Preface

Engineering and Applied Sciences Optimization: Dedicated to the memory of Professor M.G. Karlaftis

This volume is published to commemorate the life and memory of Prof. Matthew G. Karlaftis. Numerous memorial events have been organized and acclamations have been written about Matt since his untimely passing on June 4, 2014, a few hours before his opening speech at the First International Conference on Engineering and Applied Sciences Optimization (OPT-i) that we were co-organizing. He was a very special person who will be long remembered as a great scientist and educator as well as a beloved friend.

The subject areas of the volume ranges from Structural Optimization, Logistics, Transportation, Traffic and Telecommunication Networks to Operational Research, Metaheuristics, Multidisciplinary and Multiphysics Design Optimization, etc. The chapters which appear in this volume are selected studies presented at OPT-I and works written by his friends and former colleagues and students; all in the area of optimization that Matt loved and was so quantitatively driven. All contributions reflect the warmth and genuine friendship which Matt enjoyed from his associates and show how much his scientific contribution has been appreciated. He will be greatly missed and we hope that this volume will be proven as a suitable memorial to his life and achievements.

The volume consists of 25 chapters which are grouped into three categories, in the first category, the chapters deal with optimization studies related to logistics, transportation and traffic and telecommunication networks; in the second, various works are presented where metaheuristic optimization methods are used for solving various engineering problems and in the third, structural optimization and operational research problems are solved.

First Part: In the work of Roncoli et al., it is described a novel approach for defining optimal strategies in motorway traffic flow control, considering that a portion of vehicles are equipped with vehicle automation and communication systems; an optimization problem, formulated as a convex quadratic programming problem, was

developed with the purpose of minimizing traffic congestion. Qian et al. make a comprehensive use of the large-scale taxi trip data and present a three-fold study on urban dynamics pattern in NYC. First, the spatiotemporal pattern of urban activities are examined from trip dynamics by aggregating pick-up and drop-off locations; second, they explore the inherent similarities among taxi trips and reveal the underlying connections among detached places using two-step clustering algorithms. Paz et al. proposed a methodology aiming to calibrate microscopic traffic flow simulation models, which was found to be capable to calibrate simultaneously all the calibration parameters as well as demand patterns for any type of network. *Gkiotsalitis and Stathopoulos* investigated the importance of big-data in improving the organizational efficiency of physical meetings among multiple travelers in urban environments. In particular, they examined the state-of-the-art on capturing travelers' patterns based on their data traces and the expected gains from leveraging user-generated data for optimizing leisure travel. In the work of Cruciol et al. it is introduced the application of the methods of data mining to get the knowledge from air traffic big-data in management processes. The proposed approach uses a Bayesian network for data analysis to reduce the costs of flight delay. *Papathanasopoulou and Antoniou* enhance the capabilities of an existing data-driven approach while it is further validated using another training dataset; in addition, the methodology is enriched and an improved methodological framework is suggested for the optimization of car-following models. Vlahogianni presents a detailed review of the unique opportunities provided by ITS and big data and discuss the emerging approaches for transportation modeling; furthermore, the challenges and emerging opportunities posed for researchers working with such approaches are also discussed.

Second Part: Yang presents the key features of nature-inspired metaheuristic algorithms by analyzing their diversity and adaptation, exploration and exploitation, attractions and diffusion mechanisms. The author also highlights the success and challenges concerning swarm intelligence, parameter tuning, and parameter control as well as some open problems. Saka et al. used five optimum design algorithms for cold-formed steel frames made of thin-walled sections using the recent metaheuristic techniques. The algorithms considered are firefly, cuckoo search, artificial bee colony with levy flight, biogeography-based optimization, and teaching-learning-based optimization algorithms. Mehmani et al. present a new model management technique to be incorporated into population-based heuristic optimization; according to this technique different computational models are selected adaptively in order to be used during optimization, with the overall objective to result in optimal designs with high fidelity function estimates at a reasonable computational expense. Simos presents a general algorithmic method for constructing 2^q-level design matrices in order to explore and optimize response surfaces where the predictor variables are each at 2^q equally spaced levels, by utilizing a genetic algorithm. Hosseini et al. present a new optimization technique named as mesh adaptive direct search (MADS) that is used to solve optimal steady-state performance of power systems. MADS is utilized to determine the optimal settings of control variables, such as generator voltages and transformer taps for optimal reactive power and voltage control of IEEE 30-bus system.

Last Part: Murakami et al. propose a new optimization procedure including a variable adaptive step length for shear buildings with hysteretic dampers when subjected to a set of design earthquake ground motions under a constraint on total cost. The response sensitivity of buildings including hysteretic dampers is high and a devised algorithm of adaptive step-length is useful to obtain a smooth and reliable response sensitivity. Nigdeli and Bekdaş present an optimization methodology for tuning of tuned mass dampers on structures subjected to seismic loading for two different objectives, such as reducing the displacement of first story and absolute acceleration of top story of the structure. Alexandersen and Lazarov present a methodology for tailoring macroscale response by topology optimizing microstructural details, where the microscale and macroscale response are completely coupled by treating the full model. Giannakoglou et al. present adjoint methods for the computation of the first- and higher-order derivatives of objective functions used in optimization problems governed by the Navier–Stokes equations in aero/hydrodynamics. Gogarty and Pasini present a 2D hierarchical topology optimization scheme aiming to design a cellular scaffold that optimally reconciles bone resorption and permeability, two antagonist objectives of bone tissue scaffolds. Gandomi et al. study the method of evolutionary boundary constraint handling that is very easy to implement and very effective. In particular, they intended to improve the optimization results by means of evolutionary boundary constraint handling scheme on slope stability optimization problem. Talgorn et al. present different formulations for the surrogate problem considered at each search step of the mesh adaptive direct search algorithm using a surrogate management framework. Bekas et al. aim to couple the problem of structural optimization of building frames, with that of the optimization of design options for their energy efficiency. Bekdaş and Nigdeli in their work iteratively search to find the flexural moment capacity of columns under axial loading. Waycaster et al. propose a framework for understanding the types of interactions that may take place and their effect on design optimization formulation by means of game theory. These effects were considered as an economic uncertainty that arises due to limited information about interactions between stakeholders. Antoni and Giannessi present a new approach for handling bilevel multi-objective problems. The advantage of this new approach consists of the following characteristics, for solving the upper level, it does not require to know explicitly the lower level. Georgioudakis et al. integrated the extended finite element into a shape design optimization framework aiming to improve the service life of structural components subject to fatigue. Charmpis and Dimitriou developed an optimal budget allocation framework and stress-tested for the optimal scheduling of a bridges upgrading program. A suitable test case is developed for performing in-depth analysis that takes into consideration the most important features involved.

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