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Journal Pre-proof

Data-Driven Optimization for Transport and Logistics Systems

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Journal Pre-proof

Data-Driven Optimization for Transport and Logistics Systems

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The landscape of transport and logistics systems has transformed significantly due to urbanization and digitalization. The recent technological innovations and the widespread availability of massive amounts of data have created new challenges and opportunities. One of the main challenges for transport operators is to deal with large-scale and complex problems at minimal cost while satisfying the needs of service users. Operators aim at solving these complex problems in a computationally efficient way. In recent years, with the increase of demand, this task has become more challenging.

The upsurge of diverse operational data within transportation and logistics systems presents a valuable avenue. Incorporating advanced technologies into these systems is promising to pave the path for improving the already existing models. Consequently, there is a growing need to develop models and computationally efficient algorithms that are capable of leveraging the nature and volume of data available.

Our overarching objective with this special issue of the EURO Journal on Transportation and Logistics (EJTL) has been to provide a forum for novel and interdisciplinary research, emphasizing fundamentally new perspectives on the opportunities that have emerged in transport and logistics systems. In total, we received 21 submissions. After a thorough review process, five papers were accepted. The featured articles delve into diverse aspects of transport and logistics challenges, with strong ties to other applications frequently encountered in EJTL. To gain a better understanding of the focus of this special issue, we provide brief highlights of the contributing papers as follows.

(1) Silva, Pedroso and Viana consider a stochastic and dynamic last-mile delivery problem, where a company uses its fleet to make deliveries and occasional drivers in return for a small fee. This problem is challenging due to the need for swift decisions on dispatch of vehicles or occasional drivers, while the decision search space can become exceedingly vast. To tackle this, the authors present a novel deep reinforcement learning (DRL) technique that conceptualizes the problem as a sequence of interconnected states influenced by actions and transitions. The unique aspect of this DRL approach lies in its action space search methodology. Unlike previous studies that restrict action space due to the combinatorial nature of stochastic vehicle routing problems, this work formulates the action selection problem as a two-stage decision model. The first stage establishes customer delivery order, while the second stage involves routes defined by recourse,

considering scenarios and possible occasional driver assignments. The authors demonstrate the capability of the proposed approach with a numerical study.

(2) Leutwiler and Corman provide a comprehensive review about the state of the art for the application of different decomposition methods to solve problems of railway scheduling. They categorize these methods into two general principles and study both classic methods as well as recently introduced data-driven solutions. The authors investigate the mathematical principles for decomposition, which depend on the structure of the models. Based on a complementary analysis focused on solution methods, two properties have been identified; the presence of a hierarchy in the solution process, and the presence of decentralized communication within subproblems at the same level. For each type of structure, they identify different ways by which the decomposed problems are coordinated towards globally feasible and (possibly) optimal solutions. They reflect on the strength and potential for specific approaches.

(3) Heitmann, Söffker, Ulmer and Mattfeld study the operations (demand forecasting and capacity management) of dynamic ride-hailing services. They propose a combined version of value approximation function with multiple scenario approach to both forecast the demand and manage the fleet in an integrated fashion. They call the resulting method anticipatory-routing-and-service-offering (ARS). They show that the combined method significantly outperforms the individual components, improving not only the total reward but also the accepted requests. It is found that this performance is particularly high with a heavy workload and thus resources are relatively scarce. They analyse how and under which conditions the components together or individually are particularly important.

(4) Theodorou, Spiliotis and Assimakopoulos propose a data-driven framework to address the problem of inventory policy optimization at warehouse level. This approach employs advanced machine learning (ML) models to understand how inventory performance responds to demand patterns and inventory policy parameters. It is worth noting that the proposed framework is independent of specific models, relying on machine learning and forecasting methods of preference. The authors demonstrate the value of this approach by conducting extensive experiments on real-world retail industry data, coupled with indicative benchmarks. Additionally, they demonstrate that the transfer learning capabilities of the proposed ML models, enabling their widespread application, even for smaller retail companies lacking extensive data.

(5) Aslan, Ozsahin and Erdebilli solve the facility-location-allocation problem through set-covering location mathematical model coupled with machine learning methods and develop it for the problem settings of identifying electric-vehicle-charging station locations. Machine learning is employed in the proposed model to more precisely identify and determine feasible coverage sets. They demonstrate the efficiency of the proposed approach for the Capital Region of Denmark, where the green transition is part of the

political agenda and is of severe societal concern, by using the newly collected main road transportation dataset.

The exciting developments in transport and logistics systems have encouraged researchers to address a variety of problems faced by practitioners. While these five papers address distinct problems, collectively, they underscore numerous challenges and opportunities within data-driven transport and logistics systems. We hope that this special issue will serve as a useful resource for researchers and practitioners to foster new ideas, models, and solution algorithms and ultimately inspiring the advancement of more intelligent transport and logistics systems.

This special issue would not have been possible without the careful attention given by the reviewers. We would also like to thank the Editor-in-Chief, Dr. Dominique Feillet, for the opportunity and support to publish this special issue in EURO Journal on Transportation and Logistics. Finally, we sincerely thank the editorial team for their patience and continuous support.

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