Introduction: new trends on dynamical systems and differential equations

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Abstract: The main contributions of [Int. J. Dyn. Syst. Differ. Equ., Vol. 8, Nos. 1/2 (2018)], consisting of 11 papers selected and revised from the international conference IMAME'2016, are highlighted.

Biographical notes: Delfim F.M. Torres is a Full Professor of Mathematics at the University of Aveiro since 2015 and Coordinator of the Systems and Control Group of CIDMA since 2010. He obtained PhD in Mathematics in 2002 and DSc (Habilitation) in Mathematics in 2011. Professor Torres has been awarded in 2015, 2016 and 2017 with the title of ISI Highly Cited Researcher. He has written more than 400 publications, including two books with Imperial College Press, in 2012 and 2015, and two books with Springer, in 2014 and 2015. He is the Director of the FCT Doctoral Program of Excellence in *Mathematics and Applications* of Universities of Minho, Aveiro, Porto and UBI since 2013. Sixteen PhD students in mathematics (six of which woman) have successfully finished under his supervision.

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Natália Martins has PhD in Mathematics awarded by the University of Aveiro, Portugal, in 2006. She works in the Department of Mathematics of the University of Aveiro since 1992 and is Vice-Director of the department since 2008. Her research interests are in the area of time scale calculus, calculus of variations and optimal control. She is an Author of more than 30 papers in international journals and Reviewer of several scientific journals. She is also a member of organising and scientific committees of several international conferences.

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1 Introduction

The *International Meeting on Applied Mathematics in Errachidia* (IMAME'2016) was held at the Faculty of Sciences and Technics of the Moulay Ismail University, Errachidia, Morocco, May 9–12, 2016. This conference is part of the research activities of the Systems and Control Group of the Centre for Research & Development in Mathematics and Applications (CIDMA), hosted at the Department of Mathematics of the University of Aveiro, Portugal, and the Faculty of Sciences and Technics, Errachidia, Morocco, being the second conference of this series, after IMAME'2012: see Torres et al. (2013).

IMAME'2016 gathered researchers from several countries to discuss broad topics from optimisation and variational analysis, mathematical systems theory, ordinary and partial differential equations, geometric non-linear control, fractional calculus, calculus on time scales and applications. There were 4 plenary lectures and 125 communications on ongoing current research, which play an important role in all fundamental sciences and engineering applications.

This IJDSDE special issue comprises 11 original research articles that were carefully selected among works presented at IMAME'2016. The conference attracted a total of 129 selected talks from extended abstract submissions. Of these, the guest editors invited 21 for possible publication in IJDSDE. Their authors were then asked to prepare the corresponding articles, each of them underwent a double-blind expert review process with anonymous feedback. Eleven papers were finally accepted.

Each one of these papers has been carefully scrutinised, having passed the standard refereeing process. Our editorial task was made lighter by the service of unrewarded but dedicated referees: we offer them our heartfelt thanks. We take also this opportunity to thank again all the contributors and participants of IMAME'2016, the authors for submitting their work for possible publication and the members of the Organising Committee, for a splendid organisation, at all levels, including an enriching social program, which included an excursion to Merzouga, a small Berber village in the Sahara desert in Morocco. Thanks to the work of all, the meeting was unique and unforgettable. We would like also to acknowledge the generous support of the Moulay Ismail University, Faculty of Sciences and Technics of Errachidia, CIDMA, DMat-UA, CNRST-Morocco and Errachidia Province.

Next we briefly describe the main contributions of the above-mentioned 11 papers, in the areas of variational analysis and optimal control (Section 2), partial differential equations (Section 3) and applications to signal and image processing (Section 4).

2 Variational methods and optimal control

The paper of Ayoujil uses variational arguments, based on Ekeland's variational principle and the mountain pass theorem, to prove the existence of eigenvalues to a non-homogeneous quasilinear problem.

Based on a variational method, in periodic solutions to singular damped delay differential equations with impulses, Dib and Daoudi-Merzagui discuss the existence of periodic solutions for non-autonomous damped delay differential equations with singular non-linearities and in presence of impulses. Main results provide sufficient conditions for the existence of positive solutions.

Existence of positive solutions, to non-linear elliptic systems, is also obtained by Talbi et al. in variational form. The behaviour of the energy, corresponding to such positive solutions, is established.

Boutoulout and Karite investigate an extension of the notion of regional controllability for semi-linear parabolic systems, to a situation encountered in many real problems, where the state must be between two prescribed functions only on a part of the boundary. To calculate the optimal control, authors use subdifferential techniques.

3   Partial differential equations

A mathematical model, consisting on a generalised Landau–Lifshitz–Gilbert equation with a general damping tensor, is proposed on a non-scalar damping model in micromagnetism. The magnetisation dynamics is described, and existence of global weak solutions is obtained by a Faedo–Galerkin penalty method.

A vector extrapolation algorithm for non-linear reaction diffusion equations is given by Nagid et al. Main results accelerate the sequences produced by the fixed point algorithm as well as the ones generated by Schwarz's method. Several test cases are discussed in detail, showing accuracy and efficiency of the proposed approach.

Tahiri provides local mesh refinements for boundary value problems with the help of piecewise constant distributions. Results show that the optimal local refinement rate is 2, which is in agreement with required regularity assumptions.

In the paper *Nonlinear Steklov eigenvalue problem with variable exponents and without Ambrosetti–Rabinowitz condition*, Zerouali et al. study a non-linear problem involving the $p(x)$-Laplacian on a bounded domain. Main result provides conditions assuring existence of infinitely many positive eigenvalues without the need to assume an Ambrosetti–Rabinowitz condition on the non-linearity.

4   Applications to image processing and signals

A signalling protocol, with relevance in secure authentication, is proposed by Azrour et al. The analysis shows that the obtained solution is more secure than previously given methods.

The paper *Numerical analysis of some time fractional partial differential equations for noise removal* is devoted to the study of time fractional partial differential equations for image denoising processing, obtained from some classical convection diffusion equations for processing image denoising, edge preservation and compression. Stability and convergence results are given using finite differences and Perona–Malik-like methods, which give the theoretical foundations for the numerical experiments.

Finally, Chawki et al. propose a new technique for content-based image retrieval, which allows image characterisation by their frequency content and their shape information through high-resolution spectral analysis methods. Experimental results show the effectiveness and robustness of the proposed approach.

Acknowledgements

References

Torres, D.F.M., Kirane, M., Malinowska, A.B. and Sidi Ammi, M.R. (2013) 'Preface—the international meeting on applied mathematics in Errachidia (IMAME'2012)', *Advances in Dynamical Systems and Applications,* Vol. 8, No. 1, pp.1–2.