

HARNACK TYPE INEQUALITIES FOR OPERATORS IN LOGARITHMIC SUBMAJORISATION

YAZHOU HAN AND CHENG YAN

Abstract. This paper studies the Harnack type logarithmic submajorisation and Fuglede–Kadison determinant inequalities for operators in a finite von Neumann algebra. In particular, the Harnack type determinant inequalities due to Lin–Zhang [17] and Yang–Zhang [28] are extended to the case of operators in a finite von Neumann algebra.

Mathematics subject classification (2020): Primary 47A63; Secondary 46L52.

Keywords and phrases: Logarithmic submajorisation, von Neumann algebra, Harnack type inequality, Fuglede–Kadison determinant.

REFERENCES

- [1] W. B. ARVESON, *Analyticity in operator algebras*, Amer. J. Math. 89, 578–642 (1967).
- [2] D. P. BLECHER, L. E. LABUSCHAGNE, *Applications of the Fuglede–Kadison determinant: Szegő’s theorem and outers for noncommutative H^p* , Trans. Amer. Math. Soc. 360, 6131–6147 (2008).
- [3] T. N. BEKJAN, M. RAIKHAN, *An Hadamard-type inequality*, Linear Algebra and its Application 443, 228–234 (2014).
- [4] L. G. BROWN, *Lidskii theorem in the type II case, Geometric methods in operator algebras*, (Kyoto, 1983), 1–35, Pitman Res. Notes Math. Ser. 123, Longman Sci. Tech., Harlow, (1986).
- [5] P. G. DODDS, T. K.-Y. DODDS, *Unitary approximation and submajorization*, Proc. Centre Math. Appl. Austral. Nat. Univ., Austral. Nat. Univ., Canberra, 29, 42–57, (1992).
- [6] P. G. DODDS, B. DE PAGTER, F. SUKOACHEV, *Theory of noncommutative integration*, unpublished manuscript.
- [7] P. G. DODDS, T. K. DODDS, F. A. SUKOACHEV, D. ZANIN, *Logarithmic submajorization, uniform majorization and Hölder type inequalities for τ -measurable operators*, Indag. Math. 31, 809–830, (2020).
- [8] T. FACK, *Proof of the conjecture of A. Grothendieck on the Fuglede–Kadison determinant*, J. Funct. Anal. 50, 215–228 (1983).
- [9] T. FACK, H. KOSAKI, *Generalized s-numbers of τ -measurable operators*, Pac. J. Math. 123, 269–300 (1986).
- [10] L.-K. HUA, *Inequalities involving determinants*, Acta Math. Sinica 5 (4), 463–470 (1955) (in Chinese), translated into English: Transl. Amer. Math. Soc. Ser. II 32 265–272 (1963).
- [11] L.-K. HUA, *On an inequality of Harnack’s type*, Sci. Sin. 14, 791 (1965).
- [12] F. HIAI, *Majorization and stochastic maps in von Neumann algebras*, J. Math. Anal. Appl. 127, 18–48 (1987).
- [13] F. HIAI, *Log-majorizations and norm inequalities for exponential operators*, Banach Center Publications 38, 119–181 (1997).
- [14] J. HUANG, F. SUKOACHEV, D. ZANIN, *Logarithmic submajorisation and order-preserving linear isometries*, Journal of Functional Analysis 278, 108352 (2020).
- [15] Z. JIANG, M. LIN, *A Harnack type eigenvalue inequality*, Linear Algebra Appl. 585, 45–49 (2020).
- [16] M. LIN, *A Lewent type determinantal inequality*, Taiwaneses J. Math. 17, 1303–1309 (2013).
- [17] M. LIN, F. ZHANG, *An extension of Harnack type determinantal inequality*, Linear Multilinear Algebra 65, 2024–2030 (2017).
- [18] M. MARCUS, *Harnack’s and Weyl’s inequalities*, Proc. Amer. Math. Soc. 16, 864–866 (1965).

- [19] M. KASSMANN, *Harnack inequalities: an introduction*, Boundary Value Problems, 2007, 21 (2007).
- [20] A. W. MARSHALL, I. OLKIN, *Inequalities: theory of majorization and its applications*, Academic Press, New York, (1979).
- [21] Y. NAKAMURA, *An inequality for generalized s-numbers*, Integral Equations and Operator Theory 10, 140–145 (1987).
- [22] W. RUDIN, *Real and complex analysis*, McGraw-Hill, (1974).
- [23] S. H. TUNG, *Harnack's inequality and theorems on matrix spaces*, Proc. Amer. Math. Soc. 15, 375–381 (1964).
- [24] M. TAKESAKI, *Theory of Operator Algebras I*, Springer-Verlag, New York, (1979).
- [25] V. I. OVCHINNIKOV, *s-numbers of measurable operators*, Functional Analysis and Its Applications 4, 236–242 (1970).
- [26] V. I. OVCHINNIKOV, *Symmetric spaces of measurable operators*, Dokl. Akad. Nauk SSSR, 191, 769–771 (1970).
- [27] F.-Y. WANG, *Harnack inequalities for stochastic partial differential equations*, Springer (2013).
- [28] C. YANG, F. ZHANG, *Harnack type inequalities for matrices in majorization*, Linear Algebra and its Applications 588, 196–209 (2020).