

A LYAPUNOV-TYPE INEQUALITY FOR A FRACTIONAL DIFFERENTIAL EQUATION WITH HADAMARD DERIVATIVE

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Abstract. In this work, a Lyapunov-type inequality is obtained for the case when working with a fractional boundary value problem with the Hadamard derivative.

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REFERENCES

- [1] A. A. KILBAS, H. M. SRIVASTAVA AND J. J. TRUJILLO, *Theory and Applications of Fractional Differential Equations*, North-Holland Mathematics Studies, Vol. **204**, Elsevier, Amsterdam, 2006.
- [2] K. S. MILLER AND B. ROSS, *An Introduction to the Fractional Calculus and Fractional Equations*, Wiley, New York, 1993.
- [3] I. PODLUBNY, *Fractional Differential Equations*, Academic Press, New York, 1993.
- [4] R. C. BROWN, D. B. HINTON, *Lyapunov inequalities and their applications*, In: Survey on Classical Inequalities (Ed. T. M. Rassias), Math. Appl. **517**, Kluwer Acad. Publ., Dordrecht–London (2000), 1–25.
- [5] A. TIRYAKI, *Recent developments of Lyapunov-type inequalities*, Adv. Dyn. Syst. Appl. **5** (2) (2010), 231–248.
- [6] A. M. LYAPUNOV, *Probleme général de la stabilité du mouvement*, (French Transl. of a Russian paper dated 1893). Ann. Fac. Sci. Univ. Toulouse **2** (1907), 27–247; Reprinted in: Ann. Math. Studies, no. 17, Princeton (1947).
- [7] R. A. C. FERREIRA, *A Lyapunov type inequality for a fractional boundary value problem*, Fract. Calc. Appl. Anal. **16** (2013), no. 4, 978–984.
- [8] R. A. C. FERREIRA, *On a Lyapunov-type inequality and the zeros of a certain Mittag-Leffler function*, J. Math. Anal. Appl. **412** (2014), 1058–1063.
- [9] M. JLELI, B. SAMET, *Lyapunov type inequalities for a fractional differential equations with mixed boundary value problems*, Math. Inequal. Appl., **18** (2) (2015), 443–451.
- [10] J. RONG, C. Z. BAI, *Lyapunov-type inequality for a fractional differential equations with fractional boundary value problems*, Adv. Difference. Equ., (2015), 2015:82, 10 pp.
- [11] J. R. WANG, Y. ZHOU AND M. MEDVEĎ, *Existence and stability of fractional differential equations with Hadamard derivative*, Topol. Methods in Nonlinear Anal., **41** (2013), 113–133.
- [12] Q. H. MA, J. W. WANG, R. N. WANG AND X. H. KE, *Study on some qualitative properties for solutions of a certain two-dimensional fractional differential system with Hadamard derivative*, Appl. Math. Letters, **36** (2014), 7–13.
- [13] B. AHMAD, S. K. NTOUYAS, *On Hadamard fractional integro-differential boundary value problems*, J. Appl. Math. Comput., **47** (2015), 119–131.
- [14] J. R. WANG, Y. R. ZHANG, *On the concept and existence of solutions for fractional impulsive systems with Hadamard derivatives*, Appl. Math. Letters, **39** (2015), 85–90.
- [15] Q. H. MA, R. N. WANG, J. W. WANG AND Y. C. MA, *Qualitative analysis for solutions of a certain more generalized two-dimensional fractional differential system with Hadamard derivative*, Appl. Math. Comput., **257** (2015), 436–445.

- [16] RICARDO ALMEIDA, DELFIM F. M. TORRES, *Computing Hadamard type operators of variable fractional order*, *Appl. Math. Comput.*, **257** (2015), 74–88.