MATHEMATISCHES FORSCHUNGSINSTITUT OBERWOLFACH

Tagungsbericht 44/1982

Funktionalanalysis

24.10. bis 30.10.1982

Die diesjährige Tagung über Funktionalanalysis im Mathematischen Forschungsinstitut Oberwolfach fand in der Woche vom 24.10. bis 30.10.1982 statt; sie stand wie vor zwei Jahren unter der Leitung der Herren Professoren K.-D. Bierstedt (Paderborn), Heinz König (Saarbrücken) und H. H. Schaefer (Tübingen).

23 der insgesamt 47 Teilnehmer kamen aus dem Ausland (Belgien, England, Finnland, Frankreich, Indien, Österreich, Polen, Schweiz, Spanien, Tschechoslowakei und den USA); bei der Größe der Tagung konnten leider wieder mehrere weitere Interessenten aus In- und Ausland nicht mehr eingeladen werden.

In 37 Vorträgen wurde über verschiedene Teilgebiete der Funktionalanalysis berichtet; u. a. wurden Resultate vorgestellt aus den Themenkreisen: Nukleare Räume und Fréchetráume , Folgenräume und Funktionenräume, Banachraumtheorie, Banachalgebren und lokalkonvexe Algebren, Banachverbände, topologische Tensorprodukte, Distributionstheorie, partielle Differentialgleichungen, Operatorentheorie und Spektraltheorie. Nach den Vorträgen fanden (z. T. längere) Diskussionen statt, die auch in zahlreichen persönlichen Gesprächen fortgeführt wurden.

Die vorbildliche Organisation und angenehme Atmosphäre im Mathematischen Forschungsinstitut trug wesentlich zum Gelingen der Tagung bei; auch das sehr gute Wetter spielte mit. Am Freitagabend klang die Tagung mit einem kurzen Klavierkonzert von Herrn F. Haslinger (Wien) - und anschließender angeregter Diskussion - aus.

Die Herren Professoren M. M. Dragilev und W. P. Kondakov (beide Rostov, UdSSR), die an der Tagung nicht teilnehmen konnten, hatten Vortragsauszüge geschickt, die in den Tagungsbericht aufgenommen wurden.

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Vortragsauszüge

E. ALBRECHT:

Local spectral theory modulo compact operators

Let X be a Banach space. For their study in Fredholm theory, Buoni-Harte-Wickstead considered the quotient space $X_q := l^\infty(X)/pc(X)$ (where $pc(X)$ denotes the space of precompact sequences with values in X). They noticed that each $T \in \mathcal{L}(X)$ induces in the canonical way an operator $T_q \in \mathcal{L}(X_q)$ and that the kernel of this homomorphism $T \to T_q$ is the ideal $\mathcal{K}(X)$ of compact operators. This gives a possibility to introduce a local spectral theory modulo $\mathcal{K}(X)$. T will be called essentially decomposable if T_q is decomposable on X_q in the sense of Colojoară and Foiaş. This class of operators includes all decomposable operators, essentially normal operators, and Toeplitz operators and pseudo-differential operators with continuous symbols. By means of local spectral theory on X_q, we obtain results concerning the Fredholm structure of such operators and a characterisation of local type operators on Sobolev spaces and other function spaces by a commutator property. These results have been obtained in joint work with R. D. Mehta (Vallabh Vidyanagar, India).

H. APIOLA:

Twisted sums of nuclear Fréchet spaces

A non-trivial twisted sum of Fréchet spaces E and F is a short exact sequence

$$0 \to E \to X \to F \to 0$$

that does not split.

We study in the context of nuclear Fréchet spaces the possibility of methods analogous to those developed by Kalton and Peck (cf. Trans. AMS 255 (1979), 1 - 30). The results discussed (most of which are due to T. Ketonen and K. Nyberg) include a description of a canonical construction method of twisted sums and criteria for their splitting.

C. BESSAGA:

Multinorm geometry of Frêchet spaces. Two examples

The objects considered are Frêchet spaces equipped with a fixed monotone sequence of seminorms. $(X,|.|_1,|.|_2,\dots)$ and $(Y,|.|_1,|.|_2,\dots)$ are said to be multi-isometric if there is a linear bijection T of X onto Y such that $|Tx|_k = |x|_k$ for $k = 1,2,\dots$

It often happens that multi-isometric invariants of Frêchet spaces give rise to isomorphic (= linearly-homeomorphic) properties of these spaces. This is illustrated by two examples: 1. Alpseymen's characterization of basic sequences in nuclear stable infinite type power series spaces (Stud. Math. 70 (1981), 21 - 26). 2. Vogt's example of a nuclear Frêchet spaces without the bounded approximation property (preprint).

I. CIORANESCU:

On the Abstract Cauchy Problem for the operator $d^n/dt^n - A$.

Let X be a Banach space, A a closed and densely defined operator on X, $D_\infty = \bigcap_{n=0}^{\infty} D(A^n)$, considered as a Frêchet space endowed with the norm-system $||x||_n = \sum_{i=0}^{n} ||A^i x||$, $n \in \mathbb{N}$. Then Ushijima has proved that the abstract Cauchy problem is well posed (in short A.C.P. is w.p.) for the operator $d/dt - A$ iff $A|D_\infty$ generates a locally-equicontinuous semi-group of class C^∞ in $L_s(D_\infty)$.
We seek a similar result for the operator $d^2/dt^2 - A$; namely in this case $A|D_\infty$ has to generate a locally-equicontinuous cosine functions of class C^∞ in $L_s(D_\infty)$.
For $n \geq 3$ it was proved by Chazarain that the A.C.P. is w.p. for the operator $d^n/dt^n - A$ iff A is bounded; in this case the fundamental solution is an $L(x)$-valued entire function.

A. CLAUSING:

Total positivity of extended Green's kernels

It is known from theorems of Krein, Karlin, and others, that there exist numerous ordinary differential operators which in connection with suitable separated boundary conditions give rise to a totally positive Green's function.

Some of these operators also satisfy the boundary minimum principle, thus their basic functions (the solutions which are biorthonormal to the boundary conditions) are nonnegative. These functions together with the Green's kernel form the "extend Green's kernel" T.

Our main result here is that for disconjugate operators and for a large class of boundary conditions, T is a totally positive kernel if its domain is given a special order which depends on the particular form of the boundary conditions.

The theorem has implications concerning, for example, the eigenfunctions of the operator, a monotonicity property of the Green's kernel, and the associated cone of operator-concave functions.

J.F. COLOMBEAU:

New Generalized Functions. Multiplication of Distributions. Mathematical and Physical Applications

If Ω denotes any open subset of $\mathbb{R}^n$ we define an algebra $\mathcal{G}(\Omega)$ in the following situation

$$\mathcal{E}(\Omega) \subset \mathcal{D}'(\Omega) \subset \mathcal{G}(\Omega).$$

$\mathcal{E}(\Omega)$ is a subalgebra of $\mathcal{G}(\Omega)$ and any element of $\mathcal{G}(\Omega)$ admits partial derivatives to any order that are still in $\mathcal{G}(\Omega)$ (for a concept of derivation which generalizes exactly the derivation in the sense of distributions). Therefore the multiplication in $\mathcal{G}(\Omega)$ is a natural candidate for the multiplication of distributions. We develop the mathematical theory of the elements of $\mathcal{G}(\Omega)$, called "new generalized functions" and we sketch how this construction gives a mathematical meaning to the basic heuristic computations of Quantum Field Theory.

H.G. DALES:

Automatic continuity of finite-dimensional representations of Banach algebras

We are motivated by the question: Is every finite-dimensional representation of the group algebra $L^1(G)$ necessarily continuous?

We first consider an arbitrary Banach algebra A, and obtain conditions on A for each finite-dimensional representation to be automatically continuous. We then consider whether or not these conditions are satisfied by $L^1(G)$. This is the case if G is amenable, and in some other cases, but the general question remains open.

S. DIEROLF:

On spaces of continuous linear maps between locally convex spaces

For two locally convex spaces E and F let $L_b(E,F)$ denote the space of all continuous linear maps from E into F, provided with the topology of uniform convergence on all bounded subsets of E. A classical result of A. Grothendieck says that for a Mackey space E the space $L_b(E,F)$ is complete if the strong dual E'_β and F are both complete. It would be interesting to know whether similar statements hold for other properties such as barrelledness, bornologicity, or being a DF-space, instead of completeness.

Methods of constructing general counterexamples show that the interesting case in that problem is the following question of A. Grothendieck (1953): If E is metrizable and F is a DF-space, what can be said about $L_b(E,F)$?

Even in this restricted setting barrelledness does not pass over from E'_β and F to $L_b(E,F)$, since for certain dense hyperplanes H in the Hilbert-space l^2 the normed space $L_b(l^2,H)$ is not barrelled.

Moreover, there exists a reflexive DF-space F such that $L_b(l^1,F)$ is not quasibarrelled. This example shows that neither bornologicity nor quasibarrelledness are preserved in the above setting.

On the other hand, for every strict LB-space $F = \varinjlim F_n$ the space $L_b(l^1,\varinjlim F_n)$ is in a canonical way topologically isomorphic to the strict LB-space $\varinjlim L_b(l^1,F_n)$.

Furthermore, for every locally complete DF-space F the space $L_b(l^1,F)$ is again a DF-space, and the ε-product $c_0 \varepsilon F$ is a DF-space for every DF-space F.

M.M. DRAGILEV:

On Schwartz-Köthe spaces and n-fold-regular bases

Let X be a complete metric locally convex space of type S with absolute basis (Schwartz-Köthe space). There is a constant $n = n(X)$, $1 < n < \infty$, with the property: Every absolute basis in X can be made n-fold-regular by a permutation of elements.

(Def. of "n-fold-regular basis" s. Soviet Math. Dokl. vol. 11 (1970), N. 4, 1012 - 1015)

E. DUBINSKY:

Finite dimensional decompositions in power series spaces

Let E be a nuclear Frêchet space and (E_n) a sequence of finite dimensional subspaces with the property that for every $y \in E$ there is a unique expansion $y = \Sigma y_n$, $y_n \in E_n$. Such a sequence of subspaces is called a finite dimensional decomposition (FDD) or Schauder decomposition.

A criteria is described which implies the existence of a basis. An important case in which the criteria is satisfied is power series spaces and this leads to a result which we now describe.

Suppose that E has a basis (x_n) and the FDD is determined as follows. Let (m_ν) be a strictly increasing sequence of indices and suppose that L_ν^s is the space generated by $[x_{m_{\nu-1}+1} + \cdots + x_{m_\nu}]$. In the power series spaces $\Lambda_\infty(\alpha)$ (infinite type) and $\Lambda_1(\alpha)$ (finite type), (x_m) is the usual coordinate basis and we have the following result

Theorem: If the sequence (n_ν) does not grow too rapidly then every block subspace and every block quotient has a basis.

Here a block subspace is one generated by subspaces (F_ν) where each F_ν is a subspace of E_ν. Block quotients are defined similarly.

The criterion that (n_ν) does not grow to fast is as follows.

$$\Lambda_\infty(a): \sup_\nu \frac{\alpha_{n_\nu}}{\alpha_{n_{\nu-1}+1}} < \infty \quad , \quad \Lambda_1(\alpha): \lim_\nu \frac{\alpha_{n_\nu}}{\alpha_{n_{\nu-1}+1}} = 1.$$

Proof has somewhat of a geometric flavor.

K. FAN:

Iteration of analytic functions of operators

Let f be a complex function analytic on $\Delta = \{z : |z| < 1\}$ such that $f(\Delta) \subset \Delta$. Let $f^{[n]}$ be the n-th iterate of f. Then there exists a complex number w with $|w| < 1$ such that the inequalities

$$(1)\ \{I - \bar{w}f(A)\}\{I - f(A)^*f(A)\}^{-1}\{I - wf(A)^*\} \leq (I - \bar{w}A)(I - A^*A)^{-1}(I - wA^*),$$

$$(2)\ \{I - \bar{w}f(A)\}\{(1 + |w|^2)I - \bar{w}f(A) - wf(A)^*\}^{-1}\{I - wf(A)^*\}$$
$$\leq (I - \bar{w}A)\{(1 + |w|^2)I - \bar{w}A - wA^*\}^{-1}(I - wA^*),$$

$$(3)\ \left\| f^{[n]}(A) - \frac{w}{d(w,A) + |w|^2} I \right\| \leq \left\| A - \frac{w}{d(w,A) + |w|^2} I \right\|,$$

$$(4)\ \| \{f^{[n]}(A) - wI\}\{I - \bar{w}f^{[n]}(A)\}^{-1} \| \leq \| (A - wI)(I - \bar{w}A)^{-1} \|$$

hold for any operator A on a complex Hilbert space with $\|A\| < 1$ and for $n = 1,2,\ldots$, where $f(A)$, $f^{[n]}(A)$ are defined as in functional calculus, and $d(w,A) = \| (I - \bar{w}A)(I - A^*A)^{-1}(I - wA^*)\|$.

This generalizes a classical theorem of Denjoy-Wolff and improves a result of the author [Math. Z. 179 (1982), 293 - 298]. An analogous theorem for analytic functions on the half-plane $\operatorname{Re} z > 0$ is also obtained.

T. FIGIEL:

Factorizations of certain embeddings of ℓ_2^n in L_1

The results presented in the talk have been obtained in joint work with W. B. Johnson and G. Schechtman. A typical result is as follows:
We consider an operator $T: Y \to L_1 = L_1(0,1)$, rank $T = n < \infty$. Assuming that $||x||_p \leq C_p||x||_1$ for $x \in T(Y)$ and that T is an isomorphism we obtain a lower estimate for the products $||A|| \cdot ||B||$ where $Y \xrightarrow{A} Z \xrightarrow{B} L_1$ is a factorization of T with rank $B \leq m$ (m being a given integer). Applying this e.g. to the space $Y = R_n = \operatorname{span}\{r_1,\ldots,r_n\} \subset L_1$ (here the r_i's are Rademacher functions and $n = 1,2,\ldots$)

and $T: R_n \to L_1$ being the embedding operator we obtain e.g. the estimate

$\|u\| \geq \frac{1}{150}\sqrt{\frac{n}{\log m}}$, $m = \text{rank } u$, if $u: L_1 \to L_1$ satisfies $u(r_i) = r_i$ for $i = 1,\ldots,n$, and also $d(F, l_1^k) \geq \frac{1}{150}\sqrt{\frac{n}{\log k}}$, if $R_n \subseteq F \subset L_1$, $\dim F = k$. In particular, if $n \to \infty$, then rank(u) (resp. dim F) must grow exponentially for $\|u\|$ (resp. for $d(F, \ell_1^{\dim F})$) to be uniformly bounded .

B. FUCHSSTEINER:

Algebraic foundation of some distribution algebras

The properties of the noncommutative associative algebra of almost-bounded distributions are reviewed [Math. Ann. 178, 302 - 314 (1978)]. This algebra is then applied to treat the most elementary problem in shock wave theory, namely the dynamical behaviour of the hydraulic jump. It is demonstrated that the non-commutativity of the algebra is the mathematical analogon of the fact that energy-density conservation is violated by going through the shock front.

The algebraic background of this (and similar) algebras is illuminated. To be precise: It is shown that the algebra under consideration is a special case of the situation where one has an algebra A, a derivation $d_1: A \to A$, and a derivation $d_2: A \to \mathcal{A}_S$ ($\mathcal{A}_S$ some A bi-module). It is shown that in such a situation one can construct (in a canonical way) a trivial extension $A \oplus M$ of A via some A bi-module $M \supset \mathcal{A}_S$ such that the derivation $D = d_1 + d_2$ can be extended (again canonically) to all of $A \oplus M$ without enlarging its kernel.

In the last section of the lecture this algebraic construction is considered from the duality point of view. This consideration suggests that the usual C^∞-test-functions should be replaced by the almost-bounded distributions with compact support.

F. HASLINGER:

Bases in spaces of holomorphic functions

The interpolation problem $f^{(n)}(\lambda_n) = a_n$ is investigated in several spaces of holomorphic functions. With the help of the theory of bases in nuclear Fréchet spaces one can determine the sequence $(a_n)_{n=1}^\infty$, for which the above interpolation problem is solvable. It can also be shown that the results are sharp in a certain sense.

Finally some remarks are made about the problem of existence of bases in the space of all holomorphic functions on a region of infinite connectivity, which has a complement of positive logarithmic capacity and irregular boundary points.

R. HOLLSTEIN:

Locally convex α-spaces

We investigated classes of locally convex spaces which are defined by means of topological tensor products in the following way: A locally convex space E is called α-space if the topological identity $E \otimes_\alpha F = E \otimes_\pi F$ holds for all locally convex spaces F, where α denotes a tensor norm in the sense of Grothendieck. For example, the $\mathcal{L}_p$-spaces of Lindenstrauss and Pełczyński, Banach spaces which are isomorphic to subspaces (resp. quotient spaces) of $L_p(\mu)$-spaces, nuclear spaces or hilbertisable spaces are α-spaces for certain tensor norms α. The α-spaces are stable under the formation of completions, topological products and countable direct sums; subspaces (resp. quotient spaces) of α-spaces are $\alpha/$-spaces (resp. $\backslash\alpha$-spaces). Furthermore, conditions under which the strong dual of an α-space is a ${}^t\alpha$-space were given.

The α-spaces can be characterized in several ways; among others, the following result was presented:

Theorem: The following assertions are equivalent

(1) E is an α-space

(2) $E \otimes_\varepsilon F = E \otimes_{\check{\alpha}} F$ for all locally convex spaces F

(3) For each zero-neighbourhood U there exists a zero neighbourhood V, $V \subset U$, such that the canonical mapping $K_{UV}: \tilde{E}_V \to \tilde{E}_U$ is α'-integral.

A sequence characterization for $\alpha/$- and $\backslash\alpha$-spaces can be obtained by the following result

Theorem: The following assertions are equivalent

(1) E is an $\alpha/$-space (resp. $\backslash\alpha$-space)

(2) $E \tilde{\otimes}_\alpha l_1 = E \tilde{\otimes}_\pi l_1$ (resp. $E \tilde{\otimes}_{\check{\alpha}} c_o = E \tilde{\otimes}_\varepsilon c_o$)

Applications of the two theorems were presented.

H. JARCHOW:

On some 3-space properties of Banach spaces

An operator ideal A is said to have 3SP if $I_X \in A$ holds for every Banach space X which admits a subspace Y such that $I_Y \in A$ and $I_{X/Y} \in A$. Many examples of this situation are known or can easily been obtained, e.g. in case $A = \mathcal{W}$ (weakly compact operators → reflexivity), $A = \mathcal{V}$ (fully complete operators → Schur property), $A = \mathcal{R}$ (Rosenthal-operators → non-containment of l_1), $A = \mathcal{U}$ (unconditionally summing operators → non-containment of c_0), $A = \mathcal{S}$ (weakly sequentially completing operators → weak sequential completeness), etc.

Some of these examples, and further ones, can be subsumed under a general statement. Namely, ideals of the form $[F_1 \circ B_1] \circ A_1^{-1}$, $[F_1 \circ B_2] \circ A_2^{-1}$ and $[F_1 \circ B_2]^{sur} \circ A_2^{-1}$, $A_3^{-1} \circ [B_3 \circ F_\infty]$ and $A_3^{-1} \circ [B_3 \circ F_\infty]^{inj}$ have 3SP provided that $F_1 \circ B_k \subset A_k (k = 1,2)$, $B_3 \circ F_\infty \subset A_3$, $A_1 = A_1 \circ F_\infty = A_1^{inj} \circ F_\infty$, $A_2 = A_2^{inj}$, $A_3 = A_3^{sur}$. Here F_p is the ideal of operators which factor through some $l_p(\Gamma)$. E. g., the properties of satisfying Grothendieck's theorem, of being a Hilbert-Schmidt space, of having the Delbaen-Kisliakov property, etc., can be treated in this way.

If A is a regular ideal having 3SP, then the ideal A^{super} in the sense of S. Heinrich also has 3SP. This leads to further known examples of ideals having 3SP, namely $\mathcal{W}^{super}$, $\mathcal{R}^{super}$, $\mathcal{U}^{super}$. But we are also led to ask what $\mathcal{V}^{super}$ ("super-Schur property") and $\mathcal{S}^{super}$("super-weak sequential completeness") could mean.

K. JOHN:

Nuclearity and tensor products

An example is given of two non-nuclear Frêchet Schwartz hilbertisable spaces E, F with basis such that $E \otimes_\varepsilon F = E \otimes_\pi F$.

P.K. KAMTHAN:

Why do we study Schauder basis theory in T.V.S.?

The importance of the Hamel basis theory in linear algebra is well known to vector pathologists. However, the precise location of a Hamel base in an arbitrary vector space is invariably an arduous job- sometimes an impossible task. In vector spaces endowed with natural linear topologies, one can introduce the notion of a topological base (t.b.) through which we can overcome the difficulty experienced earlier. This new notion of a t.b. was introduced first by Schauder in Banach spaces. The development of the present theory of topological bases as given in author's monograph (with M. Gupta) owes much to the advancement of sequence space theory. On the other hand, the theory of t.b. is found sufficiently useful in the study of the duality theory of locally convex spaces, structure of locally convex spaces, characterization of compact sets in F-spaces and so on so forth.

The present work forms a very brief outline of the author's forthcoming monograph: Bases in Topological Vector Spaces and Applications .

G. KÖTHE:

Eine Klasse nuklearer Räume

Es seien φ bzw. ω die aus allen finiten bzw. allen Folgen aus $\mathbb{K}$ bestehenden Folgenräume ($\mathbb{K}$ der reelle oder komplexe Zahlkörper). Wir betrachten die Räume endlicher Stufe: $\sigma_1 = \varphi$, $\sigma_1^x = \omega$, $\sigma_1 \oplus \sigma_1^x$; $\sigma_2 = \varphi\omega$, $\sigma_2^x = \omega\varphi$, $\sigma_2 \oplus \sigma_2^x$,.... Sie sind bezüglich ihrer natürlichen Topologie tonneliert, vollständig und nuklear. Ein Folgenraum λ heißt konvergenzfrei, wenn er mit $x = (x_1,x_2,\dots)$ auch jedes $y = (y_1,y_2,\dots)$ enthält mit $y_n = 0$ falls $x_n = 0$. Unsere Räume sind spezielle konvergenzfreie Räume. Für zwei vollständige konvergenzfreie λ,μ ist $\mathcal{L}_b(\lambda,\mu)$ wieder ein konvergenzfreier Folgenraum. Sind λ,μ Räume endlicher Stufe, so ist auch $\mathcal{L}_b(\lambda,\mu)$ ein Raum endlicher Stufe, der sich genau bestimmen läßt, z. B. ist $\mathcal{L}_b(\sigma_n,\sigma_n)$ permutationsisomorph zu σ_{2n}^x.

V.P. KONDAKOV:

Remarks on the structure of Köthe spaces

We study the sufficient and necessary conditions for a Frêchet space F to be isomorphic to a subspace of a given Köthe space E.
The Köthe space $E = l_1[a_r(n)]$ is defined to be the set
$l_1[a_r(n)] = \{(\xi_n) \in \mathbb{C}^{\mathbb{N}} : \sum_n |\xi_n|\, a_r(n) = |(\xi_n)|_r < +\infty,\ r = 1,2,\dots\}$, where

$0 < a_r(n) < a_{r+1}(n)$, $r, n \in \mathbb{N}$, equipped with the topology generated by the sequence

of the semi-norms $|\cdot|_r$.
Let F have the sequence of the seminorms $||\cdot||_r$ such that
$\forall r \in \mathbb{N}\ \exists\ (f_m^{(r)}, f_m^{(r)'}(\cdot))_{m=1}^{\infty}\ (f_i^{(r)'}(f_j^{(r)}) = \delta_{ij})$:

$$||f||_r = \sum_m |f_m^{(r)'}(f)|\ ||f_m^{(r)}||_r,\ f \in F$$

(e. g. F is nuclear or F has an absolute basis).

Proposition. (cf. [1]). If F is isomorphic to a subspace of the Köthe-Schwartz E, then
$\exists(\varphi(r))_{r=1}^{\infty}\ (\varphi(r) \in \mathbb{N})\ \ \forall r \in \mathbb{N}\ \exists\ (n_r(m))_{m=1}^{\infty}\ (n_r(m) \in \mathbb{N},\ n_r(i) \neq n_r(j),\ i \neq j)$

$$\sup_{m:||f_m^{(r)}||_{\varphi(s)} \neq 0} \frac{a_s(n_r(m))}{a_{\varphi(r)}(n_r(m))} \frac{||f_m^{(r)}||_r}{||f_m^{(r)}||_{\varphi(s)}} < +\infty,\ s \in \mathbb{N}.$$

Theorem 1 (cf. [1]). The Köthe space $F = l_1[b_r(n)]$ is isomorphic to a subspace $E = l_1[a_r(n)] \cong (l_1[c_r(n)])^{\mathbb{N}}$ if and only if $\exists(\varphi(r))_{r=1}^{\infty}\ (\varphi(r) \in \mathbb{N})\ \forall r \in \mathbb{N}\ \exists(n_r(m))_{m=1}^{\infty}$ $(n_r(m) \in \mathbb{N},\ n_r(i) \neq n_r(j)\ \ \forall i \neq j)$

$$\sup_{m:||f_m^{(r)}||_{\varphi(s)} \neq 0} \frac{a_s(n_r(m))}{a_{\varphi(r)}(n_r(m))} \frac{b_r(m)}{b_{\varphi(s)}(m)} < +\infty,\ s \in \mathbb{N}.$$

Theorem 2 (cf. [1]). If $F = l_1[b_r(n)]$ is isomorphic to a complemented subspace of $E = l_1[a_r(n)]$, then there exist maps $\lambda: \mathbb{N} \to R$, $\sigma: \mathbb{N} \to \mathbb{N}$, $s: \mathbb{N} \to \mathbb{N}\ (s(r) > r)$ $C: \mathbb{N} \to R$ such that

$$(1)\quad \frac{1}{C_r} a_r(\sigma(m)) < \lambda_m b_{s(r)}(m) < C_r a_{s(r+1)}(\sigma(m)),\ r, m \in \mathbb{N}.$$

Corollary. In Köthe spaces $l_1[a_r(n)]$, which have regular (cf. [2]) unconditional bases, all unconditional bases are quasiequivalent (cf. [2]).

Theorem 3 (cf. [1]). If $F = l_1[b_r(n)]$ is isomorphic to a complemented subspace of $E = l_1[a_r(n)] \in (\mathcal{D}_1)$ (cf. [2]), then (1) holds with injection $\sigma: \mathbb{N} \to \mathbb{N}$.

References

1. V.P. Kondakov: On the construction of unconditional bases in some Köthe spaces, (russian) preprint

2. M.M. Dragilev: On regular bases and nuclear spaces, Mat. Sb., 68 IIO, No. 2, 1965, p. 153 - 173.

G. LUMER:

Singular diffusion problems for differential operators and local operators

Let A be a real, locally dissipative, locally closed, local operator on a locally compact Hausdorff space Ω (with countable base). Consider the following problem: (*) Given f continuous on $\bar{V}$, find $u = u(t,x)$ continuous on $[0,+\infty[\times\bar{V}$, s.t. $t > 0$, $x \in V, \exists \frac{\partial u}{\partial t}$, $\exists$ Au extending continuously to $[0,+\infty[\times\bar{V}$, and: (i) $\frac{\partial u}{\partial t} = Au$ for $t > 0$, $x \in V$; (ii) $u|\partial V = 0$ for all $t > 0$; (iii) $u(0,x) = f(x)$ for $x \in \bar{V}$.

1. Theorem. The above problem (*) always has a unique solution. Define now the operator A_V on $C_0(V)$ by $D(A_V) = \{f \in C_0(V) \cap D(A,V): Af \in C_0(V)\}$, $A_V f = Af$. Then (*) is solvable for a set E_0 of initial values f which is uniformly dense in $C_0(V)$ iff A_V generates a contraction semigroup on $C_0(V)$; and if so, the set of all initial values f for which (*) is solvable is exactly $D(A_V)$.

   The solvability of singular or degenerate problems of the above type (*) reduces in general to the existence or non existence of a "barrier". For networks this leads to the following classical situation and result (obtained jointly with R. Redheffer and W. Walter): On $]0,\varepsilon[$ consider (**) $au'' + bu' - cu < 0$ $(a > 0,\ c > 0)$, a,b,c real functions. Set for any v on $]0,\varepsilon[$, $v^*(o) = \overline{\lim_{t\to 0}}\, v(t)$, $v_*(o) = \underline{\lim_{t\to\infty}}\, v(t)$, $v(0) = \lim_{t\to 0} v(t)$ if it exists.

2. Theorem. Let u be a solution of (**). Suppose $\exists$ solutions ξ,η of (**) s.t. $\xi(0) = +\infty$, $-\infty < \eta^*(0) < 0$. Then $-\infty < u_*(0) < 0 \Rightarrow u < 0$ on $]0,\varepsilon[$.

3. Corollary. If $0 < a(t) < t$, $b(t) = 1$, $0 < c(t) < Ct^{\alpha-1}$, $\alpha > 0$, then the conclusion of theorem 2 holds.

We can extend the result of theorem 2 to general local operator setting (with the assumptions made above except locally closed), the result takes a very similar form, with $au'' + bu' - cu < 0$ replaced by $Au - cu < 0$, $]0,\varepsilon[$ replaced by V, $\{0\}$ replaced by Γ a compact proper component of ∂V. In the conclusion "$u < 0$ on $]0,\varepsilon[$" is replaced by "$\underline{u}(\Gamma_\varepsilon) < 0$ for $\varepsilon > 0$ small", where "$\underline{u}(\Gamma_\varepsilon)$" means "inf over Γ_ε", $\Gamma_\varepsilon = \gamma^{-1}(\varepsilon)$ where γ is an appropriate function on $\bar{V}$ which is 0 on Γ, > 0 off Γ (Γ_ε is a "level surface" in V). This suffices as before to show non existence of barrier (non existence of solution) for certain singular or degenerate problems. It makes possible many applications to networks, and singular or degenerate diffusion problems in several variables, for instance of the type $\frac{\partial u}{\partial t} = a\Delta u +$ (first order terms).

W.A.J. LUXEMBURG:

<u>On a theorem of Vekua and a conjecture of Whitham</u>

In this paper we shall discuss the problem of approximating the solutions of certain elliptic boundary value problems by means of linear combinations of special solutions. During the fifties such results were obtained by I.N. Vekua and are treated in his book "New methods for solving elliptic equations". In particular, it will be shown how these results are related to a conjecture of Whitham concerning a problem whether the linear span of a sequence of functions of the form $\{p_n(x)e^{inx}\}$, $n = 0,1,2,...$ is dense in say $L^2[0,2\pi]$, where the p_n's ($n = 0,1,2,...$) are special 2π-periodic continuous functions. For this special case we shall show that more elementary methods may be used to settle such questions.

R. MEISE:

<u>Extension of entire functions on locally convex spaces (joint work with D. Vogt, Wuppertal)</u>

Let F be a locally convex space over $\mathbb{C}$ and let $H(F)$ denote the space of entire functions on F. By $H_{ub}(F)$ we denote the subspace of $H(F)$ consisting of all f for which there exists a zero-neighbourhood U in F such that f is bounded on rU for all $r > 0$. For a linear subspace E of F let

$\varrho_{F,E}$: $H(F) \to H(E)$ denote the restriction map $\varrho_{F,E}(f): = f|E$. The following results were presented:

Theorem 1. Let F be an infinite dimensional (FN)-space not isomorphic to $\mathbb{C}^N$. Then there exists a closed linear subspace E of F for which $\varrho_{F,E}$ is not surjective.

Theorem 2. Let F be a Hilbertian (DFS)-space. Then $\varrho_{F,E}$ is surjective for each closed linear subspace E of F.

Theorem 3. A strongly nuclear (F)-space E has the property $H(E) = H_{ub}(E)$ iff for every Hilbertian l.c. space F which contains E as a linear topological subspace, $\varrho_{F,E}$ is surjective.

Theorem 2 extends a result of Boland and is obtained from a remark of Colombeau and Mujica and an extension lemma for functions in $H_{ub}(E)$ which is also used in the proof of Theorem 3. Concerning an inner characterization of the property $H(E) = H_{ub}(E)$ for (FN)-spaces, a necessary condition is that E has the property (LB^{∞}) of Vogt, while the property $(\tilde{\Omega})$ of E is a sufficient condition. Several characterizations of $(\tilde{\Omega})$ have been presented too.

P. MEYER-NIEBERG:

Minimal values of positive linear operators

Let E be an order complete vector lattice with weak order units, and let $T: E \to E$ be a positive linear operator. We are interested in solutions of the inequality $(\lambda I - T)\, x \geqslant 0$ with $\lambda > 0$ and x a weak order unit. If E is a Banach lattice and if $\lambda > \rho(T)$ holds, the problem is wellknown. But in applications the problem occurs: Is there any weak order unit x with $(\lambda I - T)\, x \geqslant 0$ for some $\lambda < \rho(T)$? Let us define $\rho_m(T) = \inf \{\lambda > 0 : \exists$ a weak order unit x with $\lambda x - Tx \geqslant 0\}$ and call it the minimal value of the operator T.

Some rules for the minimal value are obtained, and furthermore we got some results concerning the structure of some positive linear operators in the case of a Banach lattice with order continuous norm.

P. MIKUSIŃSKI:

Convergence of Boehmians

Let $\mathcal{L}$ be the space of locally integrable functions and let $S \subset \mathcal{L}$ consist of all functions with bounded sopport. If $f \in \mathcal{L}$ and $\varphi \in S$, then by $f\varphi$ we mean the convolution of f and φ. Let $\Delta = \{(\delta_n) \in S^N: \ \delta_n \geqslant 0, \int\delta_n = 1$ and $\forall_{\varepsilon > 0} \forall_{|t| > \varepsilon} \ \delta_n(t) = 0$ for almost all $n \in N\}$ and let $\mathcal{A} = \{(f_n)/(\delta_n): (f_n) \in \mathcal{L}^N, (\delta_n) \in \Delta$ and $\forall_{i,j \in N} \ f_i\delta_j = f_j\delta_i\}$. If $(f_n)/(\delta_n)$, $(g_n)/(\varphi_n) \in \mathcal{A}$ and $\forall_{i,j \in N} \ f_i\varphi_j = g_j\delta_i$, then we write $(f_n)/(\delta_n) \sim (g_n)/(\varphi_n)$. We put $\mathcal{B} = \mathcal{A}/\sim$. The identification $f = [(f\delta_n)/(\delta_n)]$ yields an algebraic isomorphism of $\mathcal{L}$ into $\mathcal{B}$. We have also $\mathcal{D}' \subset \mathcal{B}$. If $x_n, x \in \mathcal{B}$ and there is $(\delta_n) \in \Delta$ such that $(x_n - x)\delta_n \in \mathcal{L}$ for each $n \in N$ and $(x_n - x)\delta_n \xrightarrow{\mathcal{L}} 0$, then we say that x_n is Δ-convergent to x.

Theorem 1. $\mathcal{L}$ is dense in $\mathcal{B}$.
Theorem 2. Δ-convergence is metrizable.
Theorem 3. $\mathcal{B}$ is complete.
Theorem 4. (J. Burzyk) $\mathcal{B}$ is a Montel space without non-trivial continuous linear functionals.

B. MITYAGIN:

Nonlinear boundary problem without solution - an example

The problem

(1) $\Delta u = f(x,y), \ y \in I = [0,1], \ x \in S^1 = [0,2\pi]$

(2) $u_{|y} = 0$

(3) $(u_y - u^2_{xx})_{|y=1} = 0$

has no solution $u \in H^{3/2}(S^1 \times I)$ for the proper choice f in $L_q(S^1 \times I)$.
We transform this problem (1) - (3) into the singular equation

(4) $w(x)^2 - A^2 + \frac{1}{2\pi} \int\limits_0^{2\pi} s(\xi)\, w(x - \xi)\, d\xi = \varphi(x)$

$$(5)\ \frac{1}{2\pi}\int_0^{2\pi} w(\xi)\, d\xi = 0$$

where $s(\xi) \sim \sum_1^\infty \frac{1}{k}\,\frac{\cosh k}{\sinh k}\cos k\xi$, and φ is known ($\in H^{\gamma+1/2}$ if $f \in H^{\gamma}$), w is an unknown function on S^1 and $A^2 = \|w\|_2^2$. This problem (4) - (5) has no L_2-solution w for some $\varphi \in H^{1/2}$, and there is a continuum of L_∞-solutions w for any $\varphi \in L_\infty$ or $\varphi \in H^{1/2+\gamma}$, $\gamma > 0$.

The multidimensional problems of (1) - (3) type and their relatives of (4) - (5) type are discussed and analogous results are presented.

A. PEŁCZYNSKI :

Translation invariant quotients of L^p

For a Banach space X, $q^\infty(X)$ denotes the Banach-Mazur distance of the dual of X from a subspace of an $L^1(\mu)$-space, i.e.

$$q^\infty(X) = \inf\{\|u\|\ \|u^{-1}\|\ u: X^* \to L^1(\mu)\},$$

the infimum is extended over all isomorphic embeddings of the dual of X into an $L^1(\mu)$-space.

Let G be a compact abelian group, Γ its dual, $M \subset \Gamma$.

Let

$L^p_M = \{f \in L^p: \hat{f}(\gamma) = 0$ for $\gamma \notin M\}$, $C_M = L^p_M \cap C(G)$ $(1 < p < \infty)$

where $\hat{f}(\gamma) = \int_G f(g)\gamma^{-1}(g)\, dg$; dg is the normalized Haar measure of G.

Theorem. There is a $p_0 > 2$ and a function $\alpha(\cdot)$: $[+\infty; p_0) \to (1,+\infty)$ such that for any c.a. group G, if M is a non-empty subset of Γ and $p > p_0$, the condition $q^\infty(L^p_M) < \alpha(p)$ implies that M is a translate of a subgroup of Γ, hence $q^\infty(L^p_M) = 1$. Moreover for $p = \infty$ one can replace $q^\infty(L^\infty_M)$ by C_M.

P. PEREZ CARRERAS:

On metrizable (LF)-spaces

Let E be a non-normable Fréchet space. There is a proper dense subspace which is an (LF)-space. The proof of the result depends on Eidelheit's classical result that every non-normable Fréchet space has a quotient isomorphic to ω. Let H be a finite codimensional subspace of a non-normable Fréchet space. Then H has a quotient isomorphic to ω. If E is a Fréchet space and if F is a barrelled non quasi-Baire space, then $E \otimes_\pi F$ is barrelled if and only if E is a Banach space. If E is a non-normable metrizable barrelled space which has a continuous norm than $E \otimes_\pi \varphi$ is non barrelled. Open question: Does there exist a non normable metrizable barrelled space with no quotient isomorphic to ω?

H.-J. PETZSCHE:

Boundary values of holomorphic functions and the "Edge-of-the-Wedge" theorem:

In the first part of the lecture the general definition of the boundary value of a holomorphic function was given. The construction made intensive use of almost analytic extensions and it showed that growth conditions on a holomorphic function f determine exactly the class of generalized functions to which the boundary value of f belongs. Finally a general version of the theorem of the "Edge-of-the-Wedge" was stated.

W. RUESS:

Extreme Points in Duals of Operator Spaces (joint work with Ch. Stegall)

It is shown that for Banach spaces X and Y,

$$\text{ext } B((K(X,Y))^*) = (\text{ext } B_{X^{**}}) \otimes (\text{ext } B_{Y^*}),$$

where $x^{**} \otimes y^*(k) = (k^{**}x^{**}, y^*)$ for all $k \in K(X,Y)$ = the space of compact linear operators from X into Y.

More generally, we consider the space $K_{w^*}(X^*,Y)$ of all compact weak*-weakly continuous linear operators from X^* into Y, and show that

$$(*)\ \text{ext } B_{H^*} = (\text{ext } B_{X^*}) \otimes (\text{ext } B_{Y^*})$$

for any linear subspace H of $K_{w^*}(X^*,Y)$ containing $X \otimes Y$. This includes the aforementioned result ($K(X,Y) = K_{w^*}(X^{**},Y)$, $k \to k^{**}$), and includes the corresponding result of Ceitlin (1976) for the dual of $X \tilde{\otimes}_\varepsilon Y$.

Result (*) is combined with a result of Haydon ("if $Z \not\supset l_1$, then

$B_{Z^*} = \text{norm cl co}(\text{ext } B_{Z^*})$") to deduce that $(X \tilde{\otimes}_\varepsilon Y)^*$ (resp. $(K(X,Y))^*$) is a quotient of $X^* \tilde{\otimes}_\pi Y^*$ (resp. $X^{**} \tilde{\otimes}_\pi Y^*$), provided $X \tilde{\otimes}_\varepsilon Y \not\supset l_1$ (resp. $K(X,Y) \not\supset l_1$).

We use the James tree space JT to show the limits of our results: $JT \not\supset l_1$, but (i) $JT \tilde{\otimes}_\varepsilon JT$ does contain l_1, and (ii) $(JT \tilde{\otimes}_\varepsilon JT)^*$ is <u>not</u> a quotient of $(JT^*) \tilde{\otimes}_\pi (JT^*)$.

J. SCHMETS:

<u>Spaces of vector-valued continuous functions</u>

Let X be a completely regular Haudorff space and E be a locally convex topological vector space with P as system of seminorms. Then $C_{\mathcal{P}}(X;E)$ is the l.c. space $C(X;E)$ of the continuous functions on X with values in E endowed with the l.c. topology of uniform convergence on the elements of a suitable family $\mathcal{P}$ of relatively compact subsets of the realcompactification υX of X.
J. Mendoza has proved the following

<u>Theorem.</u> a) If every compact subset of X is finite, then $C_c(X;E)$ is barrelled (resp. quasi-barrelled) if and only if $C_c(X)$ and E are barrelled (resp. quasi-barrelled).

b) If X contains an infinite compact subset, then $C_c(X;E)$ is barrelled (resp. quasi-barrelled) if and only if $C_c(X)$ and E are barrelled (resp. quasi-barrelled) and E'_β has property (B).

Up to now there is no such characterization for bornological $C_{\mathcal{P}}(X;E)$ spaces. However there are partial results.

<u>Proposition.</u> If $C_{\mathcal{K}(\upsilon X)}(X;E)$ is bornological [$\mathcal{K}(\upsilon X)$ is the family of all compact subsets of υX], then the bornological space associated to $C_{\mathcal{P}}(X;E)$ is $C_{\mathfrak{P}}\upsilon(X;E)$ [let us recall that $C_{\mathfrak{P}}\upsilon(X)$ is the bornological space associated to $C_{\mathcal{P}}(X)$].

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This last result reduces in some sense the search for the bornological $C_{\mathcal{D}}(X;E)$ spaces to the one of the bornological $C_{\mathcal{K}(\nu X)}(X;E)$ spaces.

Proposition. a) If E is metrizable, then $C_{\mathcal{K}(\nu X)}(X;E)$ is bornological.

b) If X is locally compact and realcompact, if $E = \text{Ind } E_m$ is a countable inductive limit which is compactly regular and if $C_c(\beta X;E_m)$ is bornological for every m, then the space $C_{\mathcal{K}(\nu X)}(X;E) = C_c(X;E)$ is bornological.

A. Defant and W. Govaerts have also obtained nice results in this direction.

Ch. STEGALL:

Gateaux Differentiation in Banach spaces

The following theorem was proved:

Theorem: Let K be homeomorphic to a weak* compact subset of X^*, where X^* has the RNP. Let S and T be Haudorff topological spaces and T be a Baire space. Let C be a subset of $K \times S$ and $\varphi: C \to T$ be perfect and irreducible. Then there exists a dense G_δ subset G of T and a function $\psi: T \to K$ such that (i) ψ is continuous at each point of G and (ii) for each $t \in G$ the fiber $\varphi^{-1}(t) \subseteq \{\psi(t)\} \times S$.

This result was applied to obtain some results about weakly compact sets, wcg Banach spaces and a recent result of Christensen and Kendorov concerning Gateaux differentiation of continuous convex functions on certain Banach spaces.

T. TERZIOGLU:

On the existence of a non-compact, continuous operator between certain Köthe spaces (joint work with Z. Nurlu)

Let $\lambda(A)$ and $\lambda(B)$ be nuclear Köthe spaces. We write $(\lambda(B), \lambda(A)) \in \mathcal{K}$ if every continuous operator from $\lambda(B)$ into $\lambda(A)$ is bounded. We say the pair $(\lambda(B), \lambda(A))$ satisfies the splitting condition (S) if $\exists p \ \forall j \ \exists k \ \forall \ell \ \forall q \ \exists r$ with

$$\frac{a_m^q}{b_n^k} < \frac{a_m^p}{b_n^j} + \frac{a_m^r}{b_n^\ell} \quad \forall n,m.$$

Prop. 1. If $(\lambda(B),\lambda(A))$ satisfies (S), then either $(\lambda(B), \lambda(A)) \in \mathcal{K}$ or $\lambda(B)$ has a step space which is isomorphic to a step space of $\lambda(A)$.
In the next propositions we assume $\lambda(B)$ is regular.

Prop. 2. If $\lambda(A)$ is isomorphic to a subspace of $\lambda(B)$, then either $\lambda(B), \lambda(A)) \in \mathcal{K}$ or $\lambda(B)$ has a step space which is isomorphic to a step space of $\lambda(A)$.

Prop. 3. Let $\lambda(A)$ be isomorphic to a quotient space of $\lambda(B)$. Then either $(\lambda(A), \lambda(B)) \in \mathcal{K}$ or $\lambda(A)$ has a step space which is isomorphic to a step space of $\lambda(B)$.

M. VALDIVIA:

On Slowikowski, Raikov and de Wilde closed graph theorems

We define a topological linear space to be a Slowikowski space if it has a $\alpha\beta\gamma$-representation $(P,Q,M,E_{p,q})$ which is complete, and the topology induced by E in $E_{(p_q)}$ is coarser than the topology of $E_{(p_q)}$ for every (p_q) in M. We give the following results: 1. The class of the Slowikowski spaces coincides with the class D_0 of Raikov. 2. A locally convex space of Slowikowski has a $\mathcal{C}$-web.
We say that a space E is strict Slowikowski space if it is locally convex and has a D_0-representation $(P,Q,M,E_{p,q})$ with $E_{p,q}$ locally convex. We give the following result. 3. E is a strict Slowikowski space $\Leftrightarrow$ E has a strict $\mathcal{C}$-web.

We give an example of a locally convex Slowikowski space E which is not strict Slowikowski space. Consequently E has a $\mathcal{C}$-web and has not a strict $\mathcal{C}$-web.

D. VOGT:

Pairs of Frêchet space, between which all continuous linear maps are compact

For two Frêchet spaces E and F we denote by $L(E,F)$ the set of all continuous and by $LB(E,F)$ the set of all bounded linear maps from E to F. A necessary and sufficient condition for $L(E,F) = LB(E,F)$ was presented and used to determine the following classes of Fréchet spaces for given α with $\sup \frac{\alpha_{n+1}}{\alpha_n} < +\infty$;

$LB_r(\alpha)$ = all F such that $L(\Lambda_r(\alpha), F) = LB(\Lambda_r(\alpha), F)$

$LB^r(\alpha)$ = all E such that $L(E, \Lambda_r(\alpha)) = LB(E, \Lambda_r(\alpha))$.

They are described by linear topological invariants involving submultiplicative inequalities for the norms or dual norms respectively. They are independent of α.

Similar methods are also used in a forthcoming joint paper with E. Dubinsky to describe a class of nuclear power series spaces of infinite type in which every complemented subspace has a basis.

L. WAELBROECK:

Relative operator calculus, and operators S which are normal modulo an ideal

Let (E,τ) and (F,ρ) be two complete topological vector spaces with $F \to E$ continuous. In general, F is not closed in E, and then $E/_F$ is not Hausdorff. (For instance, E denotes the space $\mathcal{L}(H)$ of all bounded linear operators on a Hilbert space H and F is a Banach operator ideal.) - Relative problems are posed in spaces of type E/F, and the difficulties which arise when F is not closed in E lead to the use of remainders in F and properties mod F.

In my talk, I spoke of Helton's and Howe's relative operator calculus. Let H denote a Hilbert space, $S \in \mathcal{L}(H)$, and α a two-sided Banach ideal of $\mathcal{L}(H)$. Then S is normal mod α if $[S,S^*] \in \alpha$. For a neighbourhood U of $sp_e S$, the essential spectrum of S, a mapping $\varphi \to \varphi(S)$ of $C^\infty(U)$ into $\mathcal{L}(H)$ can be constructed which maps $\mathbb{1}$ (the constant 1) on I (the identity), $\underline{z}$ (the variable) on S, $\underline{\bar{z}}$ on S^* and which is a morphism mod α, i.e.

$$\forall \varphi,\psi \in C^\infty(U) : (\varphi\psi)(S) - \varphi(S)\,\psi(S) \in \alpha.$$

L. WEIS:

Eigenvalue distribution of order bounded operators (joint work with H. König (Kiel))

We give criteria for the r-summability of the eigenvalues $(\lambda_n(T_k))_n$ of an integral operator T_k in terms of conditions on its kernel k. For Hille-Tamarkin-type conditions we get

Theorem 1: If X is q-concave, $q > 2$, and
$$\iint \| k(s,t) \|_{X^*(t)} \|_{X(s)} < \infty$$
then $(\lambda_n(T_k))_n$ belongs to l_q.

For kernels k with a "completely finite double-norm" in the sense of Zaanen we have

Theorem 2: Let X be p-convex and q-concave - and let k be of completely finite double-norm.

a) If $2 \notin (p,q)$, then $(\lambda_n(T_k))_n$ belongs to l_2.

b) If $p < 2 < q$, then $(\lambda_n(T_k))_n$ belongs to l_r with $\frac{1}{r} = \frac{1}{4} + \frac{1}{4q} + \frac{1}{4p'}$.

Counterexamples show that in case II the eigenvalues are not square summable in general. This corrects a claim of Tovar and Nowosad.

G. WITTSTOCK:

Aspects of non-commutative order

To describe non-commutative order we use the concept of matrix ordered spaces in the sense of Choi and Effros. Ordered vector spaces with the Riesz separation property have a uniquely determined matrix order and are representable as spaces of real functions. Typical and interesting non-commutative ordered spaces with a natural matrix order are C*- and W*-algebras, their duals and associated L^p-spaces. We define an analogue of the Riesz separation property in terms of matrix inequalities. This matrix Riesz separation property is a characteristic property of injective W*-algebras. Especially the algebra $B(X)$ of all bounded operators has this property. Regular normed matrix ordered Hilbert spaces with this property are standard forms of injective W*-algebras.

W. ZELAZKO:

Extensions of locally convex algebras

This is a report on the content of the following papers:

1° W. Zelazko, On permanent radicals in commutative locally convex algebras,

2° -,-, Concerning a characerization of permanently singular elements in commutative locally convex algebras,

3° -,-, On non-removable ideals in commutative locally convex algebras.

In these papers, among other results, there are given the characterizations of the objects named in the titles. The first and third paper will appear in Studia Mathematica (in volumes 75 and 77 respectively) and the second one in a collection of papers dedicated to L. Iliev and edited (perhaps in 1983) by the Bulgarian Academy of Sciences.

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