

## REVISITING THE GRÜSS INEQUALITY

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*Abstract.* In this article, we explore the celebrated Grüss inequality, where we present a new approach using the Grüss inequality to obtain new refinements of operator means inequalities. We also present several operator Grüss-type inequalities with applications to the numerical radius and entropies.

*Mathematics subject classification (2020):* Primary 47A63, 26D15; Secondary 47A12, 47A30, 47A64.

*Keywords and phrases:* Grüss inequality, arithmetic mean, geometric mean, matrix mean.

### REFERENCES

- [1] S. BALLASUBRAMANIAN, *On the Grüss inequality for unital 2-positive linear maps*, Oper. Matrices. **10** (3) (2016), 643–649.
- [2] P. L. ČEBYŠEV, *Sur les expressions approximatives des intégrales définies par les autres prises entre les même limites*, Proc. Math. Soc. Kharkov, **2** (1882), 93–98 (Russian), translated in Oeuvres, **2** (1907), 716–719.
- [3] S. S. DRAGOMIR, *Some Grüss type inequalities in inner product spaces*, J. Inequal. Pure Appl. Math. **4**(2) (2003), Article 42.
- [4] S. S. DRAGOMIR, *Grüss' type inequalities for functions of selfadjoint operators in Hilbert spaces*, Ital. J. Pure Appl. Math. **28** (2011), 205–222.
- [5] S. S. DRAGOMIR, *Čebyšev's type inequalities for functions of selfadjoint operators in Hilbert spaces*, Linear Multilinear Algebra. **58**(7) (2010), 805–814.
- [6] J. I. FUJII AND E. KAMEI, *Relative operator entropy in noncommutative information theory*, Math. Japon. **34** (1989), 341–348.
- [7] S. FURUICHI, H. R. MORADI, *On further refinements for Young inequalities*, Open Math. **16** (2018), 1478–1482.
- [8] S. FURUICHI AND H. R. MORADI, *Some refinements of classical inequalities*, Rocky Mountain J. Math. **48** (7) (2018), 2289–2309.
- [9] S. FURUICHI, H. R. MORADI AND M. SABABHEH, *New sharp inequalities for operator means*, Linear Multilinear Algebra. **67** (8) (2019), 1567–1578.
- [10] S. FURUICHI, K. YANAGI AND K. KURIYAMA, *A note on operator inequalities of Tsallis relative operator entropy*, Linear Algebra Appl. **407** (2005), 19–31.
- [11] G. GRÜSS, *Über das maximum des absoluten betrages von  $\frac{1}{b-a} \int_a^b f(x)g(x)dx - \frac{1}{(b-a)^2} \int_a^b f(x)dx \int_a^b g(x)dx$* , Math. Z. **39** (1935), 215–226.
- [12] P. R. HALMOS, *A Hilbert Space Problem Book*, 2nd ed., Springer, New York, 1982.
- [13] I. H. GÜMÜŞ, H. R. MORADI AND M. SABABHEH, *More accurate operator means inequalities*, J. Math. Anal. Appl. **465** (2018), 267–280.
- [14] F. KITTANEH, *Numerical radius inequalities for Hilbert space operators*, Studia Math. **168** (1) (2005), 73–80.
- [15] XIN LI, R. N. MOHAPATRA AND R. S. RODRIGUEZ, *Grüss-type inequalities*, J. Math. Anal. Appl. **267** (2002), 434–443.
- [16] D. S. MITRINOVIĆ, J. E. PEČARIĆ AND A. M. FINK, *Grüss Inequality. In: Classical and New Inequalities in Analysis*, Mathematics and its Applications (East European Series), **61** (1993), Springer, Dordrecht.

- [17] H. R. MORADI, S. FURUICHI, F. C. MITROI AND R. NASERI, *An extension of Jensen's operator inequality and its application to Young inequality*, Rev. R. Acad. Cienc. Exactas Fis. Nat. Ser. A Mat. **113** (2) (2019), 605–614.
- [18] L. ZOU AND Y. JIANG, *Improved arithmetic-geometric mean inequality and its application*, J. Math. Inequal. **9** (1) (2015), 107–111.