

EXISTENCE AND UNIQUENESS OF A POSITIVE SOLUTION TO GENERALIZED NONLOCAL THERMISTOR PROBLEMS WITH FRACTIONAL-ORDER DERIVATIVES

MOULAY RCHID SIDI AMMI AND DELFIM F. M. TORRES

Abstract. In this work we study a generalized nonlocal thermistor problem with fractional-order Riemann–Liouville derivative. Making use of fixed-point theory, we obtain existence and uniqueness of a positive solution.

Mathematics subject classification (2010): 26A33, 35B09, 45M20.

Keywords and phrases: Riemann–Liouville derivatives, nonlocal thermistor problem, fixed point theorem, positive solution.

REFERENCES

- [1] S. ABBAS, *Existence of solutions to fractional order ordinary and delay differential equations and applications*, Electron. J. Differ. Equ., **9** (2011), 1–11.
- [2] R. P. AGARWAL, M. BENCHOHRA AND S. HAMANI, *Boundary value problems for fractional differential equations*, Georgian Math. J., **16**, 3 (2009), 401–411.
- [3] R. P. AGARWAL, Y. ZHOU AND Y. HE, *Existence of fractional neutral functional differential equations*, Comput. Math. Appl., **59**, 3 (2010), 1095–1100.
- [4] S. N. ANTONTSEV AND M. CHIPOT, *The thermistor problem: existence, smoothness uniqueness, blowup*, SIAM J. Math. Anal., **25**, 4 (1994), 1128–1156.
- [5] G. CIMATTI, *Existence of weak solutions for the nonstationary problem of the joule heating of a conductor*, Ann. Mat. Pura Appl., (4) **162** (1992), 33–42.
- [6] L. GAUL, P. KLEIN AND S. KEMPFLE, *Damping description involving fractional operators*, Mech. Syst. Signal Process., **5** (1991), 81–88.
- [7] C. GIANNANTONI, *The problem of the initial conditions and their physical meaning in linear differential equations of fractional order*, Appl. Math. Comput., **141**, 1 (2003), 87–102.
- [8] R. HILFER, *Applications of fractional calculus in physics*, World Sci. Publishing, River Edge, NJ, 2000.
- [9] S. D. HOWISON, J. F. RODRIGUES AND M. SHILLOR, *Stationary solutions to the thermistor problem*, J. Math. Anal. Appl., **174**, 2 (1993), 573–588.
- [10] A. A. KILBAS, H. M. SRIVASTAVA AND J. J. TRUJILLO, *Theory and applications of fractional differential equations*, North-Holland Mathematics Studies, 204, Elsevier, Amsterdam, 2006.
- [11] K. KWOK, *Complete guide to semiconductor devices*, McGraw-Hill, New York, 1995.
- [12] A. A. LACEY, *Thermal runaway in a non-local problem modelling Ohmic heating. II. General proof of blow-up and asymptotics of runaway*, European J. Appl. Math., **6**, 3 (1995), 201–224.
- [13] E. D. MACLEN, *Thermistors*, Electrochemical publication, Glasgow, 1979.
- [14] K. S. MILLER AND B. ROSS, *An introduction to the fractional calculus and fractional differential equations*, A Wiley-Interscience Publication, Wiley, New York, 1993.
- [15] D. MOZYRSKA AND D. F. M. TORRES, *Modified optimal energy and initial memory of fractional continuous-time linear systems*, Signal Process., **91**, 3 (2011), 379–385.
- [16] I. PODLUBNY, *Fractional differential equations*, Mathematics in Science and Engineering, 198, Academic Press, San Diego, CA, 1999.
- [17] I. PODLUBNY AND A. M. A. EL-SAYED, *On two definitions of fractional calculus*, preprint UEF (ISBN 80-7099-252-2), Solvay Academy of Science-Institute of Experimental Phys (1996), 03-06.

- [18] J. SABATIER, O. P. AGRAWAL, J. A. TENREIRO MACHADO, *Advances in fractional calculus*, Springer, Dordrecht, 2007.
- [19] S. G. SAMKO, A. A. KILBAS AND O. I. MARICHEV, *Fractional integrals and derivatives*, translated from the 1987 Russian original, Gordon and Breach, Yverdon, 1993.
- [20] H. M. SRIVASTAVA AND R. K. SAXENA, *Operators of fractional integration and their applications*, Appl. Math. Comput., **118**, 1 (2001), 1–52.
- [21] D. E. TZANETIS, *Blow-up of radially symmetric solutions of a non-local problem modelling Ohmic heating*, Electron. J. Differential Equations, **2002**, 11 (2002), 26 pp.