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Editorial: Innovative shared transportation

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Editorial

Editorial—Innovative shared transportation

Recent technological developments—mobile computing, autonomous driving, alternative fuel vehicles, and blockchain, to name a few—have enabled numerous innovations in mobility, transportation, and logistics services. They offer unprecedented opportunities to transform conventional transportation systems, for both personal travel and freight logistics, with novel solutions. Of these solutions, those built on the emerging concept of shared economy, such as Uber, Didi, and Cargostream, have received much attention recently. The rapidly expanding scope of shared transportation services now includes ride-sourcing, ridesharing, car sharing, hitch service, flexible paratransit, shared freight delivery, shared logistics, bike sharing, shared last-mile service, parking space sharing, and so on.

How to design and operate innovative shared transportation is vital—and challenging—for all stakeholders: passengers/users, drivers/service providers, platforms, and policymakers. This Special Issue invited contributions that address the design and planning, operation, and optimization, as well as competition, synergies, and interactions of shared transportation and mobility systems. Within a span of about 18 months, we received 77 submissions from scholars around the world, with the vast majority coming from North America, Asia, and Europe. After a rigorous review process, fifteen were accepted for publication in the Special Issue, which may be classified into the following categories:

- E-hailing/ride-sourcing (Wang and Yang; Yang et al.; Ban et al.)
- Carsharing (Boyaci and Zagrofas; Xu and Meng; Jian et al.; Ripoux et al)
- Ridesharing (Li et al.; Di and Ban; Bian et al.)
- Shared logistics services (Paul et al.; Bergmann et al.; Mofidi and Pazour)
- Information sharing through Vehicle-to-Vehicle (V2V) communication (Kim et al.)
- Bikesharing (Zhang et al.)

The methodologies employed in the accepted papers include but are not limited to: mixed-integer linear programming; nonlinear programming; variational inequality; differential equations; and Markov decision process. We hope that the variety of problems and modeling approaches presented in this special issue will not only showcase the state-of-the-art of this rapidly growing research field, but also will prove pedagogically valuable to young researchers and graduate students.

For the convenience of the reader, a summary of the selected papers, in the order of their submission dates, is presented below.

- Wang and Yang propose a general modeling framework for ride-sourcing systems. They also provide a timely review of the literature on important research problems, including (1) demand and pricing, (2) supply and incentives, (3) operations, and (4) competition and regulations.
- Yang et al. propose a model that describes the online matching process in ride-sourcing markets. Using the model, they examined the impact of the matching time interval and matching radius on system performance and explore how these decision variables may be jointly optimized to cope with different levels of supply and demand.
- Paul et al. propose to reduce the online order fulfillment cost by exploiting spare capacity in the vehicles replenishing store inventories. Their problem involves choosing transfer locations and the set of stores whose online orders are transferred at these locations. A mixed integer linear programming model is presented and solved by an effective and efficient heuristic.

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- Kim et al. study the problem of information sharing and propagation among vehicles equipped with V2V communication capabilities. technologies. They formulate the problem as a continuous-time Markov chain, which is shown to converge, under appropriate conditions, to a set of clustered epidemiological differential equations.
- Boyaci and Zagrofas propose an integrated modeling framework for one-way electric carsharing systems to examine the impact of temporal and/or spatial flexibility and requests processing mechanism on profitability and utilization. They apply the framework to a realistic size system and find that spatial flexibility has a strong effect on system performance.
- Li et al. develop a path-based equilibrium model for a ridesharing problem in which traffic congestion induced by ridesharing is explicitly considered. Their model, formulated as a variational inequality problem (VIP), explicitly tracks the path information of the matched drivers and riders. A heuristic routing algorithm is proposed to solve the VIP.
- Ban et al. develop a mathematical model to analyze the relationship between the use of e-hailing transportation services and the resulting impact on congestion. Their model consists of three sub-models—e-hailing service providers, customers, and network congestion—that are connected through a "market clearance" condition. The existence of equilibrium is established under mild assumptions.
- Xu and Meng study the fleet sizing problem for one-way electric carsharing services. Their problem, formulated as a set partitioning model, aims to maximize the profit while considering vehicle relocation and charging needs. They propose a tailored branch-and-price algorithm that is capable of finding the exact optimal solution of the model.
- Di and Ban provide a theoretical framework to unify several mobility services, including ridesharing and e-haling in congested road networks. The integrated mobility system is formulated as a quasi-variational inequality problem.
- Mofidi and Pazour propose and evaluate a new hierarchical approach to peer-to-peer logistics platforms. They recast the platform's role as one providing personalized menus of requests to freelance suppliers. A bilevel optimization formulation is provided to model the two-stage decision process: the platform determines which set of requests to recommend to which suppliers, and then suppliers select which request to fulfill.
- Bergmann et al. analyze the route efficiency trade-offs that emerge from combining first-mile pickup and last-mile delivery operations in an urban distribution system. They build a new analytical model based on continuum approximation that incorporates adjustment factors accounting for the effects of integrated pickup and delivery operations. Through numerical experiments and regression analysis, they further propose a set of closed-form adjustment factors that improve existing continuum approximation-based route length estimations.
- Zhang et al. propose a dynamic pricing strategy with negative prices for bike sharing systems in order to facilitate user-based bike relocation. They develop a dynamic traffic assignment model to capture travelers' mode-path choice behavior in response to the proposed pricing strategy. A path-flow swapping algorithm is used to solve the model.
- Jian et al. study an integrated carsharing and parking-sharing service, in which a carsharing operator rents parking spaces from private owners to provide convenient parking options to car sharing users. They examine how the operator's profit and social welfare differ under the existing carsharing-only service scheme and a bundled carsharing and parking-sharing service scheme and discussed the properties of carsharing user and private-vehicle traveler choice equilibrium.
- Bian et al. study a mechanism design problem that aims to promote passenger participation in on-demand first-mile ridesharing. They propose a novel mechanism that incorporates a baseline price control component into the classical Vickrey–Clarke–Groves (VCG) mechanism. Compared to VCG, the proposed mechanism avoids unreasonably low prices, thereby preventing the carriers from running deficits. An efficient heuristic is developed to solve large-scale instances of the proposed mechanism design problem.
- Repoux et al. study the operations of a one-way station-based carsharing system with a complete journey reservation policy. Using the percentage of served demand as a primary performance measure, they analyze the effect of several dynamic staff-based relocation policies, including a new proactive relocation policy based on Markov chain dynamics that utilizes reservation information to better predict the future states of the stations.

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