for them. As an application, by using this inequality, we study eigenvalues of this operator on compact domains of complete submanifolds in a Euclidean space.

BMO estimates for the $p(x)$ -Laplacian

Jehan Oh (Bielefeld University, Germany)

Thursday 14:30 Quantum M2

We study a limiting case of the nonlinear Calderón-Zygmund theory to the inhomogeneous $p(x)$ -Laplace system. We prove local BMO estimates under the assumption that the variable exponent $p(x)$ satisfies the so-called vanishing log-Hölder continuity. The talk is based on joint work with Anna Kh. Balci and Lars Diening.

Some Lipschitz operators characterized by their image

Elhadj Dahia (Ecole normale supérieure de Bousaada, Algeria)

Thursday 14:30 Quantum M3

In the theory of linear operator ideals, some classes are characterized by the nature of their image on some neighborhoods of the origin of a Banach space. We introduce the notions of Lipschitz p -compact, Lipschitz-free p -compact and Lipschitz locally p -compact operators. We show that they can be seen as a natural extension of the linear p -compact operators. We compare all these three notions and show different properties. Finally, we exhibit examples to show that these three notions are different.

Approximation of highdimensional functions

Jan Vybíral (Czech Technical University, Czech Republic)

Thursday 14:30 Quantum XVII

The approximation of smooth multivariate functions is known to suffer the curse of dimension. We discuss approximation of structured multivariate functions, which take the form of a ridge, their sum, or of the so-called sparse additive models. We give also results about optimality of such algorithms.

*Hölder continuity of weak type minimizers for functionals with generalized Orlicz growth***Mikyong Lee** (Pusan National University, South Korea)

Thursday 15:30 Quantum M2

In this talk, we discuss Hölder regularity of quasiminimizers and ω -minimizers of functionals with non-standard growth. Compared with previous results, it covers more general minimizing functionals and need fewer assumptions. This talk is based on the joint work with Petteri Harjulehto and Peter Hästö.

*Classical operators on different vanishing Morrey spaces***Alexandre Almeida** (University of Aveiro, Portugal)

Thursday 15:30 Quantum M3

Certain vanishing properties defining new subspaces of Morrey spaces were recently introduced to describe the closure of nice functions in Morrey norm. This talk aims to show that those properties are preserved under the action of various classical operators of harmonic analysis, such as maximal, singular, potential and Hardy operators. This is based on joint work with A. Albalik and S. Samko.

*Composition operators on Sobolev spaces and Neumann eigenvalues of non-linear elliptic operators***Alexander Ukhlov** (Ben-Gurion University of the Negev, Israel)

Thursday 15:30 Quantum XVII

We consider estimates of the Neumann eigenvalues of non-linear elliptic operators in non-Lipschitz domains. This study is based on the geometric theory of composition operators on Sobolev spaces that permits us to estimate constants in the Sobolev-Poincaré inequalities and as an application to obtain lower estimates of the first non-trivial Neumann eigenvalues in Ahlfors domains (quasidisks). This class of domains includes some snowflakes type domains with fractal boundaries. (Joint works with Vladimir Gol'dshtein and Valerii Pchelintsev)

*Global higher integrability of the gradient of a minimizer with generalized Orlicz growth***Arttu Karppinen** (University of Turku, Finland)

Thursday 16:00 Quantum M2

In this talk we discuss a higher integrability result in the context of generalized Orlicz spaces (also known as Musielak-Orlicz spaces). We assume that u is a minimizer of an obstacle problem

$$\mathcal{K}_\psi^f(\Omega) := \{u \in W^{1,\varphi}(\Omega) : u > \psi \text{ almost everywhere and } u - f \in W_0^{1,\varphi}(\Omega)\}$$

for an obstacle ψ and boundary function f . Under suitable assumptions on φ , we show that

$$\int_{\Omega} \varphi(x, |\nabla u|)^{1+\delta} dx < \infty$$

for some small $\delta > 0$.

*Compact embeddings of Smoothness Morrey spaces on bounded domains***Dorothee Haroske** (Friedrich Schiller University Jena, German)

Thursday 16:00 Quantum M3

We study the compact embedding between smoothness Morrey spaces on bounded domains and characterise its entropy numbers. Here we discover a new phenomenon when the difference of smoothness parameters in the source and target spaces is rather small compared with the influence of the fine parameters in the Morrey setting. In view of some partial forerunners this was not to be expected till now. Our argument relies on wavelet decomposition techniques of the function spaces and a careful study of the related sequence space setting.

This is joint work with Leszek Skrzypczak from Poznan.

New function spaces to study perturbation problems for structured population dynamics

Jakub Skrzeczkowski (University of Warsaw, Poland)

Thursday 16:00 Quantum XVII

Structured population model are transport-type PDEs of the form:

$$(0.1) \quad \begin{cases} \partial_t \mu_t + \partial_x(b(x, \mu_t)\mu_t) &= c(x, \mu_t)\mu_t & \mathbb{R}^+ \times [0, T], \\ b(0, \mu_t)D_\lambda \mu_t(0) &= \int_{\mathbb{R}^+} a(x, \mu_t)d\mu_t(x) & [0, T], \\ \mu_0 &= \nu & \mathbb{R}^+. \end{cases}$$

describing various phenomena in Biology. Well-posedness theory for measure solutions was successfully developed in the space of bounded Radon measures $\mathcal{M}(\mathbb{R}^+)$ equipped with so-called flat metric (Gwiazda, Lorenz, Marciniak - Czochra; 2010). However, to the best of our knowledge, nothing is known about differentiability of map $h \mapsto \mu_t^h$ where μ_t^h solves (0.1) with perturbed model functions $a(x, \mu_t) := a^h(x, \mu_t^h) = a^0(x, \mu_t^h) + ha_p(x, \mu_t^h)$ and so on for functions b and c . Such questions are motivated by optimal control problems and sensitivity analysis. We start with a simple example when (0.1) reduces to transport equation:

$$(0.2) \quad \begin{cases} \partial_t \mu_t + \partial_x((1+h)\mu_t) &= 0 & \mathbb{R}^+ \times [0, T], \\ \mu_0 &= \delta_0 & \mathbb{R}^+. \end{cases}$$

to see that this type of result cannot be obtained in flat metric setting. Then, we move to the bigger space $Z = \overline{\mathcal{M}(\mathbb{R}^+)}^{(C^{1+\alpha})^*}$ which has been recently introduced to tackle similar question for transport equations (Gwiazda, Hille, Łyczek, Świerczewska - Gwiazda; 2018). We first prove Fréchet differentiability of $h \mapsto \mu_t^h$ in Z for linear version of (0.1) where implicit formula for solution to (0.1) is available. Finally, using approximating sequence and idea of “differentiability propagation” along time interval, we establish result for general nonlinear model (Skrzeczkowski; 2018)

Harnack inequality for quasilinear elliptic equations in generalized Orlicz–Sobolev spaces

Allami Benyaiche (Ibn Tofail University, Morocco)

Thursday 16:30 Quantum M2

In this paper we prove, by a new method, the Harnack inequality for positive solutions of quasilinear elliptic equations in the generalized Orlicz-Sobolev space setting. Our approach is based on the usage of the Φ -functions associated to generalized Φ -functions and the Moser’s iteration technique. As a consequence, we obtain the Hölder continuity of bounded solutions of such equations.

New characterizations of Morrey spaces and their preduals with applications to fractional Laplace equations

Wen Yuan (Beijing Normal University, China)

Thursday 16:30 Quantum M3

We characterize the Morrey spaces as well as their preduals via quadratic functions related to the Taylor remainder of the kernel of the Riesz potential. As applications, the authors obtain some strong capacity inequalities, which are then used to study the regularity of the duality/weak solution to the fractional Laplace equation with measure data.

Strong well-posedness for the split variational inequalities

Morteza Oveisih (Imam Khomeini International University, Iran)

Thursday 16:30 Quantum XVII

The classical concept of well-posedness for a minimization problem which first was introduced by Tykhonov in 1966, plays an important role in the theory of optimization problems. It requires the existence and uniqueness of solution to the minimization problem and the convergence of every minimizing sequence to the unique solution. In this talk, we generalize the concept of well-posedness to a class of split variational inequalities. Under very mild assumptions on involved operators, we obtain some metric characterization of well-posedness for the split variational inequalities. The obtained results generalize and improve some related theorems on well-posedness for variational inequalities in the literature.

Friday 14th

| | | | |
|-------|---|-----------------------------------|--------------------------------|
| 10:00 | Multiplication Between Hardy Spaces and Their Dual Spaces | | |
| 10:15 | Dachun Yang, lecture hall XXII | | |
| 10:30 | | | |
| 10:45 | Coffee | | |
| 11:00 | | | |
| 11:15 | Density of smooth functions in Musielak-Orlicz spaces | | |
| 11:30 | Iwona Chlebicka, lecture hall XXII | | |
| 11:45 | | | |
| 12:00 | | | |
| 12:15 | | | |
| 12:30 | Lunch | | |
| 12:45 | | | |
| 13:00 | | | |
| 13:15 | | | |
| 13:30 | Triebel-Lizorkin... | Multiple solutions... | On some functional analysis... |
| 13:45 | Marc Hovemann; M2 | Khalil Ben Haddouch; M3 | Ahmed Youssfi; XVII |
| 14:00 | Variable exponent... | About Spectral... | Orlicz Spaces... |
| 14:15 | Henning Kempka; M2 | Vladimir Gol'dshtein; M3 | Jan Lang; XVII |
| 14:30 | Spline wavelet... | Existence of weak solutions... | |
| 14:45 | Elena Ushakova; M2 | Zakaria El Allali; M3 | |
| 15:00 | Break | | |
| 15:15 | | | |
| 15:30 | Embeddings of... | New Results on Elliptic... | |
| 15:45 | Zdeněk Mihula; M2 | Mustapha Cheggag; M3 | |
| 16:00 | New Method... | MHD equations in a bounded domain | |
| 16:15 | Victoria Rayskin; M2 | Maria Kania-Blaszczyk; M3 | |
| 16:30 | Moser meets Gauss | On the Cauchy problem... | |
| 16:45 | Lubos Pick; M2 | Hans-Jürgen Schmeisser; M3 | |
| 17:00 | Coffee | | |
| 17:15 | | | |
| 17:30 | Bounded variation spaces with variable exponent | | |
| 17:45 | Humberto Rafeiro, lecture Hall XXII | | |
| 18:00 | | | |

Invited talks on Friday

Multiplication Between Hardy Spaces and Their Dual Spaces

Dachun Yang (Beijing Normal University, China)

Friday 10:00 Agora XXII

It is well known that bilinear decompositions of products of Hardy spaces and their dual spaces play an important role in the study on various problems from analysis. In this talk, we present some recent progresses on such bilinear decompositions of products of Hardy spaces and their dual spaces. Some open questions are also mentioned in this talk.

Density of smooth functions in Musielak–Orlicz spaces

Iwona Chlebicka (University of Warsaw, Poland)

Friday 11:15 Agora XXII

Musielak–Orlicz spaces are equipped with a norm defined by the means of the functional $\xi \mapsto \int_Z M(z, \xi) dz$, where $\xi \mapsto M(\cdot, \xi)$ is convex, typically with $Z = \Omega$ or $Z = \Omega \times [0, T]$. They provide unified description of variable exponent, Orlicz, weighted Sobolev, and double-phase spaces inheriting technical difficulties resulting from general growth and inhomogeneity. See survey [Chlebicka, A pocket guide... Nonl. Anal. 2018].

One of the features of Orlicz–Sobolev spaces with non-doubling growth is that smooth functions are not dense in norm topology, but in a weaker one – the so-called modular topology. On the other hand, in inhomogeneous spaces like variable exponent or double-phase ones, we have to require regularity of the function defining norm, to get the density. Altogether, some structural conditions are needed to ensure approximation by smooth functions, that is to ensure absence of Lavrentiev’s phenomenon.

In the general case of Musielak–Orlicz spaces we formulate conditions on the balance of asymptotic behaviour of a modular function for small perturbations of z and big values of ξ . We provide the density of smooth functions in the modular topology in Musielak–Orlicz–Sobolev spaces unifying the known results in Orlicz–Sobolev spaces, as well as variable exponent Sobolev spaces for log-Hölder-continuous exponents. We confirm the precision of the method by showing the lack of Lavrentiev’s phenomenon in the double-phase case within the range $q/p \leq 1 + \alpha/N$ sharp due to [Colombo & Mingione, ARMA 2015].

I will stress the meaning of these density results in the context of applications to partial differential equations; in particular, to the theory of existence to elliptic and parabolic problems with strongly nonstandard growth and merely integrable data.

Based on joint works: Ahmida, Chlebicka, Gwiazda, Youssfi, JFA 2018 and series of results on existence with Gwiazda and Zatorska–Goldstein 2018–2019.

Bounded variation spaces with variable exponent

Humberto Rafeiro (University of UAE, United Arab Emirates)

Friday 17:30 Agora XXII

We will discuss the notion of bounded variation spaces with variable exponent (in the Wiener and in the Riesz sense). In particular, we will show some embedding results, a Riesz representation lemma, and a characterization of global Lipschitz Nemytskii operators in the Riesz bounded variation spaces with variable exponent. If time permits, we will touch on the characterization of the linear functionals on variable exponent Bochner–Lebesgue spaces in terms of the variable exponent Riesz bounded variation spaces for vector measures.

Contributed talks on Friday

Triebel–Lizorkin–Morrey spaces and differences

Marc Hovemann (Friedrich Schiller University Jena, Germany)

Friday 13:30 Quantum M2

The main subject of my talk will be the Triebel–Lizorkin–Morrey spaces $\mathcal{E}_{u,p,q}^s(\mathbb{R}^d)$ with $s \in \mathbb{R}$, $0 < p \leq u < \infty$ and $q \in (0, \infty]$. These function spaces are a generalisation of the original Triebel–Lizorkin spaces $F_{p,q}^s(\mathbb{R}^d)$ which you get if you replace the L_p -norm in the definition by the Morrey-norm. For $0 < p \leq u < \infty$ we denote the Morrey-norm by $\|\cdot\|_{\mathcal{M}_p^u(\mathbb{R}^d)}$. We can characterise the spaces $\mathcal{E}_{u,p,q}^s(\mathbb{R}^d)$ with the help of differences of order $N \in \mathbb{N}$, enoted by $\Delta_h^N f(x)$. So under the conditions $s > d \max\left(0, \frac{1}{p} - 1, \frac{1}{q} - 1\right)$ and $N \in \mathbb{N}$ with $N > s$ we get that a function $f \in L_{\min(p,q)}^{loc}(\mathbb{R}^d)$ belongs to $\mathcal{E}_{u,p,q}^s(\mathbb{R}^d)$ if and only if $f \in L_1^{loc}(\mathbb{R}^d)$ and

$$\begin{aligned} \|f\|_{\mathcal{E}_{u,p,q}^s(\mathbb{R}^d)}^{(1)} &:= \|f\|_{\mathcal{M}_p^u(\mathbb{R}^d)} \\ &+ \left\| \left(\int_0^\infty t^{-sq} \left(\frac{1}{|B(0,t)|} \int_{B(0,t)} |\Delta_h^N f(x)| dh \right)^q \frac{dt}{t} \right)^{\frac{1}{q}} \right\|_{\mathcal{M}_p^u(\mathbb{R}^d)} < \infty. \end{aligned}$$

It turns out that some of the conditions on the parameter s are also necessary. So it is not possible to characterise the spaces $\mathcal{E}_{u,p,q}^s(\mathbb{R}^d)$ with the quasi - norm $\|\cdot\|_{\mathcal{E}_{u,p,q}^s(\mathbb{R}^d)}^{(1)}$ if either

$$s \leq 0 \quad \text{or} \quad s < d \frac{p}{u} \left(\frac{1}{p} - 1 \right) \quad \text{or} \quad s \leq d \left(\frac{1}{q} - 1 \right) \quad \text{or} \quad N \leq s.$$

Multiple solutions for a Robin problem type within defnite weight in Sobolev spaces with variable exponents

Khalil Ben Haddouch (Sidi Mohamed Ben Abdellah university/ National school of applied sciences Fez, Morocco)

Friday 13:30 Quantum M3

In this work, we will study the existence of multiple solutions for the $p(x)$ -biharmonic operator under Robin boundary conditions. By using variational approach and the Mountain Pass theorem, we obtain the existence of solutions of the problem (1.1)

$$(0.3) \quad \begin{cases} \Delta (|\Delta u|^{p(x)-2} \Delta u) = \lambda V(x) |u|^{q(x)-2} u & \text{in } \Omega \\ \frac{\partial}{\partial \nu} (|\Delta u|^{p(x)-2} \Delta u) = m(x) |u|^{p(x)-2} u & \text{on } \partial\Omega, \\ \frac{\partial u}{\partial \nu} = 0 & \text{on } \partial\Omega, \end{cases}$$

where $\Omega \subset \mathbb{R}^N$, $N \geq 2$ be a bounded smooth domain, λ is a positive parameter, $m \in L^\infty(\partial\Omega)$ with $\inf_{x \in \partial\Omega} m(x) > 0$, $p(x) : \bar{\Omega} \rightarrow \mathbb{R}$ is a continuous function, and V is a given function in a generalized Lebesgue space $L^{s(x)}(\Omega)$ such that $V > 0$ in an open set $\Omega_0 \subset \Omega$ where $|\Omega_0| > 0$.

On some functional analysis results in Musielak spaces

Ahmed Youssfi (University Sidi Mohamed Ben Abdellah/National School of Applied Sciences, Morocco)

Friday 13:30 Quantum XVII

We present some recent results in Musielak-Orlicz spaces. Precisely, we give sufficient conditions for the continuity in norm of shift operator in Musielak-Orlicz spaces L_M . An application to the convergence in norm of approximate identities is given, whereby we prove density results of smooth functions in L_M , both in modular and norm topologies. Density results are then applied to get some basic topological properties. We also presente an investigation about Poincaré-type integral inequalities in the functional Musielak structure. We give conditions on the Musielak functions under which they hold. An identification with null trace functions space is discussed. The talk is based on the references (1), (2).

- (1) A. Youssfi and Y. Ahmida. Some approximation results in Musielak-Orlicz spaces. To appear in Czechoslovak Math. J.
- (2) A. Youssfi and Y. Ahmida. Poincaré-type inequalities in Musielak spaces. To appear in Ann. Acad. Sci. Fenn. Math.

Variable exponent Triebel-Lizorkin Morrey spaces

Henning Kempka (University of applied Sciences Jena, Germany)

Friday 14:00 Quantum M2

We introduce morreyfied Triebel-Lizorkin spaces with variable exponents $\mathcal{E}_{p(\cdot),q(\cdot)}^{w,u(\cdot)}(\mathbb{R}^n)$. Here the smoothness is measured in the sense of admissible weight sequences and all parameters are variable.

Starting from the important convolution inequality we obtain first characterizations of these spaces with atoms and Peetre maximal functions.

About Spectral Properties of Divergent Elliptic Operators

Vladimir Gol'dshtein (Ben Gurion University of the Negev, Israel)

Friday 14:00 Quantum M3

We study spectral properties of divergence form elliptic operators $-\operatorname{div}[A(z)\nabla f(z)]$ with Neumann boundary condition in a wide class of simply connected planar domains. Here the matrix function A is symmetric and its determinant equal to one. The studied class of domains includes quasidisks and is described in terms of integrability properties of Jacobians of quasiconformal homeomorphisms. The composition operators theory for Lebesgue and Sobolev spaces permits us to reduce the problem to weighted Sobolev-Poincaré inequalities on the unit disk. We prove discreteness of the spectrum and we obtain lower estimates of the first Neumann eigenvalue. Spectral stability estimates will be discussed also.

Joint with V. Pchelintsev and A. .

Orlicz Spaces and Generalized Orlicz Spaces

Jan Lang (The Ohio State University, USA)

Friday 14:00 Quantum XVII

We prove the compactness of the Sobolev embedding for Musielak–Orlicz spaces by way of simple conditions on the Matuszewska index of the underlying space. We provide counterexamples to show the sharpness of our conditions.

Spline wavelet decompositions in function spaces with Muckenhoupt weights

Elena Ushakova (Computing Center of the Far Eastern Branch of the Russian Academy of Sciences)

Friday 14:30 Quantum M2

We consider function spaces of Besov or Triebel–Lizorkin type with weights belonging to some Muckenhoupt class \mathcal{A}_∞ . Wavelet decomposition of these spaces is performed by compactly supported linear combinations of elements of Battle–Lemarié spline wavelet systems. As an application of the decomposition result we discuss connections between norms of images and pre-images of integration operators. The research was supported by the Russian Foundation for Basic Research (project 19-01-00223).

Existence of weak solutions for a $p(x)$ -Kirchhoff-type equation with Navier boundary conditions

Zakaria El Allali (Mohammed first university, Morocco)

Friday 14:30 Quantum M3

In this talk, we prove the existence of solutions for $p(x)$ -Kirchhoff-type problem with Navier boundary condition. Using variational approach and the Mountain Pass theorem, we establish some conditions for the existence of nontrivial weak solutions for $p(x)$ -Kirchhoff equation

*Embeddings of homogeneous Sobolev spaces on the entire space***Zdeněk Mihula** (Charles University, Czech Republic)

Friday 15:30 Quantum M2

We completely characterize the validity of the inequality $\|u\|_{Y(\mathbb{R}^n)} \leq C \|\nabla^k u\|_{X(\mathbb{R}^n)}$, where X and Y are rearrangement-invariant spaces, by reducing it to a considerably simpler one-dimensional inequality. Furthermore, we fully describe the optimal rearrangement-invariant space on either side of the inequality when the space on the other side is fixed. We also solve the same problem within the environment in which the competing spaces are Orlicz spaces. A variety of examples involving customary function spaces suitable for applications is also provided.

*New Results on Elliptic Equation with Nonlocal Boundary Coefficient-operator Conditions in UMD Spaces: Noncommutative Cases***Mustapha Cheggag** (National Polytechnic School of Oran, Algeria)

Friday 15:30 Quantum M3

This work is devoted to the study of operational second order differential equations of elliptic type with non-regular coefficient-operator boundary conditions in a non commutative framework. The study is performed when the second member f belongs to $L^p(0, 1; X)$, with general $p \in]1, +\infty[$, X being a UMD Banach space. we give some new results by using semi-groups and interpolation theory. Existence, uniqueness and optimal regularity of the strict and semi-strict solution are proved.

*New Method of Smooth Extension of Local Maps on Linear Topological Spaces. Applications and Examples***Victoria Rayskin** (Bentley University, USA)

Friday 16:00 Quantum M2

A known classical method of extension of smooth local maps uses smooth bump functions. However, such functions are absent in the majority of infinite-dimensional spaces. We suggested a new approach for Banach spaces, based on the composition with locally identical maps, which we call blid maps. In addition to smooth spaces, blid maps also allow to extend smooth local maps on non-smooth spaces, such as $C^q[0, 1]$, $q = 0, 1, 2, \dots$. We will show how to reconstruct a map from its derivatives at a point, for spaces possessing blid maps. We will also show how blid maps can assist in finding global solutions to cohomological equations having linear transformation of argument. In particular, we will discuss application of blid maps to local conjugation of maps. We will also discuss a possibility of generalization of this method for topological linear spaces such as $C^\infty(\mathbb{R})$, applications of this theory and open problems.

MHD equations in a bounded domain

Maria Kania-Blaszczyk (University of Silesia, Poland)

Friday 16:00 Quantum M3

We consider the Dirichlet boundary value problem for the incompressible magnetohydrodynamical (MHD) system

$$\begin{aligned} u_t - \nu \Delta u + u \cdot \nabla u &= -\nabla p + b \cdot \nabla b, & x \in \Omega \subset \mathbb{R}^N, t > 0, \\ b_t - \eta \Delta b + u \cdot \nabla b &= b \cdot \nabla u, & x \in \Omega \subset \mathbb{R}^N, t > 0, \\ \operatorname{div} u &= \operatorname{div} b = 0, \\ u &= 0, \quad b = 0 & \text{on } \partial\Omega, \\ u(0, x) &= u_0(x), \quad b(0, x) = b_0(x), & x \in \Omega, \end{aligned}$$

in a bounded domain $\Omega \subset \mathbb{R}^N$ with C^2 boundary, where $N = 2, 3$. Here u is the velocity of the fluid flow and b is the magnetic field. These functions are the vector-valued functions of $x \in \Omega$ and $t \geq 0$ ($u(t, x) = (u_1(t, x), \dots, u_N(t, x))$, $b(t, x) = (b_1(t, x), \dots, b_N(t, x))$). The total pressure $p = p(t, x)$ is real-valued function of $x \in \Omega$ and $t \geq 0$. The constant $\nu > 0$ is the viscosity of the fluid and $\eta > 0$ is the magnetic diffusivity.

Using Dan Henry's semigroup approach and Giga-Miyakawa estimates we construct global in time, unique solutions to fractional approximations of the MHD system in the base space $(L^2(\Omega))^N \times (L^2(\Omega))^N$. Solution to MHD system are obtained next as a limits of that fractional approximations.

[1] M.B. Kania *MHD equations in a bounded domain*, submitted;

[2] Y. Giga, T. Miyakawa, *Solutions in L_r of the Navier-Stokes Initial Value Problem*, Arch. Rational Mech. Anal., 89 (1985), 267-281.

Moser meets Gauss

Lubos Pick (Charles University, Czech Republic)

Friday 16:30 Quantum M2

We prove Moser-type estimates for Gaussian-Sobolev embeddings.

On the Cauchy problem for a generalized Navier-Stokes equation with initial data in super-critical Besov and Triebel-Lizorkin spaces

Hans-Jürgen Schmeisser (Friedrich-Schiller University Jena, Germany)

Friday 16:30 Quantum M3

We study well-posedness of the Cauchy problem for a generalized Navier-Stokes equation with initial data in super-critical Besov and Triebel-Lizorkin spaces. We prove existence and uniqueness of mild and strong solutions which are local in time.

Saturday 15th

| | |
|-------|---|
| 10:00 | Sharp estimates for Fourier multipliers Lenka Slavíková, lecture hall XXII |
| 10:15 | |
| 10:30 | |
| 10:45 | Besov regularity of parabolic PDEs Cornelia Schneider, lecture hall XXII |
| 11:00 | |
| 11:15 | |
| 11:30 | Coffee |
| 11:45 | |
| 12:00 | |
| 12:15 | Latest news on double phase problems Cristiana De Filippis, lecture hall XXII |
| 12:30 | |
| 12:45 | |
| 13:00 | Higher regularity results for non-uniformly elliptic equations Sun-Sig Byun, lecture hall XXII |
| 13:15 | |
| 13:30 | |

Invited talks on Saturday

Sharp estimates for Fourier multipliers

Lenka Slavíková (University of Missouri, USA)

Saturday 10:00 Agora XXII

A Fourier multiplier operator is given by composition of three operators: the Fourier transform, multiplication by a bounded function, and the inverse Fourier transform. The problem of finding sharp sufficient conditions for functions to define Fourier multiplier operators bounded on different function spaces is of central importance in harmonic analysis. Obtaining such conditions is the best one can expect as there is no good characterization of boundedness of multipliers, even on spaces as simple as L^p .

In this talk, I will present a sharp version of the classical multiplier theorem of Hörmander, formulated in terms of fractional Lorentz-Sobolev spaces. I will also discuss a sharp criterion for $L^2 \times L^2 \rightarrow L^1$ boundedness of bilinear operators associated with multipliers with L^∞ derivatives, given in terms of the L^q integrability of the multiplier. This is a joint work with Loukas Grafakos and Danqing He.

Besov regularity of parabolic PDEs

Cornelia Schneider (University of Erlangen-Nürnberg, German)

Saturday 10:45 Agora XXII

The talk is concerned with the regularity of solutions to linear and nonlinear evolution equations on non-smooth domains. In particular, we study the smoothness in a specific scale of Besov spaces. It is known that in many cases the order of convergence of adaptive wavelet-schemes depends on the regularity of the solution in these Besov spaces. On the other hand it is the fractional Sobolev regularity which determines the rate of convergence of non adaptive (uniform) algorithms. Therefore, in order to justify the use of adaptive schemes for solving parabolic PDEs, an analysis of the regularity of the solution in the scale of Besov spaces and a comparison with its Sobolev regularity is needed. We show that for all cases under consideration the Besov regularity is high enough to justify the use of adaptive algorithms.

*Latest news on double phase problems***Cristiana De Filippis** (University of Oxford, United Kingdom)

Saturday 12:15 Agora XXII

The Double Phase energy

$$W^{1,p}(\Omega) \ni w \mapsto \mathcal{P}(w, \Omega) := \int_{\Omega} H(x, Dw) \, dx,$$

$$H(x, z) := |z|^p + a(x)|z|^q, \quad 0 \leq a(\cdot) \in C^{0,\alpha}(\Omega), \quad 1 < p \leq q,$$

falls into the realm of non-uniformly elliptic problems in the sense that the structure of the integrand allows the ellipticity ratio

$$\mathcal{R}(z, B) := \frac{\sup_{x \in B} \text{of the highest eigenvalue of } \partial_z^2 H(x, z)}{\inf_{x \in B} \text{of the lowest eigenvalue of } \partial_z^2 H(x, z)} \approx 1 + \|a\|_{L^\infty(B)} |z|^{q-p}$$

to become unbounded for $p < q$ as $|z| \rightarrow \infty$. This type of functional has been introduced by Zhikov in the setting of homogenization and it models the behavior of strongly anisotropic materials whose hardening properties drastically change with the point. We consider minimizers of variational integrals of double phase type and discuss some of their regularity features in various frameworks.

This talk is based on the content of the following papers:

- I. Chlebicka, C. De Filippis, Removable sets in non-uniformly elliptic problems. *Submitted*.
- C. De Filippis, Regularity for solutions of fully nonlinear elliptic equations with non-homogeneous degeneracy. *In preparation*.
- C. De Filippis, G. Mingione, A borderline case of Calderón-Zygmund estimates for non-uniformly elliptic problems, *St. Petersburg Mathematical Journal*, to appear.
- C. De Filippis, G. Mingione, Manifold constrained non-uniformly elliptic problems. *J. Geometric Analysis*, to appear.
- C. De Filippis, G. Palatucci, Hölder regularity for nonlocal double phase equations, *Journal of Differential Equations*, 267, 1, 547-586, (2019).
- C. De Filippis, J. Oh, Regularity for multi-phase variational problems. *Journal of Differential Equations*, 267, 3, 1631-1670, (2019).

*Higher regularity results for non-uniformly elliptic equations***Sun-Sig Byun** (Seoul National University, South Korea)

Saturday 13:00 Agora XXII

A divergence structure quasilinear elliptic equation with non-standard growth condition is discussed. The nonlinearity involves a non-uniformly ellipticity property and the boundary of the domain is irregular. We prove an optimal regularity theory for solutions to such a highly nonlinear problem in the frame of a generalized Sobolev space.

Excursion: s/s Ukkopekka Dinner Cruise

Linnankatu 40, 20100 Turku on Wednesday 18:40–23:00 (For those who have registered in advance).

THE EVENING CRUISE ON STEAMSHIP UKKOPEKKA IS THE HIGHLIGHT OF THE SUMMER! During the summer evenings, steamship Ukkopekka sails from Turku to the fascinating island of Loistokari. There is everything you need for a wonderful evening: delicious dinner inspired by the Finnish archipelago with a variety of fish and barbecue specialties, along with live music and dancing on the pier. The ship is alive with an unforgettable atmosphere and happy people!

A tasty tapas plate will whet your appetite on the way to Loistokari. After arriving at the island, you will be served a dinner buffet, including a variety of fresh, homemade smoked fish with a selection of delicious accompaniments. A summer night in the Finnish archipelago would not be complete without a barbecue! The open-flame grill of Loistokari is about three meters long on which our crew will prepare barbecue specialties.

Live music will be playing throughout the evening on the cruise – not only on board, but also in Loistokari. Let the rhythm of the music and the magical atmosphere of the Finnish archipelago take you and dance on the pier!



The location of Ukkopekka marked with a dot and the university of Turku with a rectangle.



Map of the campus

Wifi: Available wifi connections include *Eduroam* and *UTU visitor*. The former should work automatically if your home university supports it and the latter is not a secure connection and needs to be refreshed every 8 hours.

Restaurants: The closest student restaurant, named *Galilei*, is in the Agora building next to the registration desk. Other restaurants can be found along the street Hämeenkatu next to Quantum building.