Transportation Letters
The International Journal of Transportation Research

ISSN: (Print) (Online) Journal homepage: https://www.tandfonline.com/loi/ytrl20

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TRANSPORTATION LETTERS
2021, VOL. 13, NO. 3, 149–150
https://doi.org/10.1080/19427867.2021.1892950

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FOREWORD

Modeling, simulation and evaluation of transport scenarios in the presence of innovative solutions

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Today, the possibility of accessing and processing large volumes of information (the binomial Big-Data ↔ Machine- Learning/IA) has motivated the review of methodologies for analysis, planning and management of transport systems, giving also rise to new paradigms which otherwise would not have been conceived. Besides, the continuous growth of cities, the economic crises and the pressure posed by the environmental challenge are shaping the future of urban mobility. The first noticeable effect is that cities and large metropolitan areas have experienced a reduction of car-ownership. This, coupled with the unavailability of sufficient public transport coverage, has promoted new urban transport modes based on shared mobility services. Secondly, the automotive industry has launched ambitious development plans leading to the creation of autonomous vehicle fleets, combined with the transition to the use of electric vehicles.

Accordingly, conferences and technical–scientific meetings focusing on passenger transport systems have included, for some years now, specific sections dealing with the previous topics. Such has been the case at the 22nd EWGT Meeting, held in Barcelona, September 18 to 20 2019, where there were a considerable number of papers addressing these aspects, collected in specific streams (i.e. Big-Data and Machine-Learning, Shared Mobility, Innovative Solutions, Autonomous Systems Applications, Sensor and Automatic Data Collection Methods), while in many others their influence could be seen. Specifically, this special issue includes a set of selected papers drawn from the presentations at the 22nd EWGT Meeting related to the previous topics.

As a sample of how Machine-Learning based methods have extended their domain of application to transport, Martín-Baos, García-Ródenas, and Rodríguez- Benítez (2021) show in their paper the use of Kernel Logistic Regression (KLR) in the specification of Random Utility models. One of the motivations of the authors is that using Kernel Logistic Regression does not require to specify functional forms between the arguments of the utility function. They compare KLR methods with other three methods, the classical Multinomial Logit Model, Support Vector Machines and Random Forests applied to a travel mode choice problem. The authors illustrate the estimation of relevant indicators, such as the Value of Time and the Willingness to Pay, using the aforementioned methods and revealed preference data collected in Switzerland in low-density areas and with the purpose of analyzing travel behavior. In this case, Random Forests showed better predictive accuracy than KLR and Support Vector Machines, outperforming all them the Multinomial Logit Model. Using simulated data, the authors show that KLR achieves maximum accuracy for non-linear utilities while leading to an unbiased willingness-to-pay estimator. In order to reduce the intensive computational resource requirements of the Kernel Logistic Regression a suitable version of the BFGS method is proposed.

Another example of the use of Machine-Learning methods in the field of transportation modeling is the paper by Sun, Leurent, and Xie (2020). They develop a novel data-driven framework for characterizing patterns of vehicle usage from Floating Car Data. The representative mobility features were obtained by segmenting the trips in terms of time window, ravel distance, speed and the geographical sector of the trip destination. They follow a two-step identification method based first on K-means clustering and then using Latent-Dirichlet Allocation. They apply their methodology to the Paris Region and identify the main daily mobility patterns between the pericenter and surrounding areas.

Johora and Müller (2021) present two contributions for enhancing their Game-Theoretic Social Force Model initially developed in Johora and Müller (2018), intended for representing the movements of pedestrians and cars and their interactions in shared spaces. They investigate the transferability of their simulation models between different scenarios in terms of cultural aspects or traffic conditions. One of their achievements is to define a set of criteria and conditions to follow, in order to improve the transferability of models. They present their results and conclusions in a case study where the methodology is evaluated using a traffic simulation model calibrated with data from Germany and applying it to a scenario in China.

Arjona, Linares, and Casanovas (2020) study data generated by smart parking systems in order to develop predictive methods from which predictive information for parking users can be derived. They use recurrent neural network models, such as Short-Term Memory and Gated Recurrent Unit, taking into account parking occupancy and also exogenous variables related with weather and upcoming calendar events in order to yield better predictions. It must be remarked that previous neural network models have been used successfully for traffic forecasting but not for predicting parking occupancy. The data used in this work comes partially from a pilot program within the Horizon 2020 project Fastprk2, comprising amongst others the cities of Antwerp, Wattens, Paris, Grudziadz and Los Angeles.

Martínez-Díaz and Soriguera (2020) propose a data fusion algorithm using GPS data in order to correct the drift of loop detectors, which is still the most common source of traffic data in the majority of traffic agencies. Once corrected, loop detector data can be used to predict travel times using input–output diagrams. The authors assume that it would be possible to obtain samples of at least 15% of GPS tracked vehicles during heavy traffic conditions, since on-board GPS units are not uncommon today. In their paper, the authors provide a thorough discussion on the state of the art of

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travel time prediction methods. They prove the performance of their algorithm with simulated data for a wide range of parameters, such as the time period for data aggregation and sampling frequencies.

In the city logistics field, a modeling framework for the simulation of aggregated delivery tours performed by light goods vehicles is taken up by Comi, Nuzzolo, and Polimeni (2021). Their model is shown to be useful for the estimation of origin–destination matrices and routes of vehicles, as a well as for the delivery location, by means of a model calibrated using Generalized Least Squares. The modeling framework was calibrated using a dataset of light goods vehicles in the Italian region of Veneto, using available AVM data.

Gastaldi et al. (2020) apply extreme value theory (EVT) to a road safety analysis problem without the need of crash data. Authors focus on a three-leg un-signalized intersection where the left-turn maneuver from the minor road is critical, and use data from a driving simulator. They apply two methods of Extreme Value analysis: Component-wise Maxima (CM) and Excesses Over a Threshold (EOT). In the configuration under study, they analyze the case of two conflicting points and an associated measure of safety and the case of two measures of safety associated to a single point of conflict. Note that previous works using EVT considered only the case of a single conflicting point and a single measure of safety. The authors conclude that their technique allows for a better prediction of the number of collisions observed.

Caggiani, Prencipe, and Ottomanelli (2020) propose two models for the optimal distribution of vehicles at the beginning of the operating period in one-way station-based Car-Sharing Systems with a fleet of electrical vehicles that can transfer their energy by selling it to the power network, or Vehicle-to-Grid (V2G). The authors take into account imbalance of vehicles caused by one-way trip behavior, implying that a station runs out of cars, thus unsatisfying a fraction of the demand. The models are formulated as optimization problems solved using genetic algorithms, which simultaneously maximize V2G profits while keeping lost users as low as possible. They apply the models to a realistic test case for several levels of demand of the Car-Sharing system and trends in the market of energy. In Estrada et al. (2020) three types of on-demand transit systems (taxi systems and semi-flexible bus routes) are analyzed using a common modeling framework. These systems require vehicles of different capacities (from cars, to medium buses or electric trains), the modeling framework assumes ideally that trips take place on a rectangular corridor where demand density is uniformly distributed over the rectangle and streets form a perfect grid. They formulate simplified optimization models in order to achieve equilibrium between user performance and operating costs. They analyze under different scenarios (electric, diesel and autonomous vehicles). From their analysis the authors conclude that economies of scale are only achieved in the case of systems with fixed routes and variable stops. In contrast, services based on shared vehicles with variable routing would have increasing unit costs with regard to demand. In conclusion, on-demand services with flexible designs have the direct consequence of reducing the economies of scale of the transportation system and constraining the reduction of the average cost per user.

Finally, Allen et al. (2020) present an instrument for investigating the service quality in airport transport, developing a modification of the well-known Importance-Performance Analysis (IPA) method, where the importance weights are determined by Structural Equation Modeling techniques. The authors refer to this variant as Gap-IPA. They also propose a graphical representation that is more intuitive and immediate for the operators' decision-making. The case study is the International Airport of Lamezia Terme, using data from a customer satisfaction service.

Disclosure statement

No potential conflict of interest was reported by the authors.

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