

SINGULAR INTEGRALS WITH ANGULAR INTEGRABILITY

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ABSTRACT. In this note we prove a class of sharp inequalities for singular integral operators in weighted Lebesgue spaces with angular integrability.

1. INTRODUCTION

We consider singular integral operators

$$Tf(x) := \text{P.V.} \int_{\mathbb{R}^n} f(x-y)K(y) dy, \quad (1.1)$$

where the kernel K satisfies the following conditions

$$|y|^\alpha |K| \leq C, \quad |y|^{\alpha+1} |\nabla K| \leq C, \quad |\widehat{K}| \leq C.$$

Here $C > 0$ is a constant and $\widehat{\cdot}$ denotes the Fourier transform. The main example we have in mind is the directional Riesz transform, which corresponds to the choice $K(y) := |y|^{-(n+1)} y \cdot \theta$, $\theta \in \mathbb{S}^{n-1}$.

The study of the boundedness of these operators in weighted Lebesgue spaces $L^p(w(x)dx)$, for $1 < p < \infty$ and $0 < w \in L^1_{loc}(\mathbb{R}^n)$, is a classical problem in harmonic analysis; in particular, Stein [13] proved it for the (sharp range of) homogeneous weights $w(x) = |x|^\alpha$, $-n/p < \alpha < n - n/p$. The result was later extended by Coifman and Fefferman [2] to any A_p weight.

While the weighted L^p -theory has been extensively studied, less is known in the case of Lebesgue norms with different integrability in the radial and angular directions, namely

$$\|f\|_{L^p_{|x|}, L^{\tilde{p}}_{\theta}} := \left(\int_0^{+\infty} \|f(\rho \cdot)\|_{L^{\tilde{p}}(\mathbb{S}^{n-1}, \rho^{n-1} d\rho)}^p d\rho \right)^{\frac{1}{p}}. \quad (1.2)$$

These mixed radial-angular spaces have been successfully used in recent years to improve several results in the framework of partial differential equations; see e.g. [1, 8, 10, 11, 12, 14, 15]. Notice that when $p = \tilde{p}$ the norms reduce to the usual L^p norms. Notice also that, neglecting the constants, they are increasing in \tilde{p} , and that they behave as the L^p norms under homogeneous rescaling, namely $f(\cdot) \rightarrow f(\lambda \cdot)$, $\lambda > 0$.

In a recent paper A. Córdoba [3] proved, among the other things, the $L^p_{|x|}, L^{\tilde{p}}_{\theta}$ boundedness for operators of the form (1.1). Here we give an extension of this result to the weighted setting.

Theorem 1.1. *Let $n \geq 2$, $1 < p < \infty$, $1 < \tilde{p} < \infty$ and $-n/p < \alpha < n - n/p$. Then*

$$\| |x|^\alpha T\phi \|_{L^p_{|x|}, L^{\tilde{p}}_{\theta}} \leq C \| |x|^\alpha \phi \|_{L^p_{|x|}, L^{\tilde{p}}_{\theta}}, \quad (1.3)$$

where C is a constant depending only on α, p, \tilde{p}, n .

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Singular Integrals Proceedings

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Singular Integrals Alberto P. Calderón,2000 *Proceedings of the Cambridge Philosophical Society* Cambridge Philosophical Society,1925 Weighted Polynomial Approximation and Numerical Methods for Integral Equations Peter Junghanns,Giuseppe Mastroianni,Incoronata Notarangelo,2021-08-10 The book presents a combination of two topics one coming from the theory of approximation of functions and integrals by interpolation and quadrature respectively and the other from the numerical analysis of operator equations in particular of integral and related equations The text focusses on

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Proceedings of the Israel Mathematical Union Conference Igud le-matematikah be-Yisra'el. Kenes,1988

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as that of the state itself prior to the admission of oklahoma into the union as the nation s 46th state its geographical confines were denominated into two distinct regions oklahoma territory and indian territory

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