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## Terraced Matrices, Rhaly Operators, Statistical Density

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We present a general view upon Rhaly operators on Hilbert spaces, that is operators defined by "terraced matrices" for sequences of complex numbers. There is a strong connection between statistical zero density of subsequences of natural numbers and properties of Rhaly operators boundedness, compactness. We also emphasize a singular fact, the value of a Rhaly operator lays actually in the closed subspace generated by the orbit of the right shift, in other words Rhaly operators are weighted power series of the right shift.

## Bisingular integral operator with a Cauchy kernel in generalized Hölder spaces

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Let  $\omega(\delta_1, \delta_2)$  be a modulus of continuity;  $\Omega_1(\delta)$ ,  $\Omega_2(\delta)$  are the corresponding elementary moduli of continuity [1] satisfying Zygmund-Bari-Stechkin conditions;  $\gamma = \gamma_1 \times \gamma_2$  is Cartesian product of closed Lyapunov curves. Let  $H_\omega(\gamma)$  denotes the space of continuous functions  $x(t, \tau)$  (on  $\gamma$ ) whose moduli of continuity satisfy the next conditions:

$$(1) \quad \omega(x; \delta_1, \delta_2) \leq c_1 \omega(\delta_1, \delta_2);$$

$$(2) \quad \omega_{1,1}(x; \delta_1, \delta_2) \leq c_2 \Omega_1(\delta_1) \Omega_2(\delta_2)$$

(where  $\omega_{1,1}(x; \delta_1, \delta_2)$  is mixed modulus of continuity of the second order). Introduce a norm in this space in the following way:

$$\|x\|_{H_\omega} = \max_{(t,\tau) \in \gamma} |x(t, \tau)| + \sup_{\delta_1^2 + \delta_2^2 \neq 0} \frac{\omega(x; \delta_1, \delta_2)}{\omega(\delta_1, \delta_2)} + \sup_{\delta_1^2 + \delta_2^2 \neq 0} \frac{\omega_{1,1}(x; \delta_1, \delta_2)}{\Omega_1(\delta_1) \Omega_2(\delta_2)}.$$

$H_\omega(\gamma)$  is Banach space for this norm. Singular integrals are considered:

$$(S_1\varphi)(t, \tau) = \frac{1}{\pi i} \oint_{\gamma_1} \frac{\varphi(t_0, \tau)}{t_0 - t} dt_0, \quad (S_2\varphi)(t, \tau) = \frac{1}{\pi i} \oint_{\gamma_2} \frac{\varphi(t, \tau_0)}{\tau_0 - \tau} d\tau_0,$$

$$(S_{12}\varphi)(t, \tau) = -\frac{1}{\pi^2} \oint_{\gamma_1} \oint_{\gamma_2} \frac{\varphi(t_0, \tau_0)}{(t_0 - t)(\tau_0 - \tau)} dt_0 d\tau_0 \quad (= S_1 \otimes S_2)$$

(integrals are understood in the sense of the Cauchy principal value). As is well known, in one-dimensional case singular integral (Cauchy operator) is bounded in generalized Hölder space  $H_\omega(\gamma)$  when structural characteristic  $\omega(\delta)$  of the space satisfies Zygmund-Bari-Steckin conditions. But this is not enough in two-dimensional case; bisingular Cauchy integral is unbounded ( $S_{12} : H_{\omega(1)} \rightarrow H_{\omega(2)}$ ,  $H_{\omega(1)} \subset H_{\omega(2)}$ ). To establish an analogue of the theorem Privalov-Plemelj we need condition (2).

**Theorem.** Bisingular Cauchy operators  $S_1$ ,  $S_2$ ,  $S_{12}$  are bounded in generalized Hölder space  $H_\omega(\gamma)$ .

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## Pettis-types integrals for vector multifunctions

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Taking into account that the scalarization is a way for studying the vector problems, the Pettis method provides some types of integrals (as Pettis-Lebesgue, Pettis-Sugeno, Aumann-Pettis-Sugeno integrals) which will be studied in this paper.

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