Special volume on operational research on the interrelated application areas of energy, transportation and the environment

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Operational Research has been used with success in energy, environmental and transportation sector. In this Special Volume on Operational Research on the inter-related application areas of energy, transportation and the environment, a number of relevant papers provide contributions to: (a) the applicability of operational research on large-scale areas of energy, transportation and the environment, (b) the robustness and efficiency of solutions procedures and (c) the analysis of convergence properties of the methods. Applications to air traffic management, emission calculation, green vehicle routing problem, energy market, Energy and environmental efficiency, green vessel schedule design and natural gas storage are addressed.

G. Saharidis introduce a new emissions factor referred to as the Environmental Externalities score (EES) as a measure of transportation network factors (e.g., gradient, rolling resistance, air resistance, weather condition, wind velocity, traffic congestion etc.) having an impact on fuel consumption as well as GHG and non-GHG emission of a vehicle. The author expresses the EES by vehicle class (i.e. light-duty and heavy-duty) as a function of each one of the transportation factors affecting energy consumption and emission production. This novel emission factor is developed to define the objective function of any green vehicle routing problem (e.g. with time windows, periodic, capacitated etc.). ESS is based on extensive bibliographic research and used in www.greenyourroute.com platforms.

M.R. Douiri et al. presents an improved direct torque control based on artificial neural network techniques fed by a three levels neutral-point-clamped inverter for high power asynchronous motor drive. A better precision in the torque and flux responses

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was achieved with a great reduction in the execution time of the controller; hence the steady-state control error is almost eliminated.

Another interesting topic is addressed by Coletsos John and Ntakolia Charis. The authors present a novel dynamic integer mathematical model with two level hierarchical architecture to solve air traffic management problem by transforming it from an ‘airport-centered’ to an ‘airplane-centered’ problem. This model mainly increases safety and energy efficiency, supports the free flight concept, distributes fairly ground-holding and air delays among the flights, increases the air sectors’ capacity avoiding congestions and prioritizes the airline preferences. The problem is divided into two sub-problems (upper and lower level) in order to decrease its computational efforts and its complexity as well as to allow flexibility, supporting in the same time the free flight scenario.

Ma-lin Song et al. study, the relationship between electricity supply, coal price, and economic growth. The authors develop a coal-electricity vertical price transmission model for analyzing the relationships between power supply, coal price, and economic growth. The results suggest that there is a long-run equilibrium relationship between the three variables. Applying a bootstrapped Granger causality test, the authors find unidirectional Granger causality from power supply to economic growth and from coal price to power supply, and bidirectional Granger causality between coal price and economic growth. Finally, Ma-lin Song et al. discuss some policy implications suggested by presented results.

X. Liu and J. Wu use a data envelopment analysis to assess the energy and environmental efficiency of China’s regional transportation sectors with the ultimate goal of saving energy and protecting the environment. The proposed analysis does not only evaluate the energy and environmental efficiency for the transportation sectors but also it effectively identifies the potential amount of reductions in both energy consumption and CO₂ emissions for those sectors. Their study shows that most of the provincial-level regions in China do not have eco-efficient transportation industries. The energy and environmental efficiency scores in most regions are lower than 0.5, which means that most of them perform poorly in saving energy and protecting environment. Additionally, X. Liu and J. Wu show that the eastern and northwestern areas of China generally performed significantly better than the other areas of China. Therefore, more measures should be taken to balance and coordinate the development between the six large areas.

M.A. Dulebenets et al. propose a mathematical model for the green vessel scheduling problem, imposing constraints on emissions produced by a vessel at each voyage leg of the liner shipping route. A novel mixed integer non-linear mathematical model is developed, linearized and solved efficiently minimizing the total route service cost. Numerical experiments were conducted for the Europe Pakistan India Consortium route, served by CMA CGM liner shipping company. Numerical experiments demonstrate the high accuracy of the suggested solution approach. The proposed methodology can serve as an efficient planning tool for liner shipping companies in design of green vessel schedules and improving energy efficiency.

I. D. Psychas et al. propose a three parallel multi-start non-dominated sorting differential evolution algorithms for the solution of four multi-objective route based fuel consumption vehicle routing problems and their results are compared with the

results of a parallel multi-start NSGA II algorithm. The problems that are formulated with two competitive objective functions are the multi-objective symmetric and asymmetric delivery route based Fuel Consumption vehicle routing problem and the multi-objective symmetric and asymmetric pick-up route based fuel consumption vehicle routing problem. In each algorithm a variable neighborhood search algorithm for the improvement of each solution separately is used. The main contribution of the paper, in addition to the proposed algorithm, is the four new multi-objective formulations of the problem using combinations of symmetric and asymmetric formulations in pick-up and delivery problems. The formulation includes real route parameters, as the direction of the wind and the behavior of the drivers, and, thus, very realistic formulations were produced.

A.M. Malyscheff and T.B. Trafalis present a method to value natural gas storage contracts via least squares Monte Carlo and support vector machine regression. Their approach allows for gas storage contracts to be valued in a more realistic two factor model. Least squares Monte Carlo represents an efficient approach to carry out storage valuation when the dimensionality of the state space is high. The authors carry out a comparison between one factor and two factor models using a spot trading strategy. To this end they base their experiments on a forward curve that was obtained using monthly averages of the NBP Day-ahead contract from 2004 to 2009.

We hope that this special issue will stimulate both theoretical and applied research in operational research on the interrelated application areas of energy, transportation and the environment. We would like to thank the authors that have contributed to this special issue, the reviewers who have graciously provided their valuable time and effort to ensure the quality of the papers finally accepted. We are most thankful to Prof. Steffen Rebennack, Editor in Chief of Energy Systems for given us the opportunity to arrange this special issue, and to the Springer staff for their support.