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Algebras of convolution type operators with continuous data do not always contain all rank one operators

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Abstract

Let $X(\mathbb{R})$ be a separable Banach function space such that the Hardy-Littlewood maximal operator is bounded $X(\mathbb{R})$ and on its associate space $X'(\mathbb{R})$. The algebra $C_X(\dot{\mathbb{R}})$ of continuous Fourier multipliers on $X(\mathbb{R})$ is defined as the closure of the set of continuous functions of bounded variation on $\dot{\mathbb{R}} = \mathbb{R} \cup \{\infty\}$ with respect to the multiplier norm. It was proved recently by C. Fernandes, Yu. Karlovich and myself that if the space $X(\mathbb{R})$ is reflexive, then the ideal of compact operators is contained in the Banach algebra $\mathcal{A}_{X(\mathbb{R})}$ generated by all multiplication operators aI by continuous functions $a \in C(\dot{\mathbb{R}})$ and by all Fourier convolution operators $W^0(b)$ with symbols $b \in C_X(\dot{\mathbb{R}})$. We show that there are separable and non-reflexive Banach function spaces $X(\mathbb{R})$ such that the algebra $\mathcal{A}_{X(\mathbb{R})}$ does not contain all rank one operators. In particular, this happens in the case of the Lorentz spaces $L^{p,1}(\mathbb{R})$ with $1 < p < \infty$. This is a joint work with Eugene Shargorodsky (King's college London, UK): `https://arxiv.org/abs/2007.10266`

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