# Conference on Geometric Functional Analysis in Honour of Nicole Tomczak-Jaegermann
# May 16 - May 20, 2016

## ABSTRACTS
## (in alphabetic order by speaker surname)

Speaker: **David Alonso-Gutierrez** (Universidad de Zaragoza)
Title: *The variance conjecture on hyperplane projections of the $\ell_p^n$ balls*
Abstract: We show that for any $1 \leq p \leq \infty$, the family of uniform probability measures on projections of the unit ball of $\ell_p^n$ onto hyperplanes verify the variance conjecture

$$\mathrm{Var}|X|^2 \leq C \max_{\xi \in S^{n-1}} \mathbb{E}\langle X, \xi\rangle^2 \mathbb{E}|X|^2,$$

where $C$ depends on $p$ but not on the dimension $n$ or the hyperplane.

Speaker: **Razvan Anisca** (Lakehead University)
Title: *On hereditary approximation property*
Abstract: The talk stems from the recent investigation by Johnson and Szankowski of Banach spaces with the hereditary approximation property, that is, spaces whose all subspaces have the approximation property. Among several interesting results, their main theorem states that if $X$ is a Banach space such that the sequence of distances to a Hilbert space $\{d_n(X)\}$ grows sufficiently slowly as $n \to \infty$, then $X$ must have the hereditary approximation property. We identify a rather large class of Banach spaces $X$ with the property that when the rate of growth of $\{d_n(X)\}$ is at least the same as $(\log n)^\beta$, for some $\beta > 1$, then $X$ does not have the hereditary approximation property.

Speaker: **Karoly Bezdek** (University of Calgary)
Title: *On non-separable families of positive homothetic convex bodies - the Goodman-Goodman conjecture*
Abstract: A finite family $\mathcal{B}$ of balls with respect to an arbitrary norm in $\mathbb{R}^d$ ($d \geq 2$) is called a non-separable family if there is no hyperplane disjoint from $\bigcup \mathcal{B}$ that strictly separates some elements of $\mathcal{B}$ from all the other elements of $\mathcal{B}$ in $\mathbb{R}^d$. In this talk we prove that if $\mathcal{B}$ is a non-separable family of balls of radii $r_1, r_2, \ldots, r_n$ ($n \geq 2$) with respect to an arbitrary norm in $\mathbb{R}^d$ ($d \geq 2$), then $\bigcup \mathcal{B}$ can be covered by a ball of radius $\sum_{i=1}^n r_i$. This was conjectured by Erdős for the Euclidean norm and was proved for that case by A. W. Goodman and R. E. Goodman [Amer. Math. Monthly 52 (1945), 494-498]. On the other hand, in the same paper A. W. Goodman and R. E. Goodman conjectured that their theorem extends to arbitrary non-separable finite families of positive homothetic convex bodies in $\mathbb{R}^d$, $d \geq 2$. Besides giving a counterexample to their conjecture, we prove that conjecture under various additional conditions. This is a joint work with Zs. Lángi (Univ. of Tech., Budapest).

Speaker: **Sergey Bobkov** (University of Minnesota)
Title: *Berry-Esseen bounds in central limit theorem for transport distances.*
Abstract: For sums of independent random variables $S_n = X_1 + \ + X_n$, Berry-Esseen-type bounds are derived for the transport power distances $W_p$ in terms of Lyapunov coefficients $L_{p+2}$.

Speaker: **Djalil Chafaï** (Universite Paris-Dauphine)
Title: *About the spectral edges*

Speaker: **Nassif Ghoussoub** (University of British Columbia)
Title: *Optimal martingale transport*

Speaker: **Olivier Guédon** (University Paris Est, Marne-la-Vallee)
Title: *On some problems related to random matrices: selection of characters, restricted isometry properties, norms.*
Abstract: As suggested in the title, I will present several results in analysis whose study relies on different problems concerning random matrices whose rows are independent random vectors. On the way, we will see how to study several empirical processes.

Speaker: **Bill Johnson** (Texas A&M University)
Title: *Essentially Euclidean Spaces and Operators With Dense Range on $\ell_\infty$*
Abstract: In the first part I will show that essentially Euclidean spaces, which were essentially introduced by Nicole, A. Litvak, and V. Milman, are preserved under quotient mappings onto spaces of proportional dimension (joint with T. Figiel). In the second part, I will outline how a finite dimensional theorem due to five computer scientists can be used to answer a question about operators on the non separable Banach space $\ell_\infty$ (joint with A. B. Nasseri, G. Schechtman, and T. Tkocz).

Speaker: **Sergey Kislyakov** (PDMI, St. Petersburg)
Title: *Some observations about the corona theorem*
Abstract: This is a short survey of fairly recent results (obtained by the author and D.Rutsky, partly jointly, partly separately) concerning the classical corona theorem in the disk. The relationship between estimates for solutions of the Besout equation in analytic functions will be discussed, along with certain links with interpolation theory and fixed point theorems.

Speaker: **Hermann Koenig** (Christian Albrechts University)
Title: *Rigidity and Stability of the Chain Rule and the Leibniz Rule Operator Equation*
Abstract: We consider perturbations of the chain rule and the Leibniz rule operator equations

$$T(f \circ g) = T(f) \circ g \cdot T(g)\ ,\ T(f \cdot g) = T(f) \cdot g + f \cdot T(g)$$

for maps $T : C^1(\mathbb{R}) \to C(\mathbb{R})$, $f, g \in C^1(\mathbb{R})$. So e.g. the difference $|T(f \circ g) - T(f) \circ g \cdot T(g)|$ is assumed to be bounded by a function $S$ of the independent variable and the function values of $f \circ g$ and $g$. We show under a mild continuity assumption and a non-degeneration assumption on $T$ that the chain rule is rigid: the perturbed equation has the same solutions as the unperturbed chain rule, i.e. for $S = 0$. In the case of the Leibniz rule, we have stability: the solutions of the perturbed equation are perturbations of the solutions of the Leibniz rule equation. We also study one-sided chain rule inequalities. After a localization step, the proofs require to study the solutions of certain sub- and supermultiplicative functions on the real line and of some specific functional equations. Altogether, it turns out that there are fewer solution operators of these equations than one might think. This is joint work with Vitali Milman.

Speaker: **Rafal Latała** (University of Warsaw)
Title: *Two-sided bounds for $L_p$-norms of combinations of products of independent random variables*
Abstract: We show that for every $p > 0$, the $L_p$-norm of linear combinations (with scalar or vector coefficients) of products of i.i.d. random variables, whose moduli have a nondegenerate distribution with the $L_p$-norm one, is comparable to the $l_p$-norm of the coefficients and the constants are explicit. As a result the same holds for linear combinations of Riesz products.

The talk is based on the joint work with Ewa Damek, Piotr Nayar and Tomasz Tkocz.

Speaker: **Vitali Milman** (Tel Aviv University)
Title: *Algebraic Related Structures and the Reason Behind Some Classical Constructions in Convex Geometry.*

Speaker: **Sergii Myroshnychenko** (Kent State University)
Title: *On polytopes with congruent projections*
Abstract: Let $P$ and $Q$ be two polytopes in $\mathbb{R}^n$, $n \geq 3$, such that their projections onto any $k$-dimensional subspace, $2 \leq k \leq n-1$, are congruent (i.e. coincide up to a rigid motion). We show that $P$ and $Q$ coincide up to translation and reflection in the origin.

Speaker: **Marton Naszodi** (Eötvös University, Budapest and EPFL, Lausanne)
Title: *Proof of a conjecure of Bárány, Katchalski and Pach*
Abstract: Bárány, Katchalski and Pach proved the following quantitative form of Helly's theorem: If the intersection of a family of convex sets in $\mathbb{R}^d$ is of volume one, then the intersection of some subfamily of at most $2d$ members is of volume at most some constant $v(d)$. They gave the bound $v(d) \leq d^{2d^2}$, and conjectured that $v(d) \leq d^{cd}$. We recently confirmed it. We discuss the proof and further results.

Speaker: **Fedor Nazarov** (Kent State University)
Title: *A toy model for the David-Semmes problem.*
Abstract: We shall describe non-atomic measures $\mu$ in $R^d$ such that all convolution type Calderon-Zygmund operators with regular kernels of a given non-integer order $s \in (0, d)$ are bounded in $L^2(\mu)$. This is a joint work with Ben Jaye.

Speaker: **Hoi Nguyen** (Ohio State University)
Title: *Normal vector of a random hyperplane*
Abstract: Let $v_1, ..., v_{n-1}$ be $n-1$ independent vectors in $R^n$ (or $C^n$). We study x, the unit normal vector of the hyperplane spanned by the $v_i$. Our simple finding is that x strongly resembles a random vector chosen uniformly from the unit sphere, under some randomness assumption on the $v_i$. We will also present some applications of this result in random matrix theory. Joint with V. Vu.

Speaker: **Alain Pajor** (University Paris Est, Marne-la-Vallee)
Title: *On the empirical covariance matrix*
Abstract: We will survey recents results on the empirical covariance matrix of a sample from a random vector which coordinates are not necessarily independent.

Speaker: **Grigoris Paouris** (Texas A&M University)
Title: *On condition number of random polynomial systems.*
Abstract: We consider the sensitivity of real roots of polynomial systems with respect to perturbations of the coefficients. In particular we establish new, more robust probabilistic estimates that allow subgaussian families of probability measures. We also take some steps towards quantifying the role of sparsity in probabilistic condition number estimates for real-solving. Joint work with Alperen Ergur and Maurice Rojas.

Speaker: **Joscha Prochno** (University of Hull)
Title: *On operator norms of Gaussian random matrices*
Abstract: We will present estimates for the expected value of operator norms of Gaussian random matrices, acting as operators between $\ell_p$ spaces, with inhomogeneous variance structure, i.e., independent, but not necessarily identically distributed entries. The talk is based on joint work with O. Guédon, A. Hinrichs, and A.E. Litvak.

Speaker: **Mark Rudelson** (University of Michigan)
Title: *Delocalization of eigenvectors of random matrices.*
Abstract: Heuristically, delocalization for a random matrix means that its normalized eigenvectors look like the vectors uniformly distributed over the unit sphere. This can be made precise in a number of different ways. We will consider two complimentary approaches to delocalization. For a matrix with independent entries, we show that with high probability, the largest coordinate of a normalized eigenvector is of the

same order as for a uniform random unit vector. This means that the Euclidean norm of an eigenvector cannot be concentrated on a few coordinates. On the other hand, we show that with high probability, any sufficiently large set of coordinates of an eigenvector carries a non-negligible portion of its Euclidean norm. The latter result pertains to a large class of random matrices including the ones with independent entries, symmetric, skew-symmetric matrices, as well as more general ensembles. Joint work with Roman Vershynin.

Speaker: **Volker Runde** (University of Alberta)
Title: *(Non-)amenability of $B(E)$*
Abstract: In 2010, relying crucially on results by Yehoram Gordon, I proved that $B(l^p)$ is never amenable for any $p \in [1, \infty]$. I shall report on progress on the question of when $B(E)$ is amenable for a Banach space $E$.

Speaker: **Bunyamin Sari** (University of North Texas)
Title: *Separable elastic Banach spaces are universal*
Abstract: A Banach space $X$ is elastic if there is a constant $K$ so that whenever a Banach space $Y$ embeds into $X$, then there is an embedding of $Y$ into $X$ with constant $K$. We prove a conjecture of Johnson and Odell asserting that separable elastic Banach spaces contain a copy of $C[0, 1]$. This is a joint work with Dale Alspach.

Speaker: **Christos Saroglou** (Kent State University)
Title: *Characterization of simplices via the Bezout inequality for mixed volumes*
Abstract: We consider the following Bezout inequality for mixed volumes:

$$V(K_1, \dots, K_r, D[n-r])V_n(D)^{r-1} \leq \prod_{i=1}^{r} V(K_i, D[n-1]) \quad \text{for } 2 \leq r \leq n.$$

It was shown previously that the inequality is true for any $n$-dimensional simplex $\mathbb{D}$ and any convex bodies $K_1, \dots, K_r$ in $\mathbb{R}^n$. It was conjectured that simplices are the only convex bodies for which the inequality holds for arbitrary bodies $K_1, \dots, K_r$ in $\mathbb{R}^n$. In this paper we prove that this is indeed the case if we assume that $D$ is a convex polytope. Thus the Bezout inequality characterizes simplices in the class of convex $n$-polytopes. In addition, we show that if a body $D$ satisfies the Bezout inequality for all bodies $K_1, \dots, K_r$ then the boundary of $D$ cannot have *strict* points. In particular, it cannot have points with positive Gaussian curvature. Joint work with Ivan Soprunov and Artem Zvavitch.

Speaker: **Gideon Schechtman** (Weizmann Institute of Science)
Title: *On complemented subspaces of Schatten p classes*
Abstract: A new complemented subspace of the Schatten $p$ class in the reflexive range (and $p \neq 2$) will be presented. Time permitting I'll also talk about a second result this one concerns paving of matrices with respect to the Schatten $p$ norm. The two results and a third one are contained in a paper entitled: Three observations regarding Schatten $p$ classes.

Speaker: **Maria Shcherbina** (Institute for Low Temperature Physics of Ukrainian Ac. Sci.)
Title: *Transfer matrix approach to the analysis of 1d random band matrices.*
Abstract: We discuss an application of the transfer matrix approach to the analysis of the integral representations obtained by the Grassmann integration method for different characteristics of 1d random band matrices: correlation functions of characteristic polynomials, density of states and spectral correlation functions. We show that when the band width W is proportional to $n^{1/2}$, the model has a kind of phase transition (crossover), whose nature can be explained by the spectral properties of the transfer operator.

Speaker: **Stanislaw Szarek** (Case Western Reserve University)
Title: *Detecting quantum entanglement and Dvoretzky's theorem*

Abstract: We present a link between Dvoretzky's theorem in its tangible version due to Milman and the problem of entanglement detection in quantum information theory. Specifically, we use the inequality of Figiel-Lindenstrauss-Milman (1977) giving bounds on the number of vertices/faces of polytopes, which we interpret as a result on approximating of convex bodies by polytopes. We also identify some peculiarities in so approximating various sets that appear naturally in the non-commutative context.

Speaker: **Konstantin Tikhomirov** (University of Alberta)
Title: *Sample covariance matrices of heavy-tailed distributions*

Speaker: **Petros Valettas** (University of Missouri)
Title: *Almost isometric embeddings of $\ell_2^k$ in finite dimensional subspaces of $L_p$*
Abstract: In this talk we discuss the classical Dvoretzky theorem on almost spherical sections for finite dimensional subspaces of $L_p$. Our main interest is focused on the dependence on $\varepsilon$ in the critical dimension $k = k(n, \varepsilon)$ r equired to embed $1 + \varepsilon$ the Euclidean space $\ell_2^k$ into any $n$-dimensional normed space $X$ of $L_p$, $p > 2$. Our study reveals a two-level behavior of the function $k(n, \varepsilon)$ depending on the range of the distortion. The aforementioned estimate is in a sense optimal. This is based on joint work with G. Paouris (Texas A & M University).

Speaker: **Ramon van Handel** (Princeton University)
Title: *The Borell-Ehrhard game*
Abstract: A precise description of the convexity of Gaussian measures is provided by a remarkable Brunn-Minkowski type inequality due to Ehrhard and Borell. The delicate nature of this inequality has complicated efforts to develop more general geometric inequalities in Gauss space that mirror the rich family of results in the classical Brunn-Minkowski theory. In this talk, I will aim to shed some new light on Ehrhard's inequality by showing that it arises from a somewhat unexpected game-theoretic mechanism. This insight makes it possible to identify new results, such as an improved form of Barthes reverse Brascamp-Lieb inequality for Gaussian measures.

Speaker: **Deping Ye** (Memorial University of Newfoundland)
Title: *On the affine isoperimetric inequalities for affine and geominimal surface areas*
Abstract: Affine and geominimal surface areas are two closely related and fundamental concepts in convex geometry. They were developed in rather different ways, but many properties of these two concepts are the same. One major difference between them is that the geominimal surface area is continuous but the affine surface area is only upper-semicontinuous. Moreover, the affine surface area can be formulated by a convenient integral involving the Gauss curvature and the support function; while the geominimal surface area does not have such an integral expression. In this talk, I will explain how to define the Orlicz affine and geominimal surface areas, and will talk about their affine isoperimetric inequalities. The connection of these affine invariants with the classical $f$-divergence is also discussed.

Speaker: **Pierre Youssef** (University Paris 7)
Title: *Restricted invertibility revisited.*
Abstract: Given an operator A from $\ell_2^m$ to $\ell_2^n$, the restricted invertibility principle asks to find a large coordinate subspace on which the operator $A$ is invertible and get quantitative estimates on the norm of the inverse. We revisit this problem and improve over a series of works, starting with the seminal Bourgain-Tzafriri Restricted Invertibility Principle, through the works of Vershynin, Spielman-Srivastava and Marcus-Spielman-Srivastava. This is a joint work with Assaf Naor.