

ON ASYMPTOTIC PROPERTIES OF SOME NEUTRAL DIFFERENTIAL EQUATIONS INVOLVING RIEMANN–LIOUVILLE FRACTIONAL DERIVATIVE

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Abstract. The main purpose of the present note is to investigate asymptotic properties of some neutral delay differential equations involving Riemann-Liouville fractional derivative by means of Lyapunov functions. Integer order derivatives are used to overcome the difficulties of calculating the derivatives of Lyapunov functions. Two examples are given to illustrate the results.

Mathematics subject classification (2020): 34K20, 34K40.

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REFERENCES

- [1] A. A. KILBAS, H. M. SRIVASTAVA, AND J. J. TRUJILLO, *Theory and Applications of Fractional Differential Equations*, Volume **204**, Elsevier Science, Jan 2006.
- [2] IGOR PODLUBNY, *Fractional Differential Equations*, Volume **198**, Academic Press, Oct 1998.
- [3] SONG LIU, XIANG WU, XIAN-FENG ZHOU, AND WEI JIANG, *Asymptotical stability of Riemann-Liouville fractional nonlinear systems*, *Nonlinear Dynamics*, **86** (1): 65–71, Jun 2016.
- [4] DUMITRU BALEANU, JOSÉ ANTÓNIO TENREIRO MACHADO, AND ALBERT C. J. LUO, *Fractional Dynamics and Control*, Springer-Verlag New York, 2012.
- [5] SONG LIU, XIANG WU, YAN-JIE ZHANG, AND RAN YANG, *Asymptotical stability of Riemann-Liouville fractional neutral systems*, *Applied Mathematics Letters*, 69: 168–173, Jul 2017.
- [6] RUOXUN ZHANG, SHIPING YANG, AND SHIWEN FENG, *Stability analysis of a class of nonlinear fractional differential systems with Riemann-Liouville derivative*, *IEEE/CAA Journal of Automatica Sinica*, pages 1–7, 2017.
- [7] JIN DONG LI, ZENG BAO WU, AND NAN JING HUANG, *Asymptotical stability of Riemann-Liouville fractional order neutral-type delayed projective neural networks*, *Neural Processing Letters*, **50** (1): 565–579, May 2019.
- [8] WENGUI YANG, AHMED ALSAEDI, TASAWAR HAYAT, AND HABIB M. FARDOUN, *Asymptotical stability analysis of Riemann-Liouville q -fractional neutral systems with mixed delays*, *Mathematical Methods in the Applied Sciences*, **42** (14): 4876–4888, Jun 2019.
- [9] RICHARD L. MAGIN, *Fractional calculus models of complex dynamics in biological tissues*, *Comput. Math. Appl.*, **59** (5): 1586–1593, Mar 2010.
- [10] SONG LIU, XIAN-FENG ZHOU, XIAOYAN LI, AND WEI JIANG, *Stability of fractional nonlinear singular systems and its applications in synchronization of complex dynamical networks*, *Nonlinear Dyn.* **84** (4): 2377–2385, Jun 2016.
- [11] ZHANYING YANG AND JIE ZHANG, *Stability Analysis of Fractional-Order Bidirectional Associative Memory Neural Networks with Mixed Time-Varying Delays*, *Complexity*, Oct 2019.
- [12] R. C. KOELLER, *Applications of Fractional Calculus to the Theory of Viscoelasticity*, *J. Appl. Mech.*, **51** (2): 299–307, Jun 1984.
- [13] R. L. BAGLEY AND R. A. CALICO, *Fractional order state equations for the control of viscoelastically damped structures*, *Journal of Guidance, Control, and Dynamics*, May 2012.
- [14] JACK K. HALE AND SJOERD M. VERDUYN LUNEL, *Introduction to Functional Differential Equations*, Springer. Springer-Verlag New York, 1993.

- [15] KAI DIETHELM, *The Analysis of Fractional Differential Equations – An Application-Oriented Exposition Using Differential Operators of Caputo Type*, Springer-Verlag Berlin Heidelberg, 2010.