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Special issue: Optimization in the natural sciences

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EDITORIAL

Special issue: Optimization in the natural sciences

This volume of *Optimization* contains selected papers presented during the EURO Mini-Conference (MEC) on Optimization in the natural sciences, hosted by the University of Aveiro, Portugal, from 5–9 February 2014. The conference was the 30th event in the series initiated by EURO, Association of European OR Societies.

The project of organizing MEC XXX was designed by EUROPT, EURO Working Group on Continuous Optimization (http://europt.iam.metu.edu.tr/), and supported by EURO (http://www.euro-online.org/) and CIDMA – the Center for Research and Development in Mathematics and Applications of the Mathematics Department of the University of Aveiro (cidma.mat.ua.pt/). This led to the choice of the theme of the mini-conference – Optimization in the natural sciences – that in turn reflected three directions of research that are being developed in EUROPT and CIDMA: Dynamical Systems, Optimization and Statistics with special attention to their applications in the natural sciences and bioinformatics. The conference topics reflected the diversity of different lines of research in optimization and its application in the natural sciences, including applications of modelling and optimization in physics, biology, chemistry and medicine; biomedical engineering; design optimization; data visualization for optimal decisions; image processing; linear and nonlinear programming, infinite and semi-infinite optimization with applications; inverse problems; multi-criteria optimization with applications; optimal control applied to biological models; optimal mass transfer; optimization in bioinformatics and computational biology; shape optimization; solution of optimization problems using statistical methods; statistical and probabilistic modelling; and others.

The conference was attended by about 100 registered participants representing 21 countries. The talks by the invited speakers Giuseppe Buttazzo (University of Pisa), Leonid Bunimovich (Georgia State University, Atlanta), Alexander Dudin (Belarusian State University), Michael Greenacre (University Pompeu Fabra, Barcelona), Gueorgui Smirnov (University of Minho, Portugal) and Sergei Tabachnikov (Pennsylvania State University), aroused lively interest among the participants. Two tutorial lectures were offered by Yaroslav D. Sergeyev from the University of Calabria. The participants discussed recent achievements in optimization theory, exchanged experiences in solving real-world problems, reported on the latest developments of appropriate models of optimization and their applications in the natural sciences. The XXX EURO Mini-Conference provided an excellent forum for researchers and practitioners in optimization to promote their recent advances to the wider scientific community and to identify new research challenges in theory, methods and applications.

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There were many submissions for our special issue. Only nine passed the first phase of selection where the following criteria were checked to be satisfied: relationship to the aims and scope of the journal *Optimization*; relationship to the applications of optimization to the natural sciences; and significant mathematical contribution. Based on rigorous reviewing processes at the second phase, only three papers were accepted for publication. We provide below their short descriptions.

In the paper 'An application of interactive multi-criteria optimization to air pollution control' by L.J. Alvarez-Vázquez, N. García-Chan, A. Martínez and M.E. Vázquez-Méndez, a problem dealing with the optimal management of a set of industrial plants inside a populated area is formulated by means of the diffusion transport equation, including a linear reaction term and source terms modelled by Dirac deltas. Introducing adjoint state techniques, the authors have transformed this problem into a problem of multi-objective optimization in Banach spaces. Since the large number of objective functions discourages the complete search of its Pareto front, two interactive methods of multi-objective programming are proposed by the authors: the VIA and the STEM algorithms. These two algorithms are combined in one that solves efficiently a real-life problem posed in the metropolitan area of Guadalajara (Mexico).

The paper 'Optimality conditions for fractional variational problems with dependence on a combined Caputo derivative of variable order' by D. Tavares, R. Almeida and D.F.M. Torres is dedicated to study of variational problems with a Lagrangian depending on a combined Caputo derivative of variable fractional order a. The endpoint of the integral is free, and thus the transversality conditions are proved. The authors claim that this variational problem may describe better some nonconservative physical phenomena, since fractional operators are nonlocal and contain memory of the process. The main results of the paper provide necessary optimality conditions of Euler–Lagrange type, described by fractional differential equations of variable order, and different transversality optimality conditions. Several particular cases are considered illustrating the new results.

In the paper 'Profit optimization for cattle growing in a randomly fluctuating environment' by P.A. Filipe, C.A. Braumann and C. Carlos, a class of stochastic differential equation models was applied to describe the evolution of the weight of Mertolengo cattle. The authors have determined the optimal mean profit obtained by selling an animal at the cattle market, using two approaches. One consists in determining the optimal selling age (independently of the weight) and the other consists in selling the animal when a fixed optimal weight is achieved for the first time (independently of the age). The profit probability distribution can be computed for such optimal age/weight. For typical market values, it is observed that the second approach achieves a higher optimal mean profit compared with the first one, and, in most cases, even provides a lower standard deviation.

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