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## **Preface: Special Issue on the VeRoLog 2015 Conference**

VeRoLog is the annual conference sponsored by the EURO Working Group on Vehicle Routing and Logistics Optimization within EURO, the Association of the European Operational Research Societies. It brings together the large community of researchers and practitioners interested in vehicle routing optimization and its relations with logistics. The conference is open to high-quality methodological contributions as well as relevant real-world applications and case studies from the industry and service sectors. VeRoLog 2015, which forms the basis of the current special issue, was organized in Vienna. The former conferences were located in Bologna (2012), Southampton (2013), and Oslo (2014).

Researchers in the field of Vehicle Routing and Logistics from many parts of Europe and beyond met at the University of Vienna from June 8th to June 10th, 2015. There were 181 participants from 29 countries (Algeria, Argentina, Australia, Austria, Belgium, Brazil, Canada, Chile, China, Colombia, Denmark, France, Germany, Greece, India, Israel, Italy, Netherlands, Norway, Poland, Portugal, Serbia, Slovenia, South Korea, Spain, Switzerland, Turkey, United Kingdom, USA). The conference was organized into two plenaries (given by Martin Savelsbergh and Tolga Bektas) and 37 sessions including 123 presentations. A strong focus was on rich and real-world routing, especially in the field of green and electric vehicle routing problems, city logistics and bike sharing, and safe and secure routing. In total 28 presentations focused on one of these topics. VeRoLog now also has a solver challenge on rich vehicle routing. The paper of the winner is also included in the special issue.

The following seven papers are a selection of the best papers presented during the conference.

The paper by Beloso, Juan, Faulin, and Martinez, entitled “A Biased-Randomized Metaheuristic for the Vehicle Routing Problem with Clustered and Mixed Backhauls,” analyzes the Vehicle Routing Problem with Backhauls, where delivery and pickup customers are served from a central depot. Initially, it focusses on the version with clustered backhauls (VRPCB), where all delivery customers on a route have to be served before the first pickup customer can be visited. This is motivated by the fact that vehicles are often rear loaded. The paper presents a relatively simple to implement yet efficient metaheuristic algorithm that employs a biased randomized version of the popular savings heuristic within a metaheuristic framework. A skewed probability distribution is used to induce a biased (oriented) randomization effect on the savings list of routing edges, and the sequencing constraints are considered via penalty costs. On some classical benchmark instances for the VRPCB, competitive results are obtained and a new best-known solution is found. In order to show the robustness of the proposed approach, it is also applied—after a minor adaptation—to the Vehicle Routing Problem with Mixed Backhauls, where line-haul and backhaul customers might appear in any order during a route.

The second paper, entitled “An Adaptive and Diversified Vehicle Routing Approach to Reducing the Security Risk of Cash-in-Transit Operations” and authored by Bozkaya, Salman, and Telciler, considers the new problem class of inconsistent vehicle routing problems. The authors consider the transportation of valuables (e.g., cash). Due to the high-risk nature of this operation (e.g., robberies), they consider a bi-objective function where they

attempt to minimize the total transportation cost and the security risk of transporting valuables along the designed routes. For risk minimization, they propose a composite risk measure that is a weighted sum of two risk components: (i) following the same or very similar routes, and (ii) visiting neighborhoods with low socio-economic status along the routes. They also consider vehicle capacities in terms of monetary value carried as per insurance regulations. As the solution technique, an Adaptive Randomized Bi-Objective Path Selection Algorithm is used.

The third paper, authored by Kloimüller and Raidl, is entitled “Full-Load Route Planning for Balancing Bike Sharing Systems by Logic-Based Benders Decomposition.” Public Bike Sharing Systems require some kind of rebalancing in order to avoid rental stations running empty or entirely full, which would make the system ineffective and annoy customers. Usually a fleet of vehicles with trailers is used for moving bikes between stations. A rarely studied real-world aspect of the problem is that in large efficient bike sharing systems, drivers almost never pick up or deliver only a few bikes, but normally work with full vehicle loads. Many stations even require several visits with full loads. In this paper, the authors investigate such a simplified model, in which only full vehicle loads are moved between the rental stations. They formulate the rebalancing problem as a selective unit-capacity pickup and delivery problem with time budgets on a bipartite graph and present a compact mixed integer linear programming model, a logic-based Benders decomposition, and a variant named Branch-and-Check for it. The solution approach is applied to instances derived from real-world data provided by Citybike Wien, which is based in Vienna.

The fourth paper by Lum, Cerrone, Golden, and Wasil, entitled “Partitioning a Street Network into Compact, Balanced, and Visually Appealing Routes” deals with a problem of practical relevance by looking at the aesthetic quality of a set of routes. In real-world applications, the visual appeal of a proposed set of routes can have a strong influence on the willingness of a client to accept or reject a specific routing plan. Hence, the routes should not only be short, but also as compact as possible, and overlap minimally. They consider the Min-Max  $K$ -Windy Rural Postman Problem (MMKWRPP), in which a homogeneous fleet of  $K$  vehicles is routed such that the cost of the longest route is minimized. An algorithmically simple heuristic is developed, which produces competitive solutions, and performs well with respect to metrics measuring compactness and separation. The heuristic uses a partitioning scheme in which the weight of a vertex includes contributions from both incident streets requiring service and the distance needed to travel to a vertex. Computational results are presented for a set of instances generated from real-world street networks and for a set of artificial instances.

The fifth paper, entitled “Iterated Local Search for the Capacitated Vehicle Routing Problem with Sequence-Based Pallet Loading and Axle Weight Constraints,” is authored by Pollaris, Braekers, Caris, Janssens, and Limbourg. The authors present an Iterated Local Search (ILS) algorithm for the capacitated vehicle routing problem with sequence-based pallet loading and axle weight constraints. The challenge of axle loading constraints is becoming increasingly important in the transportation industry and has been addressed only by a few authors. The problem considered in this paper has been introduced by the authors in a previous article, where a mathematical formulation of the problem has been presented. The proposed algorithm is based on a variable neighborhood descent approach embedded in an ILS procedure. The

results of the proposed metaheuristic compare well with the ones obtained using CPLEX. In addition, the effect of introducing axle weight constraints in a CVRP on total routing cost is analyzed. Results show that integrating axle weight constraints does not lead to a large cost increase. However, not including axle weight constraints in the planning process may induce major axle weight violations.

The sixth paper, entitled “An Iterated Beam Search Algorithm for the Green Vehicle Routing Problem” by Yavuz proposes an iterated beam search algorithm for solving a variant of the green vehicle routing problem. The vehicles considered in this research are “alternative fueled vehicles” (AFVs) that need to be recharged/refueled at internal (customer nodes) and external (additional nodes) service stations. At internal service stations, refueling is performed during the service time at the customer node, whereas the vehicles are fully refueled/recharged at external service stations. The proposed algorithm can employ different lower and upper bounding strategies, and can work as an exact or a heuristic algorithm. A dominance strategy is also presented improving the efficiency of the algorithm. Computational experiments on various-sized test instances show that the algorithm's performance is competitive with existing approaches. The author compares the results of the proposed algorithm to results obtained using a standard optimization package (CPLEX) as well as to best known solutions from the literature.

Last, but not least, the paper by Geiger from the solver challenge, entitled “On an Effective Approach for the Coach Trip with Shuttle Service Problem of the VeRoLog Solver Challenge 2015,” describes the solution approach of the winning algorithm. It provides a solution approach for the coach trip with shuttle service problem (CTSSP), a passenger transportation problem. The algorithm is based on variable neighborhood search and iterated local search. Efficient tree data structures are used for the representation of feasible solutions. The source code of the algorithm presented in this article is available online.

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## Guest Editors

Karl F. Doerner, Richard Eglese, Richard F. Hartl, and Jakob Puchinger