ORDER BOUNDEDNESS AND ESSENTIAL NORM OF GENERALIZED WEIGHTED COMPOSITION OPERATORS ON BERGMAN SPACES WITH DOUBLING WEIGHTS

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Abstract. In this paper, the order boundedness and essential norm of generalized weighted composition operators on Bergman spaces with doubling weights are characterized. Specially, we estimate the essential norm of these operators on weighted Bergman spaces by using the reduce order method.

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REFERENCES

- C. COWEN AND B. MACCLUER, Composition Operators on Spaces of Analytic Functions, CRC Press, Boca Raton, 1995.
- [2] Z. ČUČKOVIĆ AND R. ZHAO, Weighted composition operators on the Bergman space, J. London Math. Soc., 70 (2004), 499–511.
- [3] Z. ČUČKOVIĆ AND R. ZHAO, Weighted composition operators between different weighted Bergman spaces and different Hardy spaces, Illinois J. Math., 51 (2007), 479–498.
- [4] R. DEMAZEUX, Essential norms of weighted composition operators between Hardy spaces H^p and H^q for $1 \le p, q \le \infty$, Studia Math., **206** (2011), 191–209.
- [5] J. DU, S. LI AND Y. SHI, Weighted composition operators on weighted Bergman spaces induced by doubling weights, Math. Scand., 126 (2020), 519–539.
- [6] K. ESMAEILI AND K. KELLAY, Weighted composition operators on weighted Bergman and Dirichlet spaces, Canad. Math. Bull., 66 (2023), 286–302.
- [7] Y. GAO, S. KUMAR AND Z. ZHOU, Order bounded weighted composition operators mapping into the Dirichlet type spaces, Chinese Ann. Math. Ser. B, 37 (2016), 585–594.
- [8] H. HEDENMALM, B. KORENBLUM AND K. ZHU, *Theory of Bergman Spaces*, Graduate Texts in Mathematics, vol. 199 Springer, New York, Berlin, etc., 2000.
- [9] R. HIBSCHWEILER, Order bounded of weighted composition operators, Contemporary Mathematics, 454 (2008), 93–105.
- [10] R. HIBSCHWEILER AND N. PORTNOY, Composition followed by differentiation between Bergman and Hardy spaces, Rocky Mountain J. Math., 35 (2005), 843–855.
- [11] H. HUNZIKER AND H. JARCHOW, Composition operators which improve integrability, Math. Nachr., 152 (1991) 83–99.
- [12] Q. LIN, J. LIU AND Y. WU, Order boundedness of weighted composition operators on weighted Dirichlet spaces and derivative Hardy spaces, Bull. Belg. Math. Soc. Simon Stevin, 27 (2020), 627– 637.
- [13] B. LIU, Generalised weighted composition operators on Bergman spaces induced by doubling weights, Bull. Aust. Math. Soc., 104 (2021), 141–153.
- [14] B. LIU AND J. RÄTTYÄ, Compact differences of weighted composition operators, Collect. Math., 73 (2022), 89–105.
- [15] B. LIU, J. RÄTTYÄ AND F. WU, Compact differences of composition operators on Bergman spaces induced by doubling weights, J. Geom. Anal., 31 (2021), 12485–12500.



- [16] D. LUECKING, Forward and reverse inequalities for functions in Bergman spaces and their derivatives, Amer. J. Math., 107 (1985), 85–111.
- [17] L. LUO AND J. CHEN, Essential norms of composition operators between weighted Bergman spaces of the unit disc, Acta Math. Sin. (Engl. Ser.), 29 (2013), 633–638.
- [18] A. MALHOTRA AND A. GUPTA, Complex symmetry of generalized weighted composition operators on Fock space, J. Math. Anal. Appl., 495 (2021), Paper No. 124740, 12 pp.
- [19] J. MANHAS AND R. ZHAO, Products of weighted composition operators and differentiation operators between Banach spaces of analytic functions, Acta Sci. Math. (Szeged), 80 (2014), 665–679.
- [20] J. MANHAS AND R. ZHAO, Essential norms of products of weighted composition operators and differentiation operators between Banach spaces of analytic functions, Acta Math. Sci. Ser. B (Engl. Ed.), 35 (2015), 1401–1410.
- [21] J. MANHAS AND R. ZHAO, Products of weighted composition and differentiation operators into weighted Zygmund and Bloch spaces, Acta Math. Sci. Ser. B (Engl. Ed.), 38 (2018), 1105–1120.
- [22] J. PELÁEZ, Small weighted Bergman spaces, Proceedings of the Summer School in Complex and Harmonic Analysis and Related Topics, Publ. Univ. East. Finl. Rep. Stud. For. Nat. Sci., vol 22, (Univ. East. Finl., Fac. Sci. For., Joensuu, 2016), 29–98.
- [23] J. PELÁEZ AND J. RÄTTYÄ, Weighted Bergman spaces induced by rapidly increasing weights, Mem. Amer. Math. Soc., 227 (2014), 124 pp.
- [24] J. PELÁEZ AND J. RÄTTYÄ, Bergman projection induced by radial weight, Adv. Math., 391 (2021), Paper No. 107950, 70 pp.
- [25] J. PELÁEZ, J. RÄTTYÄ AND K. SIERRA, Berezin transform and Toeplitz operators on Bergman spaces induced by regular weights, J. Geom. Anal., 28 (2018), 656–687.
- [26] J. SHAPIRO, The essential norm of a composition operator, Ann. Math., 125 (1987), 375-404.
- [27] J. SHAPIRO, Composition Operators and Classical Function Theory, Universitext: Tracts in Mathematics, Springer-Verlag, New York, 1993.
- [28] A. SHARMA, On order bounded weighted composition operators between Dirichlet spaces, Positivity, 21 (2017), 1213–1221.
- [29] M. SHARMA AND A. SHARMA, On order bounded difference of weighted composition operators between Hardy spaces, Complex Anal. Oper. Theory, 13 (2019), 2191–2201.
- [30] A. SHARMA AND S. UEKI, Composition operators between weighted Bergman spaces with admissible Békollé weights, Banach J. Math. Anal., 8 (2014), 64–88.
- [31] S. UEKI, Order bounded weighted composition operators mapping into the Bergman space, Complex Anal. Oper. Theory, 6 (2012), 549–560.
- [32] S. UEKI AND L. LUO, Essential norms of weighted composition operators between weighted Bergman spaces of the ball, Acta Sci. Math. (Szeged), 74 (2008), 829–843.
- [33] E. WOLF, Order bounded of weighted composition operators, J. Aust. Math. Soc., 93 (2012), 333– 343.
- [34] W. YANG AND X. ZHU, Differences of generalized weighted composition operators between growth spaces, Ann. Polon. Math., 112 (2014), 67–84.
- [35] K. ZHU, Duality of Bloch spaces and norm convergence of Taylor series, Michigan Math. J., 38 (1991), 89–101.
- [36] X. ZHU, Products of differentiation, composition and multiplication from Bergman type spaces to Bers type spaces, Integral Transforms Spec. Funct., 18 (2007), 223–231.
- [37] X. ZHU, Generalized weighted composition operators on weighted Bergman spaces, Numer. Funct. Anal. and Optim., 30 (2008), 881–893.
- [38] X. ZHU, Generalized weighted composition operators on weighted Bergman spaces, II, Math. Inequal. Appl., 22 (2019), 1055–1066.