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Recent Advances in Functional Analysis:

Dedicated to the memory of Joe Diestel and Victor Lomonosov. October 11-14, 2018.

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General Information

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Conference presentations are given at the Mathematical Sciences Building (Room 228) and Liquid Crystal Institute at Kent State University.

Conference lunches will be provided at the Mathematical Sciences Building.

The Mathematical Sciences Building is located on Summit Street, Kent, OH 44242. To search its map on Goggle Maps, use the address 1400 East Summit Street, Kent, Ohio 44240. The Liquid Crystal Institute is just next to it.

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Schedule

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Thursday, October 11

09:00 - 10:00 Registration
10:00 - 10:15 Very short welcome remarks.
10:15 - 11:00 Vladimir Troitsky (University of Alberta).
11:15 - 12:00 Thomas Schlumprecht (Texas A&M University).
12:05 - 01:50 Lunch
02:00 - 02:45 Guillermo P. Curbera (Universidad de Sevilla).
02:45 - 03:15 Coffee/Discussion.
03:15 - 04:00 Alexander Koldobsky (University of Missouri, Columbia).
04:05 - 04:50 Leonid Friedlander (University of Arizona).
05:00 - 05:45 Evgeny Abakumov (Universit de Marne-la-Vallée).

Friday, October 12

09:15 - 10:00 Gideon Schechtman (Weizmann Institute of Science).
10:05 - 10:50 William B. Johnson (Texas A&M University).
10:50 - 11:05 Coffee/Discussion.
11:05 - 11:40 Nicole Tomczak-Jaegermann (University of Alberta).
11:45 - 12:10 Daniel Freeman (St. Louis University).
12:15 - 02:00 Lunch
02:00 - 02:45 Beata Randrianantoanina (Miami University).
02:50 - 03:15 Florent Baudier (Texas A&M University).
03:15 - 03:45 Coffee/Discussion.
03:45 - 04:30 Denka Kutzarova (The University of Illinois at Urbana-Champaign).

Joe and Victor: research and more

05:00 - 05:45 Per Enflo (Kent State): Victor Lomonosov.
06:00 - 06:45 Christopher Lennard (University of Pittsburgh): Joe Diestel.
07:00 - 09:00 Tea+[1] stories about Joe & Victor (Lab, 3rd floor, Math. Sciences Bldg)

[1]The event is free. The department will provide some food and drinks. The participants and their guest, are welcome, to bring addition beverages/food. Please, note alcoholic beverages are allowed and welcomed! but will be distributed by designated bartenders.

Saturday, October 13

09:15 - 10:00 Gilles Pisier (Texas A&M University).
10:15 - 11:00 Alexander Volberg (Michigan State University).
11:15 - 12:00 Boris Mityagin (Ohio State University).
12:00 - 01:35 Lunch
01:35 - 02:00 Bruno Braga (York University).
02:05 - 02:30 Pavlos Motakis (The University of Illinois at Urbana-Champaign).
02:30 - 03:00 Coffee/Discussion.
03:00 - 03:45 Peter Kuchment (Texas A&M University).
04:00 - 04:45 Marianna Csörnyei (University of Chicago).
04:45 - 05:30 Poster Session
06:00 - 07:30 Piano Recital, Per Enflo (at Ludwig Recital Hall, Kent State University)
07:45 - 09:30 Conference Dinner[2]: Wild Papaya Thai Cuisine (1665 E Main St #100 C, Kent, OH 44240).

Sunday, October 14

09:00 - 09:45 Sergei Treil (Brown University).
10:00 - 10:45 Leonid Bunimovich (Georgia Institute of Technology).
11:00 - 11:45 Vladimir Peller (Michigan State University).
12:00 - 12:45 Mark Rudelson (University of Michigan).
12:45 - 02:15 Lunch

[2]We are sorry, but we need to collect a $20. This does cover the food and soft drinks. Wine will be provided by organizers.

Abstracts and Titles.

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- **Evgeny Abakumov: Nearly invariant subspaces in Cauchy - de Branges spaces.**
  Abstract: I will start by reviewing several results on invariant and nearly invariant subspaces in spaces of analytic functions. In the second part of the talk, I'll discuss recent advances on the ordering structure of nearly invariant subspaces in some classes of Hilbert spaces of entire functions. (This is a joint work with A. Baranov and Yu. Belov)
- **Florent Baudier: Metric characterizations in the asymptotic setting.**
  Abstract: Ribe's rigidity theorem from 1976 was the foundational result of what is now called the Ribe program. Ribe's rigidity theorem suggests that "local" properties of Banach spaces might admit a purely metric reformulation. About 10 years ago, the philosophy of the Ribe program was implemented in the asymptotic setting. In this talk I will discuss metric characterizations, in the form of graph preclusion, of classes of Banach spaces which are defined by certain asymptotic properties.
- **Bruno Braga: Quotients of uniform Roe algebras.**
  Abstract: In this talk, we introduce quotients of uniform Roe algebras, called uniform Roe coronas, and talk about rigidity results involving them. Our main result says that it is consistent with ZFC that isomorphism between uniform Roe coronas implies coarse equivalence between the underlying spaces, for the class of uniformly locally finite metric spaces which coarsely embed into a Hilbert space. This is a joint work with Ilijas Farah and Alessandro Vignati.
- **Leonid Bunimovich: Isospectral Transformations.**
  Abstract: I will talk about a new approach to analyzing matrices, networks and multidimensional dynamical systems. It is tempting when dealing with huge networks to compress them while keeping as much as possible information about network. It turned out that it is possible to compress networks while keeping all information about about their spectrum. Moreover it turned out that one can use such isospectral transformations for many other applications, e.g.for estimation of eigenvalues of matrices, stability of dynamical systems, uncovering intrinsic structure of real networks, etc. of dynamical networks.
- **Marianna Csörnyei: "Projection theorem in infinite dimensional spaces."**
  Abstract: A fundamental theorem in geometric measure theory is the Besicovitch-Federer projection theorem which characterizes rectifiability in terms of projections. In this talk, among other problems, we study the projection theorem in infinite dimensional spaces. (The talk is based on joint works with D. Bate and B. Wilson.)
- **Guillermo P. Curbera: Local and weighted Khintchine inequalities.**
  Abstract: We discuss the extension of Zygmund's local version of Khintchine inequality in $L^2([0,1])$ to rearrangement invariant spaces.
- **Per Enflo: Victor Lomonosov's work and its impact on Functional Analysis.**
  Abstract: In 1973 Victor Lomonosov proved the sensational result, that an operator on a Banach space commuting with a compact operator has invariant subspaces. This had immediately a great impact on the development of Operator Theory and Functional Analysis in general, a development that is going on with full force today. Lomonosov's short and elegant proof gave a much stronger result on the central and important Invariant Subspace Problem than the previous 40 years of efforts by strong mathematicians. And it worked not just in Hilbert Space, but in general Banach Spaces.

So, Lomonosov's early work gave new techniques to develop Operator Theory in several directions. And it gave inspiration to further studies of connections between Operator Theory and the Geometry of Banach Spaces. Lomonosov himself has given very important contributions to this development.

Some of Lomonosov's most spectacular and famous contributions are his proving of far-reaching extensions of Burnside's Theorem and his showing of limitations of the Bishop-Phelps' Theorem. But there are quite a few others.

We will also give some examples of recent developments inspired by Lomonosov's work. They are in their beginning, with a few results and many open problems.

- **Leonid Friedlander: Multiplicative anomaly for determinants.** *Abstract: For regularized determinants of elliptic operators, the determinant of a product need not be equal to the product of determinants. I will discuss the problem of computing the multiplicative anomaly blth in the case of two elliptic operators and in the case when one of the operators is of the form $I+T$ where T is an operator from a Schatten class. Some of the results that I will discuss are old, and some of them are relatively new.*
- **Daniel Freeman: Frame potential for finite-dimensional Banach spaces.** *Abstract: Abstract: Frames for Hilbert spaces can be considered as redundant coordinate systems. A finite unit norm tight frame (FUNTF) for a n-dimensional Hilbert space H is a sequence of k unit vectors $(x_j)_{j=1}^k$ in H so that for all $x \in H$,*

$$\frac{k}{n}x = \sum_{j=1}^{k} \langle x_j, x\rangle x_j$$

Benedetto and Fickus proved that FUNTFs can be characterized as minimizers of a certain function, which they called the frame potential. We prove the corresponding result for finite dimensional Banach spaces, where the 2-summing norm takes the place of the frame potential. This leads to many interesting questions for both frames in Banach spaces as well as the structure of the space of 2-summing operators on a Banach space. This is joint work with J.Alejandro Chavez-Dominguez and Keri. Kornelson.
- **William B. Johnson: Several 20+ year old problems about Banach spaces and operators on them.**
Abstract: Some of what I have been doing this millennium, with a LOT of help.
- **Alexander Koldobsky: An estimate for the distance from a convex body to unit balls of subspaces of L_p.**
Abstract: For $p \geq 1$, $n \in N$, and an origin-symmetric convex body K in R^n, let

$$d_{\rm ovr}(K, L_p^n) = \inf\left\{ \Big(\frac{|D|}{|K|}\Big)^{1/n} : K \subseteq D,\ D \in L_p^n \right\}$$

be the outer volume ratio distance from K to the class L_p^n of the unit balls of n-dimensional subspaces of L_p. We prove that there exists an absolute constant $c > 0$ such that

$$\frac{c\sqrt{n}}{\sqrt{p \log\log n}} \leq \sup_K d_{\rm ovr}(K, L_p^n) \leq \sqrt{n}. \tag{1}$$

This result follows from a new slicing inequality for arbitrary measures. Namely, there exists an absolute constant $C > 0$ so that for any $p \geq 1$, any $n \in N$, any compact set $K \subseteq R^n$ of positive volume, and any Borel measurable function $f \geq 0$ on K,

$$\int_K f(x)\,dx \ \leq\ C\sqrt{p}\ d_{\rm ovr}(K, L_p^n)\ |K|^{1/n} \sup_H \int_{K\cap H} f(x)\,dx, \tag{2}$$

where the supremum is taken over all affine hyperplanes H in R^n. Combining (2) with a recent counterexample for the slicing problem with arbitrary measures, we get the lower estimate from (1).

This is a joint work with Sergey Bobkov and Bo'az Klartag.

- **Peter Kuchment: Parseval frames of Wannier functions.**
Abstract: Wannier function bases are extensively used in material science and solid state computations, since they tend to be strongly (exponentially) localized near atoms and thus make the problem almost discrete. However, it was shown in 1980s by D. Thouless that a topological obstacle might exist (e.g., in presence of magnetic field, or in topological insulators) that prevents such functions from decaying, and thus rendering them useless. We will present a result joint with D. Auckly showing that even in presence of the topological obstacle one can add just one extra family of Wannier functions to get a Parseval (= tight) frame of exponentially decaying Wannier functions.
- **Denka Kutzarova: Lipschitz free spaces on finite metric spaces.**
Abstract: The main results of the talk: (1) For any finite metric space M the Lipschitz free space on M contains a large well-complemented subspace which is close to ℓ_1^n. (2) Lipschitz free spaces on large classes of recursively defined sequences of graphs are not uniformly isomorphic to ℓ_1^n of the corresponding dimensions. These classes contain well-known families of diamond graphs and Laakso graphs.
(joint work with S. J. Dilworth and M. I. Ostrovskii)
- **Christopher Lennard: Nothing is bigger than Joe.**
Abstract: Joe Diestel was larger than life..... This talk is about the many ways he was and is special, influential and sorely missed: amongst his students, friends and colleagues - in math and in life.
- **Boris Mityagin: Concentration of measures related to an anharmonic oscillator operator.**
Abstract: Let $\mathbb{N}_0 = \mathbb{N} \cup \{0\}$, and let $\{\varphi_k(x)\}_{k\in\mathbb{N}_0}$ be an orthonormal system of eigenfunctions of an anharmonic oscillator operator

$$Ly = -y'' + q(x)y, \quad x \in \mathbb{R}^1,$$

where q is real-valued, even, monotone on $(0, +\infty)$, $q(x) \nearrow \infty$, and slowly varying, so

$$L\varphi_k = \lambda_k \varphi_k, \quad k \in \mathbb{N}_0,$$

with turning points $x_k > 0$, $q(x_k) = \lambda_k$. We consider measures

$$d\mu_k = \sqrt{x_k}\varphi_k^2(x_k t)\, dt, \quad t \in \mathbb{R}^1,$$

and

$$\nu_k((-\infty, t)) = \frac{1}{k+1}\#\{w : \varphi_k(x_k w) = 0, \quad w \le t\}.$$

They have remarkable concentration problerties. Say, if $q(x) = |x|^\beta$, or $= |x|^\beta \log(e + |x|)$, then

$$\mu_k \to \mu_*, \quad \nu_k \to \nu_*,$$

i.e., for any f in $C_0^\infty(\mathbb{R})$,

$$\int f(t)\, d\mu_k \to c(\beta) \int_{-1}^{+1} \frac{f(t)}{\sqrt{1 - |t|^\beta}}\, dt,$$

$$\int f(t)\, d\nu_k \to d(\beta) \int_{-1}^{+1} f(t)\sqrt{1 - |t|^\beta}\, dt.$$

A little bit mysterious is an observation that the dependence on β is quite different from the universality we have in the OP-case (orthogonal polynomials).

(The talk is based on the joint work of the speaker, Petr Siegl, and Joseph Viola.)

- **Pavlos Motakis: Strategically reproducible bases and the factorization property.**
  Abstract: We introduce the concept of strategically reproducible bases in Banach spaces and show that operators which have large diagonal with respect to strategically reproducible bases are factors of the identity. We give several examples of classical Banach spaces in which the Haar system is strategically reproducible: multi-parameter Lebesgue spaces, mixed-norm Hardy spaces and most significantly the space L^1. Moreover, we show the strategical reproducibility is inherited by unconditional sums.
  (This is joint work with R. Lechner, P. F. X. Müller, and Th. Schlumprecht.)
- **Vladimir Peller: Absolute continuity of spectral shift via the Sz.-Nagy-Foias dilation theorem.**
  Abstract: Birman and Solomyak offered a new approach to the Lifshits-Krein trace formula. Their approach is based on double operator integrals. However, it did not lead to the absolute continuity of spectral shift. Instead they were able to prove the existence of a spectral shift measure. It turns out that double operator integrals can lead to absolute continuity if we reduce the case of self-adjoint (or unitary) operators to the case of contractions and use the Sz.-Nagy-Foias theorem on the absolute continuity of the spectral measure of the minimal unitary dilation of a completely nonunitary contraction.
- **Gilles Pisier: On Sidon sets.**
  Abstract: We will recall some of the classical theory of Sidon sets of characters on compact groups (Abelian or not). We will then give several recent extensions to Sidon sets, randomly Sidon sets and subgaussian sequences in bounded orthonormal systems, following recent work by Bourgain and Lewko, and by the author (all currently available on arxiv). The case of matricial systems, analogous to Fourier-Peter-Weyl series on compact groups, connects the subject to random matrix theory. An unpublished result of Rider (circa 1975) will also be highlighted.
- **Beata Randrianantoanina: Characterizations of superreflexivity, old and new.**
  Abstract: We will discuss characterizations of superreflexivity, some old and some new. We will focus on several new characterizations of superreflexivity that have been discovered in the recent years as part of the Ribe program. These are nonlinear characterizations referring only to the metric properties of Banach spaces. Some open problems will be presented.
- **Mark Rudelson: Circular law for sparse random matrices.**
  Consider a sequence of n by n random matrices A_n whose entries are independent identically distributed random variables. The circular law asserts that the distribution of the eigenvalues of properly normalized matrices A_n converges to the uniform measure on the unit disc as n tends to infinity. We prove this law for sparse random matrices under the optimal sparsity assumption.
  (Joint work with Konstantin Tikhomirov.)
- **Gideon Schechtman: Pisier's cotype dichotomy problem revisited.**
  Abstract: In an effort to renew interest in the dichotomy problem, I'll survey what is known and in particular tell you about an old/new result of NicoleTomczak-Jaegermann and myself along the lines of a result of Bourgain but with some improvement. This

gives the best known estimate concerning the dichotomy problem . I'll also try to suggest what should be done next.

- **Thomas Schlumprecht: On the coarse embedability of Hilbert space and the metric characterization of asymptotic properties.**
  Abstract: A new concentration inequality is proven for Lipschitz maps on the infinite Hamming graphs taking values into Tsirelson's original space, or more generally in any reflexive space which is asymptotically c_0. This concentration inequality is then used to disprove the conjecture, originating in the context of the Coarse Novikov Conjecture, that the separable infinite dimensional Hilbert space coarsely embeds into every infinite dimensional Banach space. Secondly we show that the class of reflexive spaces which are asymptotically c_0 is coarsely rigid, meaning that every Banach space which coarsely embeds into one space of this class also belongs to this class.

  This is joint work with Florent Baudier and Gilles Lancien (first part) and with Florent Baudier Gilles Lancien, and Pavlos Motakis (second part).
- **Nicole Tomczak-Jaegermann: Some observations on absolutely summable families of vectors.**
- **Vladimir Troitsky: Unbounded convergences and applications.**
  Abstract: we will discuss recent progress in the theory of vector and Banach lattices related to unbounded convergences. We will discuss the general process of unbounding a convergence, as well as some important examples. We will discuss applications to Measure Theory, Stochastic Processes, and duality of Banach lattices.
- **Sergei Treil: Finite rank perturbations, matrix weights and the Aronszajn–Donoghue theory.**
  Abstract: The classical Aronszajn–Donoghue theorem states that the singular parts of the spectral measures of a self-adjoint operator and its rank one perturbation (by a cyclic vector) are mutually singular. While simple direct sum type examples would indicate that such result is impossible for the scalar spectral measures, it holds if one introduces the notion of vector mutual singularity of matrix-valued measures.

  The matrix-valued measures provide a natural language for the theory of finite rank perturbations: two weight estimates with matrix weights and the matrix A_2 condition appear natively in this context, and will be used to prove the Aronszajn–Donoghue for finite rank perturbations.

  I'll also discuss the Aleksanrov's disintegration theorem for matrix Clark measures, as well as a simple proof of the Kato–Rosenblum theorem.
- **Alexander Volberg: Harmonic measure and harmonic analysis.**
  Abstract: Several recent results solving long standing problems of Chris Bishop will be mentioned in this talk. Those results use non-homogeneous T1 theorem as the main tool to derive geometric properties of harmonic measure of arbitrary domain in arbitrary dimension. However, the main subject of the talk will be Carleson's theorem that harmonic measure has always dimension strictly less than one for any plane domain with self-similar boundary. Our goal will be to give a new proof of this result using estimates of singular integrals. It is a very common point of view that having "good harmonic measure" implies "good" properties of certain singular integrals.

  We demonstrate (using Carleson's theorem as an example) that this point of view can be reversed: analysis information about singular integrals implies geometric information about harmonic measure. Our example also highlights certain still open problems of harmonic measure theory.

Poster Presentations.

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- **Leandro Antunes (Universidade de São Paulo):***"Light Groups of Isomorphisms in Banach Spaces and Invariant LUR Renormings."*
- **Louisa Catalano (Kent State University):***"On maps preserving products".*
- **Timothy Clos (Bowling Green State University)***"Compactness of Hankel Operators on the Bergman Spaces of Convex Reinhardt Domains in* $\mathbb{C}^2$*."*
- **Pamela Delgado (University of Pittsburgh)***"Near-infinity concentrated norms and the fixed point property for nonexpansive maps on closed, bounded, convex sets".*
- **Mingu Jung (POSTECH):** *"Bishop-Phelps-Bollobás Properties in Hilbert Spaces and Absolute Sums."*
- **Luis C. Garca-Lirola (Kent State):***"A characterization of the Daugavet property in spaces of Lipschitz functions."*
- **Jireh Loreaux (Southern Illinois University):***"Restricted Diagonalization of Finite Spectrum Normal Operators and Essential Codimension."*
- **Tomás Merchán (Kent State University):***On the relation between* L^2 *boundedness and existence of principal value integral for a Calderón-Zygmund operator.*
- **Gabriel T. Prăjitură (SUNY Brockport):***"Operators and Frames."*
- **Mienie Roberts (Texas A&M University-Central Texas):** *"Teacher Self Efficacy regarding ability to Teach Mathematics Using Self-Created Manipulatives with* $3D$ *printer."*
- **Behzad Djafari Rouhani (University of Texas at El Paso):** *"On some new ergodic and fixed point theorems for nonlinear mappings."*
- **Michael Roysdon (Kent State University)** *"On Rogers-Shephard inequalities for general measure."*
- **Adam Stawski (University of Pittsburgh):** *"*c_0 *and the* $N1$ *property."*
- **Mitchell A. Taylor (University of California, Berkeley):** *"Minimal topologies on vector lattices."*
- **Shiwen Zhang (Michigan State University):** *Large deviation estimates for analytic quasi-periodic Schödinger cocycles."*