

FRACTIONAL DE LA VALLÉE POUSSIN INEQUALITIES

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Abstract. In this work we derive some inequalities for fractional boundary value problems, that generalize the well-known de la Vallée Poussin inequality. With our results we also were able to improve the intervals where some Mittag–Leffler functions don’t possess real zeros.

Mathematics subject classification (2010): 26D10, 34A08.

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REFERENCES

- [1] R. P. AGARWAL AND A. OZBEKLER, *Lyapunov type inequalities for mixed nonlinear Riemann–Liouville fractional differential equations with a forcing term*, J. Comput. Appl. Math. **314** (2017), 69–78.
- [2] I. CABRERA, B. LOPEZ AND K. SADARANGANI, *Lyapunov type inequalities for a fractional two-point boundary value problem*, Math. Methods Appl. Sci. **40** (2017), no. 10, 3409–3414.
- [3] I. J. CABRERA, J. ROCHA AND K. B. SADARANGANI, *Lyapunov type inequalities for a fractional thermostat model*, Rev. R. Acad. Cienc. Exactas Fís. Nat. Ser. A Math. RACSAM **112** (2018), no. 1, 17–24.
- [4] J. H. E. COHN, *On an oscillation criterion of de la Vallée–Poussin*, Quart. J. Math. Oxford Ser. (2) **39** (1988), no. 154, 173–174.
- [5] R. A. C. FERREIRA, *A Lyapunov-type inequality for a fractional boundary value problem*, Fract. Calc. Appl. Anal. **16** (2013), no. 4, 978–984.
- [6] R. A. C. FERREIRA, *On a Lyapunov-type inequality and the zeros of a certain Mittag–Leffler function*, J. Math. Anal. Appl. **412** (2014), no. 2, 1058–1063.
- [7] R. A. C. FERREIRA, *Lyapunov-type inequality for an anti-periodic fractional boundary value problem*, Fract. Calc. Appl. Anal. **20** (2017), no. 1, 284–291.
- [8] R. A. C. FERREIRA, *A de La Vallée Poussin type inequality on time scales*, Results Math. **73** (2018), no. 3, Art. 88, 9 pp.
- [9] B. J. HARRIS, *On an oscillation criterion of Cohn*, Quart. J. Math. Oxford Ser. (2) **42** (1991), no. 167, 309–313.
- [10] P. HARTMAN AND A. WINTNER, *On an oscillation criterion of de la Vallée Poussin*, Quart. Appl. Math. **13** (1955), 330–332.
- [11] A. A. KILBAS, H. M. SRIVASTAVA AND J. J. TRUJILLO, *Theory and applications of fractional differential equations*, North-Holland Mathematics Studies, 204, Elsevier Science B.V., Amsterdam, 2006.
- [12] M. JLELI, M. KIRANE AND B. SAMET, *Lyapunov-type inequalities for a fractional p -Laplacian system*, Fract. Calc. Appl. Anal. **20** (2017), no. 6, 1485–1506.
- [13] J. MAWHIN, *The Legacy of De La Vallée Poussin’s work on boundary value problems of ordinary differential equations: a survey and a bibliography*, Académie Royale De Belgique, Ch.-J. de La Vallée Poussin Collected Works, vol. II, 357–401.

- [14] D. S. MITRINOVIC, J. E. PECARIC AND A. M. FINK, *Inequalities involving functions and their integrals and derivatives*, Mathematics and its Applications (East European Series), 53, Kluwer Academic Publishers Group, Dordrecht, 1991.
- [15] J. J. TRUJILLO, M. RIVERO AND B. BONILLA, *On a Riemann-Liouville generalized Taylor's formula*, J. Math. Anal. Appl. **231** (1999), no. 1, 255–265.