ANTI–PERIODIC BOUNDARY VALUE PROBLEM FOR NONLINEAR FIRST ORDER ORDINARY DIFFERENTIAL EQUATIONS

DANIEL FRANCO, JUAN J. NIETO AND DONAL O'REGAN

Abstract. We prove several new existence results for a nonlinear anti-periodic first order problem using a Leray-Schauder alternative. Two definitions of lower and upper solutions are presented and we show in this paper the validity of the lower and upper solution method. Also, we give a method to generate a sequence of approximate solutions converging to a solution of the anti-periodic problem.

REFERENCES

[1] A. ABDURRAHMAN, F. ANTON, J. BORDES, *Half-string oscillator approach to string field theory (Ghost sector. I)*, Nuclear Phys. B, **397** (1993), 260–282.

[2] R. AFTABIZADEH, Y. K. HUANG, N. H. PAVEL, *Nonlinear third-order differential equations with anti-periodic boundary conditions and some optimal control problems*, J. Math. Anal. Appl., **192** (1995), 266–293.

[3] R. AFTABIZADEH, N. H. PAVEL, Y. K. HUANG, *Anti-periodic oscillations of some second-order differential equations and optimal control problems*, J. Comput. Appl. Math., **52** (1994), 3–21.

[4] C. AHN, C. RIM, *Boundary flows in general coset theories*, J. Phys. A, **32** (1999), 2509–2525.

[5] S. AIZICOVICI, S. MCKIBBEN, S. REICH, *Anti-periodic solutions to nonmonotone evolution equations with discontinuous nonlinearities*, Nonlinear Anal. Ser. A: Theory, Methods, **43** (2001), 233–251.

[6] S. AIZICOVICI, N. H. PAVEL, *Anti-periodic solutions to a class of nonlinear differential equations in Hilbert space*, J. Funct. Anal., **99** (1991), 387–408.

[7] S. AIZICOVICI, S. REICH, *Anti-periodic solutions to a class of non-monotone evolution equations*, Discrete Contin. Dynam. Systems, **5** (1999), 35–42.

[8] A. CABADA, J. J. NIETO, *Fixed points and approximate solutions for nonlinear operator equations*, J. Comput. Appl. Math., **113** (1999), 17–25.

[9] H. L. CHEN, *Antiperiodic wavelets*, J. Comput. Math., **14** (1996), 32–39.

[10] Y. Q. CHEN, *On Massera's theorem for anti-periodic solution*, Adv. Math. Sci. Appl., **9** (1999), 125–128.

[11] F. J. DELVOS, L. KNOCHE, *Lacunary interpolation by antiperiodic trigonometric polynomials*, BIT, **39** (1999), 439–450.

[12] D. FRANCO, J. J. NIETO, *First-order impulsive ordinary differential equations with anti-periodic and nonlinear boundary conditions*, Nonlinear Anal., **42** (2000), 163–173.

[13] H. KLEINERT, A. CHERVYAKOV, *Functional determinants from Wronski Green functions*, J. Math. Phys., **40** (1999), 6044–6051.

[14] G. S. LADDE, V. LAKSHMIKANTHAM, A. S. VATSALA, *Monotone Iterative Techniques for Nonlinear Differential Equations*, Pitman, Boston, (1985).

[15] M. NAKAO, *Existence of an anti-periodic solution for the quasilinear wave equation with viscosity*, J. Math. Anal. Appl., **204** (1996), 754–764.

[16] H. OKOCHI, *On the existence of anti-periodic solutions to a nonlinear evolution equation associated with odd subdifferential operators*, J. Funct. Anal., **91** (1990), 246–258.

[17] D. O'REGAN, *Existence Theory for Nonlinear Ordinary Differential Equations*, Kluwer, Dordrecht, (1997).

[18] S. PINSKY, U. TRITTMANN, *Antiperiodic boundary conditions in supersymmetric discrete light cone quantization*, Phys. Rev. D (3), **62** (2000), 87701, 4 pp.

[19] P. SOUPLET, *Optimal uniqueness condition for the antiperiodic solutions of some nonlinear parabolic equations*, Nonlinear Anal., **32** (1998), 279–286.

[20] Y. YIN, *Anti-periodic solutions of some semilinear parabolic boundary value problems*, Dynam. Contin. Discrete Impuls. Systems **1** (1995), 283–297.

[21] Y. YIN, *Monotone iterative technique and quasilinearization for some anti-periodic problems*, Nonlinear World, **3** (1996), 253–266.

[22] Y. YIN, *Remarks on first order differential equations with anti-periodic boundary conditions*, Nonlinear Times Digest, **2** (1995), 83–94.

© ELEMENT, Zagreb
Paper MIA-06-44

Mathematical Inequalities & Applications
www.ele-math.com
mia@ele-math.com