MATHEMATISCHES FORSCHUNGSINSTITUT OBERWOLFACH

Tagungsbericht 35/1996

Geometrie der Banachräume

Gefördert durch
DFG Deutsche Forschungsgemeinschaft

Introduction

The conference was organized by H. König (Kiel), J. Lindenstrauss (Jerusalem) and A. Pełczyński (Warsaw), and attended by 46 people from 13 countries including 11 from Germany. Many of the participants are among the leaders in the area. In comparison with previous conferences, the number of lectures was reduced to 26. Among the lectures from neighboring areas were Talagrand's on majorizing measures and Haagerup's on non-commutative probability. These leading experts in their respective fields exposed new directions in probability theory and C^*-algebras which interact closely with Banach space theory. These methods, techniques and results were of great interest to the audiance. All the lectures presented new results and developments in the many aspects of Banach space theory and related fields, i.e. structure theory of infinite-dimensional Banach spaces, local theory of Banach spaces, non-linear theory, convexity in $\mathbb{R}^n$, complex and harmonic analysis. The lectures were well-attended. Among the most exciting results presented we mention the works of Odell/Schlumprecht on renormings of separable Banach spaces and characterizations of spaces containing c_0 and ℓ_1 in terms of spreading models and the significant progress of Banaszczyk on the Komlós conjecture using a gaussian measure technique and convex surgery. The participants spent many hours on informal discussions, which resulted in several new research projects as well as progress done on existing joint research.

Abstracts of the talks

S. Alesker

Polynomial valuations on convex sets and integral formulas

A map ϕ defined on the convex compact sets in $\mathbb{R}^n$ is called a valuation, if for all convex compact sets $K_1, \ldots, K_s$ such that $\bigcup_{j=1}^{s} K_j$ is convex the following equality holds

$$\phi\left(\bigcup_{j=1}^{s} K_j\right) = \sum_{\sigma \subset \{1,..,s\}} (-1)^{|\sigma|-1} \phi\left(\bigcap_{j\in\sigma} K_j\right).$$

A typical example for a valuation is the one which assigns to a convex, compact K set its volume, its surface area respectively. Another one is given by the mixed volume $\phi(K) = V(\underbrace{K, \ldots, K}_{n-i}, A_1, \ldots, A_i)$ where $A_1, .., A_i$ are fixed sets.

Due to the classical theorem of Hadwiger translation and rotation invariant valuations which are continuous with respect to the Hausdorff distance are linear combinations of mixed volumes with $A_1 = A_2 = \cdots = A_i = \mathcal{D}$. We are interested in the larger class of rotation invariant valuations. A valuation is called polynomial of degree $\leq d$ if for all convex compact sets K in $\mathbb{R}^d$, the function $x \mapsto \phi(K + x)$ is a polynomial in x of degree at most d. We show that the linear spaces of $SO(n)$-invariant continuous valuations of polynomial a fixed degree d is finite dimensional. We also formulate a conjecture which explicitly describes such evaluations. This conjecture holds true if $n \leq 3$ and d is arbitrary or if $d \leq 4$ and n is arbitrary. Furthermore, we obtain applications in terms of integral formulas.

S. A. Argyros

Examples of asymptotic ℓ^1 spaces

The method of construction mixed Tsirelson norms will be given with emphasis on the modified version of them and we will discuss some recent examples.

W. Banaszczyk

n-dimensional Gaussian measures, convex surgery and the Komlós conjecture

Let K be an n-dimensional convex body. Denote by $\sigma(K)$ the best constant with the following property: given arbitrary vectors $x_1, .., x_m$ in $\mathbb{R}^n$ with $\|x_i\|_2 \leq 1$, one can find signs $\varepsilon_1, .., \varepsilon_m = \pm 1$ such that

$$\varepsilon_1 x_1 + \varepsilon_2 x_2 + \cdots + \varepsilon_m x_m \in \sigma(K)\, K.$$

Let C_n be the n-dimensional cube. The Komlós conjecture says that $\sigma(C_n)$ is bounded as $n \to \infty$. In September of this year the following result was obtained:

(∗) If the n-dimensional standard Gaussian measure of K is $\geq \frac{1}{2}$, then $\sigma(K)$ is bounded by some universal constant.

This implies that $\sigma(C_n) = O(\sqrt{log(n)})$ which is better than the previously known bound $\sigma(C_n) = O(\log(n))$. The result (∗) is also a strengthening of the results of recent papers by S. Szarek and the author (to appear in Discrete & Computational Geometry) and by A. Giannopoulos (to appear in Studia Mathematica).

E. Behrends

New vector-valued Banach-Stone theorems

Let X be a Banach space. X is said to have the Banach-Stone property (BSP) if, for compact spaces L and M, $C(L, X) = C(M, X)$ yields $L = M$.
In the seventies several methods have been developed to prove that certain Banach spaces have the BSP. These theorems led in the early eighties to a unifying theory which proved (in a sense which could be made precise) best possible results. It can, however, be shown that with the theory one can never show that a (nontrivial) $C(K)$ space has the BSP, and it was an open problem for more then 15 years whether this can happen for a suitable K. Behrends/Pelant solved this in 1995 in the affirmative. The proof of this result also leads to more recent developments, e.g. how to get X from $C(K, X)$.

A. Defant

Scalar and vector-valued inequalities of Marcinkiewicz-Zygmund type

Let $1 \leq p, q, r \leq \infty$ and X and Y be Banach spaces. We consider bounded and linear operators $T : L_p(\mu; X) \to L_q(\nu; Y)$ which satisfy inequalities of the following type: There is a constant $c \geq 0$ such that for all $n \in \mathbb{N}$ and all functions $x_1, .., x_n \in L_q(\mu; X)$

$$\left\| \left(\sum_k \|Tx_k\|_Y^r \right)^{\frac{1}{r}} \right\|_p \leq c \left\| T \right\| \left\| \left(\sum_k \|x_k\|_X^r \right)^{\frac{1}{r}} \right\|_q .$$

Such inequalities have a long history — important results go back to Paley, Marcinkiewicz, Zygmund, Grothendieck, Kwapień, Rosenthal, Maurey, Rubio De Francia and others. In the scalar case $X = Y = \mathbb{K}$ we study the question when such inequalities hold for all T. For certain triples (p, q, r) we calculate best constants, or give asymptotical optimal estimates for their graduation in n. As a by-product we obtain best constants of several well-known inequalities from the theory of summing operators. In the vector-valued case we use the Rosenthal-Maurey cycle of ideas to show that such inequalities are equivalent to certain weighted norm inequalities. Applications (in particular for (p,q)-completely bounded maps) follow if these results are combined with vector-valued analogues of Grothendieck's inequality. Joint work with M. Junge, Kiel.

R. DEVILLE

The smooth variational principle with constraints

We prove the following smooth variational principle with constraints: Let X be a Banach space which admits a C^1 smooth, Lipschitz continuous real valued bump function. Assume that Y is a subspace of X and f is a lower semi-continuous mapping from X in the real line. If moreover either Y is finite dimensional or f is uniformly continuous and if $p \in D^-(f|_Y)(0)$, then there exists $x \in X$ and $q \in D^-(f)(x)$ such that $\|x\| \leq \varepsilon$, $|f(x)| < \varepsilon$ and $\|p - q|_Y\| < \varepsilon$. A counterexample shows that the assumption "Y finite dimensional or f uniformly continuous" is necessary. We also give connections of the result with "fuzzy calculus" of A. Ioffe and uniqueness results of viscosity solutions of Hamilton-Jacobi equations.

V. FERENCZI

Some properties of hereditary indecomposable Banach spaces

A Banach space is said to be hereditarily indecomposable (or H.I.) if it has no decomposable subspace. By Gowers' dichotomy theorem, every Banach space contains either an unconditional basic sequence or a H.I. subspace. Because of this theorem it is important to know about general properties of H.I. spaces. We show that if X is a complex H.I. space, Y a subspace of X, then every operator from Y to X is a strictly singular perturbation of a multiple of the canonical inclusion map. We also study the real case (in particular, we show that if X is H.I. real then $\mathcal{L}(X)/\mathcal{S}(X)$ is a division ring isomorphic to $\mathbb{R}$, $\mathbb{C}$, or $\mathbb{H}$ (the quaternions)).

UFFE HAAGERUP

Free products of operator algebras and Voiculescu's non-commutative probability theory

Recent development in the operator algebra theory is based on the non-commutative probability theory which was introduced some 12 years ago by Voiculescu in order to study the von Neumann algebras $\mathcal{L}(F_N)$ associated with the free groups F_n on N generators $2 \leq N \leq \infty$. The "trick" is to choose a special set of selfadjoint generators $X_1, .., X_N$ for $\mathcal{L}(F_N)$, namely Voiculescu's "semicircular system", which has a large degree of symmetry, and which is linked to the theory of selfadjoint, complex, Gaussian random matrices. A key result in the theory, obtained by Dykema and Radulescu independently, is that for $2 \leq N, M < \infty$, $\mathcal{L}(F_N)$ and $\mathcal{L}(F_M)$ are "stabily isomorphic", i.e. $\mathcal{L}(F_N)\bar{\otimes}B(\ell_2) \simeq \mathcal{L}(F_N)\bar{\otimes}B(\ell_2)$.
In the case $N = 2$, the operator $Y = \frac{1}{\sqrt{2}}(X_1 + iX_2)$ is linked to non-selfadjoint, complex Gaussian random matrices. We prove, that the "distribution of eigenvalues" in the sense of L. G. Brown of the operator Y is the uniform distribution on the unit disk D in the complex plane. This is in concordance with results on limit distributions of eigenvalues for random matrices, but the proof does not rely on random matrix techniques.

AIKE HINRICHS

Rademacher and Gaussian averages and Rademacher cotype of operators

A basic result of B. Maurey and G. Pisier states that Gaussian and Rademacher averages in a Banach spaces X are equivalent if and only if H has finite cotype. We complement this for linear bounded operators between Banach spaces. For $T \in \mathcal{L}(X, Y)$, let $\rho(T | \mathcal{G}_n, \mathcal{R}_n)$ be the least constant c such that

$$\left(\left\|\sum_{k=1}^{n} Tx_k g_k\right\|^2\right)^{\frac{1}{2}} \leq c \left(\left\|\sum_{k=1}^{n} x_k r_k\right\|^2\right)^{\frac{1}{2}},$$

where $(g_k)_1^n$, $(r_k)_1^n$ are n independent, normalized Gaussian, Rademacher variables, respectively. Let $RC_2^n(T)$ be the Rademacher cotype norm of T computed with n vectors. We show that

$$\rho(T | \mathcal{G}_n, \mathcal{R}_n) = o((1 + \log n)^{\frac{1}{2}}) \quad \text{if and only if} \quad RC_2^n(T) = o(\sqrt{n}).$$

Moreover, we prove inequalities which nearly determine the asymptotic behaviour of the sequence $\rho(T | \mathcal{G}_n, \mathcal{R}_n)$ for $n \to \infty$ if the sequence $RC_2^n(T)$ is known.

M. JUNGE

Volumes in L_p-spaces

Classical volume formulas for ellipsoids and zonoids are extended to p-sums of segments in the sense of Firey. Using duality and further tools, we obtain volume formulas in terms of random determinants for arbitrary n-dimensional sections in L_p $(0 < p < \infty)$.
The proof of such formulas leads to the investigation of p-sums of segments of maximal volume which are contained in the unit ball of a fixed n-dimensional Banach space. This generalizes the concept of maximal ellipsoids and zonoids contained in the unit ball. The ellipsoid of maximal volume is very well understood, the connection between the theory of 1-summing operators and "the" zonoid of maximal volume was discovered by K. Ball in connection with the hyperplane problem for convex sets.
As an application, we obtain new distance estimates for subspaces of L_p and discover geometric properties of finite dimensional subspaces of p-convex and q-concave Banach lattices. We show that for an n-dimensional Banach space there is a subspace such that the volume ratio of the unit ball (with respect to ellipsoids) can be estimated be the volume ratio of this subspace with respect to the larger class of zonoids. Joint work with Y. Gordon, Haifa.

S. KISLIAKOV

BMO-regular lattices and interpolation

We consider quasi-Banach lattices X of measurable functions on $(\mathbb{T}\times S, m\times\mu)$, $\mathbb{T}$ the unit circle with Lebesgue measure m. For any such X we introduce its analytic subspace

$$X_A = \{f \in X \ : \ f(\cdot,\omega) \text{ belongs to the Smirnov class } N_+ \text{ on } \mathbb{T} \text{ for a. e. } \omega\} \ .$$

Under some mild restrictions on X, X_A is a closed subspace. Having a couple (X, Y) of Banach lattices of measurable functions, we discuss the relationship between the interpolation properties if the couples (X, Y) and (X_A, Y_A). A couple (X, Y) is said to be BMO-regular if, given any vectors $x \in X$, $y \in Y$, there are two other vectors $u \in X$, $v \in Y$ satisfying

$$i) \quad |x| \le u,\ |y| \le v\,; \quad ii)\ \|u\|_X \le C\,\|x\|_X,\ \|v\|_X \le C\,\|y\|_X\ ;$$
$$iii) \quad \left\|\log\frac{u}{v}\right\|_{BMO} \le C\,.$$

Here C is a constant depending on the lattices X and Y only. For a BMO-regular couple, we show that a function $f = x + y \in X_A + Y_A$, $x \in X$, $y \in Y$ admits another decomposition $f = x_0 + y_0$, $x_0 \in X_A$, $y_0 \in Y_A$ satisfying the pointwise estimates $|x_0| \leq C'u$ and $|y_0| \leq C'v$ with (u, v) from the definition above. This is used to show that for the real interpolation spaces the analytic subspace of the interpolation space $(X, Y)_{\theta,q}$ is obtained by interpolating the analytic subspaces X_A and Y_A. If X and Y are Banach lattices and some of them has absolutely continuous norm, the same is true for the complex interpolation method. This covers most part (probably, all) of the known results in this direction, known form the earlier work of Q. Xu and the author, G. Pisier, and N. Kalton.

W. LUSKY

A characterization of Banach spaces with bases

A separable Banach space X has the commuting bounded approximation property, briefly $CBAP$ if there is a sequence of linear bounded finite rank operators $R_n : X \to X$ satisfying $R_n R_m = R_{\min(n,m)}$ if $m \neq n$ and $\lim_{n\to\infty} R_n x = x$ for all $x \in X$. It is shown that Banach spaces with $CBAP$ do not necessarily have bases.
We show that X has a bases if and only if X has $CBAP$ with operators R_n where, in addition, $R_n - R_{n-1}$ factors uniformly through ℓ_p^m's for some $p \in [1, \infty]$.
As an application we obtain conditions on subsets $\Lambda \subset \mathbb{Z}$ such that $C_\Lambda =$ closed linear span of $\{z^k : k \in \Lambda\} \subset C(\mathbb{T})$ and $L_\Lambda =$ closed linear space of $\{z^k : k \in \Lambda\} \subset L_1(\mathbb{T})$ have bases.

V. MILMAN

Diameters of random proportional sections of a symmetric convex body

Let $K \subset \mathbb{R}^n$ be a symmetric convex body and $\|\cdot\|_K$ be the norm with the unit ball K. Let $\mathcal{D}$ be the standard euclidean ball in $\mathbb{R}^n$; K° be the polar of K. Consider the following averaging parameters of K:

$$M_K = \int_{S^{n-1}} \|x\|_K \, d\mu(x) \, , \; M_K^* = \int_{S^{n-1}} \|x\|_{K^\circ} \, d\mu(x) \, , \text{ and } M_K^*(r) = \frac{M_{K\cap r\mathcal{D}}^*}{r} \, ,$$

where μ is the normalized, rotation invariant measure on the sphere and $r > 0$. For fixed $\frac{1}{2} < \lambda < 1$ we consider $k = [\lambda n] + 1$. The following follows from known results: If r satisfies the equation $M_K^* = \frac{1}{2}\sqrt{1-\lambda}$ then, with very high probability a random k-dimensional subspace $E \subset \mathbb{R}^n$ satisfies

$$\frac{1}{2}\text{diam}(K \cap E) \;\leq\; r \, . \qquad (*)$$

We complement this result by showing that for $\lambda = \frac{1}{2}$ and r_0 satisfying $M_K^*(r_0) = 1 - \frac{1}{48\cdot 36}$ the inequality

$$\frac{1}{2}\mathrm{diam}(K \cap E) \geq \frac{1}{60} r_0$$

is satisfied for a k-dimensional section with probability $\geq 1 - (\frac{1}{2})^k$. So, both the upper and lower bounds for "random" $[\lambda n]$-dimensional sections of K are of the same order. The proof uses a new lower M-estimate (instead of the well-known M^*-estimate used in $(*)$) and Borsuk's antipodal theorem. Joint work with A. Giannopoulos.

P. X.F. MÜLLER

Rearrangements of the Haar system

Let $\{h_I\}$ be the L^∞ normalized Haar system indexed by dyadic intervals in $[0, 1]$, and let τ be a rearrangement of the dyadic intervals. We give a geometric characterization for those τ for which the induced operators

$$\begin{aligned} T_p : L^p \to L^p \quad &; \quad \frac{h_I}{|I|^{\frac{1}{p}}} \mapsto \frac{h_{\tau(I)}}{|\tau(I)|^{\frac{1}{p}}} \\ T : BMO \to BMO \quad &; \quad T : h_I \mapsto h_{\tau(I)} \end{aligned}$$

extend to a bounded linear operator on L^p respectively BMO.

E. ODELL

A problem on spreading models

Let (e_i) be a normalized basis for X. We write $(x_i) \prec (e_i)$ if (x_i) is a normalized block basis of (e_i). Every such (x_i) admits a subsequence (x_i') having a spreading model (s_i) in the following sense: For some $\varepsilon_n \downarrow 0$ for all $(a_i)_1^n \subset [-1, 1]^n$,

$$\left| \left\| \sum_1^n a_i \, x_{k_i'} \right\| - \left\| \sum_1^n a_i \, s_i \right\| \right| < \varepsilon_n$$

if $n \leq k_1 < .. < k_n$. We proove the following theorems

A) If $\|s_1 + s_2\| = 2$ whenever (s_i) is spreading model of some $(x_i) \prec (e_i)$ then X contains ℓ_1.

B) If $\|s_1 + s_2\| = 1$ whenever (s_i) is spreading model of some $(x_i) \prec (e_i)$ then X contains c_0.

For the Tsirelson space T space we can prove that for all $(x_i) \prec (e_i)$ there exists $(y_i) \prec (x_i)$ having a spreading model (s_i) satisfying for all $(a_i)_1^n$

$$\left\| \sum_1^n a_i s_i \right\| = \sum_1^n |a_i| .$$

Moreover, there exists an equivalent norm $|\cdot|$ on T so that if (s_i) is a spreading model of any $(x_i) \prec (e_i)$, then $\|s_1 + s_2\| < 2$. Joint work with Thomas Schlumprecht.

M. Ostrovskii

Generalization of projection constants: sufficient enlargements of unit balls

Let X be a Banach space and let Y be its finite dimensional subspace. We denote the unit ball of X by $B(X)$. Let $P : X \to Y$ be some continuous linear projection. Then $P(B(X)) \supset B(Y)$ and $P(B(X))$ is a convex, symmetric with respect to 0, bounded subset of Y. It is very natural to ask the following question: How small can be made the set $P(B(X))$ under a proper choice of P? In this connection it is natural to introduce the following definition. Let X by a finite dimensional normed space. A symmetric with respect to 0 bounded closed convex body $A \subset X$ is called sufficient enlargement for X if for arbitrary isometric embedding $X \subset Y$ there is a projection $P : Y \to X$ such that $P(B(Y)) \subset A$. The purpose of this talk is to present first steps in the investigation of sufficient enlargements.

A. Pietsch

Topologies in the class of all Banach spaces

Let X and Y be infinite dimensional Banach spaces. Then

$$a_n(X,Y) := \sup_{E_n} \inf_{F_n} d(E_n, F_n) ,$$

where E_n and F_n range over all n-dimensional subspaces of X and Y, respectively. Here $d(E_n, F_n)$ denotes the Banach-Mazur distance. Write

$$s_n(X,Y) := \max\{a_n(X,Y), a_n(Y,X)\} .$$

The sequence $1 \le s_1(X,Y) \le s_2(X,Y) \le s_3(X,Y) \le ..$ can be used to define various topologies on the class of all Banach spaces. The neighborhoods are given by

$$U_a(X_0) := \{X : s_n(X, X_0) \le c\,\alpha_n \text{ for some } C > 0\} ,$$

where $a = (\alpha_n)_n$ is a positive sequence tending to ∞.

$$\begin{aligned} \text{polynomial topology} &: \quad a = (n^\varepsilon) \text{ with } \varepsilon > 0\,, \\ \text{logarithmic topology} &: \quad a = ((1+\log(n))^\varepsilon) \text{ with } \varepsilon > 0\,, \\ \text{ultra topology} &: \quad \text{all } a = (\alpha_n)\,. \end{aligned}$$

Using this terminology, one has the following results: The class of B-convex Banach spaces is open in the polynomial topology and closed in the logarithmic topology. The class of Banach spaces having Rademacher type 2 is nowhere dense in all the above topologies.

H. ROSENTHAL

On wide-(s) sequences and their applications to certain classes of operators

A basic sequence in a Banach space is called wide-(s) if it is bounded and dominates the summing basis. These sequences and their quantified versions, termed λ-wide-(s) sequences, are used to characterize various classes of operators between Banach spaces, such as weakly compact, Tauberian, and super-Tauberian operators, as well as a new intermediate class introduced here, the strongly Tauberian operators. This is a nonlocalizable class which nevertheless forms an open semigroup and is closed under natural operations such as taking double adjoints. It is proved for example that an operator is non-weakly compact iff for every $\varepsilon > 0$, it maps some $(1+\varepsilon)$-wide-(s) sequence to a wide-(s) sequence. This immediately yields the quantitative triangular array result characterizing reflexivity, due to R.C. James. It is shown that an operator is non-Tauberian (resp. non-strongly Tauberian) iff for every $\varepsilon > 0$, it maps some $(1+\varepsilon)$-wide-(s) sequence into a norm-convergent sequence (resp. a sequence whose image has diameter less than ε). This is applied to obtain a direct "finite" characterization of super-Tauberian operators, as well as the following characterization which strengthens a recent result of M. González and M. Martínez-Abejón: An operator is non-super-Tauberian iff there are for every $\varepsilon > 0$, finite $(1+\varepsilon)$-wide-(s) sequences of arbitrary length whose images have norm at most ε.

GIDEON SCHECHTMAN

Non–linear quotients

A Lipschitz (resp. uniform) quotient map f from a Banach space X onto another Y is a Lipschitz (resp. uniformly continuous) map such that, for every $x \in X$ and $r > 0$, the image of a ball of radius r around x contains a ball of radius cr (resp. $\phi(r) > 0$) around $f(x)$. Here $c > 0$ (resp. ϕ) is

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independent of x. We start the investigation of the following question: to what extend does the existence of such non-linear quotient map between two Banach spaces imply the existence of a linear one. First results are obtained by Bates, Johnson, Lindenstrauss, Preiss and the speaker.

THOMAS SCHLUMPRECHT

On Asymptotc Properties of Banach Spaces under Renormings

It is shown that a separable Banach space X can be given an equivalent norm $|||\cdot|||$ with the following property: If $(x_n) \subset X$ is relatively weakly compact and

$$\lim_{m\to\infty} \lim_{n\to\infty} |||x_m + x_n||| = 2 \lim_{m\to\infty} |||x_m|||$$

then (x_n) converges in norm. This leads to a geometric characterization of reflexive Banach spaces and solves a problem stated by V. Milman. In addition it is shown that some spreading model of a sequence in $(X, |||\cdot|||)$ is 1-equivalent to the unit vectors basis of ℓ_1 (respectively, c_0) if and only if X contains an isomorphic copy of ℓ_1 (respectively c_0).

M. TALAGRAND

Majorizing measures and the Rademacher-Menchov theorem

The classical Rademacher-Menchov theorem assert that if a sequence (a_n) satisfies

$$\sum_n a_n^2 (\log n)^2 < \infty \qquad (1)$$

then for every orthonormal system (ϕ_n), the series $\sum_n a_n \phi_n$ converges a.s. Assuming without loss of generality that $0 < a_n < \frac{1}{2}$, we show that for every $\varepsilon > 0$, (1) can be replaced by

$$\sum_n a_n^2 (\log \frac{1}{a_n})^{2-\varepsilon} (\log n)^{\varepsilon} < \infty . \qquad (2)$$

The proof relies on a new maximal inequality, i.e. an estimate for $A_N = \|\max_{k\leq N} Y_k\|_2^2$, where $Y_k = \sum_{n\geq k} \alpha_n \phi_n$. This is a problem of the type "control of the supremum of a process under an increment condition", for which the efficient tool is the theory of majorizing measures. The conceptual clarification brought by this approach allows to concentrate on the combinatorics of the problem, and allows to obtain a bound for A_N that does not depend upon N, yielding (2).

D. WERNER

The Daugavet equation for operators on function spaces

We prove the norm identity

$$\|Id + T\| = 1 + \|T\| ,$$

which is known as the Daugavet equation, for some classes of operators, e.g. the weakly compact ones, on some classes of Banach spaces, e.g. function algebras or L^1-predual spaces, provided a non-discreteness assumption is met.

M. WOJCIECHOWSKI

A lower bound estimate for L^p norms of invariant operators

Let $s : \mathbb{Z}^d \to \mathbb{C}$ be a bounded symmetric ($s(n) = s(-n)$) multiplier. Assume that there are sequences $(k'_j)_{j=1}^{\infty}$, $(k''_j)_{j=1}^{\infty} \subset \mathbb{Z}^d$ such that

$$\lim_{j\to\infty} s(n + k'_j) = a \neq b = \lim_{j\to\infty} s(n + k''_j)$$

for all $n \in \mathbb{Z}^d$. Then there exists $c > 0$ such that if S is the translation invariant operator induced by s then

$$\left\|S : L^p(\mathbb{T}^d) \to L^p(\mathbb{T}^d)\right\| > c|a - b| \max\{p, \frac{p}{p-1}\} .$$

By the deLeeuw transference theorem a similar result holds for $\mathbb{R}^d$. The proof uses the martingale inequality for the square function and the Riesz product techniques. As a consequence it seems that one gets precise asymptotics of the function

$$p \mapsto \|S : L^p \to L^p\|$$

for invariant operators of weak type $(1, 1)$ induced by a wide class of rational functions. This seems to be new even in the case of the multiplier $s(x, y) = \frac{x^4}{x^4+y^4}$.

K. WOŹNIAKOWSKI

On algebraic polynomial basis on $C[-1,1]$

Let $(t_n)_{n=0}^{\infty}$ be any Schauder basis in the space $C[-1,1]$ consisting of algebraic polynomials. A. A. Privalov has shown that in this case we cannot have estimation $deg\, t_n \leq (1+\varepsilon_n)n$ for any sequence $\varepsilon_n \to 0$. On the other hand for every $\varepsilon > 0$ he gave example of the system (t_n) such that $deg\, t_n \leq (1+\varepsilon)n$. We show that this can be done under the additional condition that the polynomials t_n are orthogonal on the interval $[-1,1]$ with respect to the Lebesgue measure. In this way such a basis in $C[-1,1]$ is also a basis in the spaces $L_p[-1,1]$, $1 \leq< p < \infty$. The result is obtained by appropriate modyfication of earlier constructions ot trigonometric polynomial basis in the space $C(\mathbb{T})$, where $\mathbb{T}$ is a unit circle in the complex plain.

V. ZIZLER

Uniform Eberlein compacta and renormings

A norm $\|\cdot\|$ of a Banach space X is called weakly uniformly rotund if $x_n - y_n \to 0$ weakly in X whenever x_n, $y_n \in X$ are such that $\|x_n\| = \|y_n\| = 1$ and $\lim \|x_n\| + \|y_n\| = 2$. A norm is called locally uniformly rotund if $\|x_n - x\| \to 0$ whenever x_n, $x \in X$ are such that $\|x_n\| = \|x\| = 1$ and $\lim \|x_n + x\| = 2$. A compact space K is called uniform Eberlein compact if K is homeomorphic to a weakly compact set in a in a Hilbert space considered in its weak topology. We will discuss the main ideas in the proof that a Banach space X admits an equivalent weakly uniformly rotund norm if and only if the second dual ball $B_{X^{**}}$ of X^{**} in its weak topology is a uniform Eberlein compact. As a corollary we will obtain that every space with weakly uniformly rotund norm admits an equivalent norm that is locally uniformly rotund and Fréchet differentiable. Joint work with M. Fabian and P. Hájek.

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