

WEIGHTED MORREY ESTIMATES FOR HAUSDORFF OPERATOR AND ITS COMMUTATOR ON THE HEISENBERG GROUP

JIANMIAO RUAN, DASHAN FAN AND QINGYAN WU

Abstract. In this paper, we study the high-dimensional Hausdorff operators, defined via a general linear mapping A , and their commutators on the weighted Morrey spaces in the setting of the Heisenberg group. Particularly, under some assumption on the mapping A , we establish their sharp boundedness on the power weighted Morrey spaces.

Mathematics subject classification (2010): 42B35, 46E30, 22E25.

Keywords and phrases: Hausdorff operator, commutator, Morrey space, weight.

REFERENCES

- [1] D. R. ADAMS AND J. XIAO, *Morrey spaces in harmonic analysis*, Ark. Mat. **50**, (2012), 201–230.
- [2] J. ALVAREZ, J. LAKEY AND M. GUZMAN-PARTIDA, *Spaces of bounded λ -cenetal mean oscillation, Morrey Spaces, and λ -central Carleson measure*, Collect. Math. **51**, (2000), 1–47.
- [3] H. ARAI AND T. MIZUHARA, *Morrey spaces on spaces of homogeneous type and estimates for \square_b and the Cauchy-Szegö projection*, Math. Nachr. **185**, (1997), 5–20.
- [4] J. CHEN, D. FAN AND J. LI, *Hausdorff operators on function spaces*, Chin. Ann. Math. Ser. B, **33**, (2012), 537–556.
- [5] J. CHEN, D. FAN, X. LI AND J. RUAN, *The fractional Hausdorff operators on the Hardy spaces $H^p(\mathbb{R}^n)$* , Anal. Math. **42**, (2016), 1–17.
- [6] J. CHEN, D. FAN AND S. WANG, *Hausdorff operators on Euclidean space*, Appl. Math. J. Chinese Univ. Ser. B, **28**, (2014), 548–564.
- [7] J. CHEN AND X. ZHU, *Boundedness of multidimensional Hausdorff operators on $H^1(\mathbb{R}^n)$* , J. Math. Anal. Appl. **409**, (2014), 428–434.
- [8] F. CHIARENZA AND M. FRASCA, *Morrey spaces and Hardy-Littlewood maximal function*, Rend. Mat. Appl. **7**, (1987), 273–279.
- [9] X. T. DUONG, J. XIAO AND L. X. YAN, *Old and new Morrey spaces with heat kernel bounds*, J. Fourier Anal. Appl. **13**, (2007), 87–111.
- [10] G. FOLLAND AND E. STEIN, *Hardy Spaces on Homogeneous Groups*, Mathematical Notes **28**, Princeton University Press, Princeton, N.J., University of Tokyo Press, Tokyo, 1982.
- [11] V. GULIEV, *Two-weighted L^p -inequalities for singular integral operators on Heisenberg groups*, Georgian Math. J. **1**, 4 (1994), 367–376.
- [12] R. HOWE, *On the role of the Heisenberg group in harmonic analysis*, Bull. Amer. Math. Soc. **3**, (1980), 821–843.
- [13] T. HYTÖNEN, C. PÉREZ AND E. RELA, *Sharp reverse Hölder property for A_∞ weights on spaces of homogeneous type*, J. Funct. Anal. **263**, (2012), 3883–3899.
- [14] S. INDRATNO, D. MALDONADO AND S. SILWAL, *A visual formalism for weights satisfying reverse inequalities*, Expo. Math. **33**, (2015), 1–29.
- [15] Y. KANJIN, *The Hausdorff operator on the real Hardy spaces $H^p(\mathbb{R})$* , Studia Math. **148**, (2001), 37–45.
- [16] A. KORÁNYI AND H. REIMANN, *Quasiconformal mappings on the Heisenberg group*, Invent. Math. **80**, (1985), 309–338.
- [17] Y. KOMORI AND S. SHIRAI, *Weighted Morrey spaces and a singular integral operator*, Math. Nachr. **282**, (2009), 219–231.

- [18] A. LERNER AND E. LIFLYAND, *Multidimensional Hausdorff operators on real Hardy spaces*, J. Aust. Math. Soc. **83**, (2007), 79–86.
- [19] E. LIFLYAND, *Open problems on Hausdorff operators*, Complex Analysis and Potential Theory, World Sci. Publ., Hackensack, NJ, (2007), 280–285.
- [20] E. LIFLYAND, *Boundedness of multidimensional Hausdorff operators on $H^1(\mathbf{R}^n)$* , Acta Sci. Math. (Szeged), **74**, (2008), 845–851.
- [21] E. LIFLYAND, *Hausdorff operators on Hardy spaces*, Eurasian Math. J. **4**, (2013), 101–141.
- [22] E. LIFLYAND AND A. MIYACHI, *Boundedness of the Hausdorff operators in H^p spaces, $0 < p < 1$* , Studia Math. **194** (2009), 279–292.
- [23] E. LIFLYAND AND F. MÓRICZ, *The Hausdorff operator is bounded on the real Hardy space $H^1(\mathbf{R})$* , Proc. Amer. Math. Soc. **128**, (2000), 1391–1396.
- [24] E. LIFLYAND AND F. MÓRICZ, *Commutating relations for Hausdorff operators and Hilbert transforms on real Hardy space*, Acta Math. Hungar. **97**, (2002), 133–143.
- [25] S. LU, Y. DING AND D. YAN, *Singular integrals and related topics*, World Scientific Publishing Company, Singapore, 2007.
- [26] A. MIYACHI, *Boundedness of the Cesàro operator in Hardy space*, J. Fourier Anal. Appl. **10**, (2004), 83–92.
- [27] F. MÓRICZ, *Multivariate Hausdorff operators on the spaces $H^1(\mathbf{R}^n)$ and $\text{BMO}(\mathbf{R}^n)$* , Anal. Math. **31**, (2005), 31–41.
- [28] C. B. MORREY, *On the solutions of quasi-linear elliptic partial differential equations*, Trans. Amer. Math. Soc. **43**, (1938), 126–166.
- [29] B. MUCKENHOUPT, *Weighted norm inequalities for the Hardy maximal function*, Trans. Amer. Math. Soc. **165**, (1972), 207–226.
- [30] J. RUAN AND D. FAN, *Hausdorff operators on the power weighted Hardy spaces*, J. Math. Anal. Appl. **433**, (2016), 31–48.
- [31] J. RUAN AND D. FAN, *Hausdorff operators on the weighted Herz-type Hardy spaces*, Math. Inequal. Appl. **19**, (2016), 565–587.
- [32] J. RUAN AND D. FAN, *Hausdorff type operators on the power weighted Hardy spaces $H_{[·]}^p(\mathbf{R}^n)$* , Math. Nachr. **290**, (2017), 2388–2400.
- [33] J. RUAN, D. FAN AND Q. WU, *Weighted Herz space estimates for Hausdorff operators on the Heisenberg group*, Banach J. Math. Anal. **11**, (2017), 513–535.
- [34] W. SCHEMPP, *Harmonic analysis on the Heisenberg nilpotent Lie group, with applications to signal theory*, Longman Sci. and Tech. Pitman Research Notes in Math Sci. **147**, Harlow, Essex, 1986.
- [35] F. WEISZ, *The boundedness of the Hausdorff operator on multi-dimensional Hardy spaces*, Analysis (Munich), **24**, (2004), 183–195.
- [36] Q. WU AND D. FAN, *Hardy space estimates of Hausdorff operators on the Heisenberg group*, Nonlinear Anal. **164**, (2017), 135–154.
- [37] Q. WU AND Z. FU, *Weighted p -adic Hardy operators and their commutators on p -adic central Morrey spaces*, Bull. Malays. Math. Sci. Soc. **40**, 2 (2017), 635–654.
- [38] X. WU, *Necessary and sufficient conditions for generalized Hausdorff operators and commutators*, Ann. Funct. Anal., **6**, (2015), 60–72.