

ON THE ARITHMETIC–GEOMETRIC MEAN INEQUALITY

MOHAMMAD SABABHEH, SHIGERU FURUICHI,
ZAHRA HEYDARBEGYI AND HAMID REZA MORADI

Abstract. In this article, we present a new treatment of the arithmetic-geometric mean inequality and its siblings, the Heinz and the Young inequalities. New refinements via calculus computations and convex analysis are presented and a new Heinz-type inequality is presented for any symmetric operator mean.

Mathematics subject classification (2020): Primary 26E60, 26A51; Secondary 47A64, 47B15.

Keywords and phrases: Positive real numbers, arithmetic-geometric mean inequality, Heinz mean, convex function.

REFERENCES

- [1] S. FURUICHI AND H. R. MORADI, *On further refinements for Young inequalities*, *Open Math.* **16** (2018), 1478–1482.
- [2] S. FURUICHI, H. R. MORADI AND M. SABABHEH, *New sharp inequalities for operator means*, *Linear Multilinear Algebra* **67** (8) (2019), 1567–1578.
- [3] I. H. GÜMÜŞ, H. R. MORADI AND M. SABABHEH, *More accurate operator means inequalities*, *J. Math. Anal. Appl.* **465** (2018), 267–280.
- [4] F. KITTANEH AND M. KRNIĆ, *Refined Heinz operator inequalities*, *Linear Multilinear Algebra* **61** (8) (2013), 1148–1157.
- [5] F. KITTANEH AND Y. MANASRAH, *Improved Young and Heinz inequalities for matrices*, *J. Math. Anal. Appl.* **361** (2010), 262–269.
- [6] F. KITTANEH AND Y. MANASRAH, *Reverse Young and Heinz inequalities for matrices*, *Linear Multilinear Algebra* **59** (9) (2011), 1031–1037.
- [7] 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 Fís. Nat. Ser. A Mat.* **113** (2) (2019), 605–614.
- [8] M. SABABHEH, *Convexity and matrix means*, *Linear Algebra Appl.* **506** (2016), 588–602.
- [9] M. SABABHEH, *Integral inequalities of the Heinz means as convex functions*, *J. Math. Inequal.* **10** (2) (2016), 313–325.
- [10] M. SABABHEH AND H. R. MORADI, *Radical convex functions*, *Medit. J. Math.* **18**, 137 (2021), <https://doi.org/10.1007/s00009-021-01784-8>.
- [11] M. SABABHEH, A. YOUSEF, AND R. KHALIL, *Interpolated young and Heinz inequalities*, *Linear Multilinear Algebra* **63** (11) (2015), 2232–2244.