Editorial
Discrete Dynamics in Transportation System

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1. Overview

A transportation system is a dynamic, diverse, random and complex system, which consists of road users, vehicles, roadway, and the environment. An efficient transportation system is essential for the function and prosperity of modern, industrialized societies, and any disturbance of the components will transform the state of the whole system.

A transportation system exhibits extremely complex behavior derived from several components: the heterogeneous nature of human behavior, highly nonlinear group dynamics, and large system dimensions. Advances in mobility are most clearly illustrated by the spread of motorized traffic and transport and the development of the transportation industry, including vehicle manufacturing and its associated infrastructure. However, because of the growth of the transportation system, it also shows some negative impacts such as the increasing number of traffic accidents, the danger of health problems due to pollution, and the possibility of economical drawbacks due to congestion problems. Therefore, to reduce these negative impacts, the current developments in the transportation system represent one of the main challenges for information science and intelligent technology.

In order to reach a more efficient and safe road usage, some innovative techniques are performing in a transportation system, for example, intelligent transportation system (ITS). ITS includes a wide and growing suite of technologies and applications, aiming at providing available services relating to different modes of transportation and traffic management and enabling various users to make safer, more coordinated, and "smarter," use of transportation system. The whole techniques of ITS can be divided into two parts:

stand-alone systems and cooperative systems. The two kinds of systems should work together to deliver the most efficient, safe, secure and comfortable journey.

To tackle the problems that were introduced before, traffic on an urban transportation system can be considered as a dynamical system. In recent years, some researches based on chaos theory were used to describe the traffic flow. Nonlinear chaotic phenomena was found in the short-term traffic flows, and even some implications were discussed for urban and transportation planning and forecasting. Period doubling, intermittency, and quasiperiodicity would make the transportation system into chaotic. The chaotic traffic flow model is a macroscopic model, which was established by adopting car following model. The model is a discrete and dynamic one derived from both the flow-density-speed fundamental diagram and the Greenshield's model, which use occupancy as variable and the ratio of free flow and average speed as control parameter.

With the development of society, the transport system shows a high complex and variational scene and enormous stochasticity. Various transportation problems and activities, such as accidents, unreasonable control signal, and temporary society actives, are derived from nonlinear singular factors which are the main causes of the stochasticity. This stochasticity can be defined as the impedance of the path. Consequently, the problem proposed how to find out the expected shortest path in a transport network, where the link travel times are modeled as a continuous-time stochastic process. The famous approaches for solving the problem are the Bellman's dynamic programming method for directed networks, the Dijkstra labeling method, and Bellman-Ford successive approximation method for networks with

nonnegative cost coefficients. Some important applications of the path optimization problem include vehicle routing in transportation systems, traffic routing in communication networks, and path planning in robotic systems.

Discrete optimization is a specific branch of optimization in applied mathematics and computer science. A very well-known application area of discrete optimization is a rail transport system. It helps us to plan and optimize the railroad network, in particular, the computation of the line plans, train schedules, and schedules of rolling stock. For example, the line planning consists in choosing a set of operating lines and its frequencies to serve the passenger demand and to optimize some given objective. However, the process of privatization of state-owned railroads enforces the efficient resource utilization. For this reason, cost-optimal line planning is modeled. Besides the routes and the frequencies, in the cost-optimal line planning approach, one has to find the optimal number of coaches per train, based on trivial estimates of the circulation of rolling stock.

To solve problems of a transportation system, next to optimization also human behavior plays a crucial role. Among various disturbances of transportation system, the reliability of human action in transportation system plays a crucial role in optimizing both person-task fit and safety issues. According to the result of all investigations over the world, accidents are to be led back to more than 95% exclusively on the driver's behavior. Disturbances such as human error can make the transportation system into a variety of unreliable state. On the basis of the measuring system disturbances, the unstable state can be defined as varying degrees of safety, such as conflict, near accident, or accident. Certainly, an unreliable transportation system can also transform into a reliable state by compensate strategies in safety efforts. The advanced driver assistance systems (ADASs) is such a subsystem of ITS, which helps drivers in perception, decision making, and action while driving and enhances the possibility of human error compensation, such as collision warning systems, lane departure warning systems, adaptive cruise control system (ACC), vision enhancement, and pedestrian detection.

The focus of this special issue is to foster links between basic and applied research relating to discrete dynamics problems in a transportation system. We invite original contributions on all topics in both new theoretical developments and studies of practical implementations, which propose and study novel dynamic and diverse models to reveal the mechanism of transportation system. The topics include intelligent transportation system (ITS), dynamic problem in urban transport system, transit and rail systems operation, application of chaos in traffic flow, discrete and stochastic theory of transport system, vehicle active safety and intelligent vehicle, discrete optimization methods in traffic system, traffic operations, management and control, energy, transport policy and economics, driving behavior, and driver assistance system.

2. Summary

An efficient and safe transportation system is essential for the function and prosperity of modern society. Nowadays, we have benefited from the rapid development of the transportation industry. However, we also have to suffer from serious problems in transportation. Therefore, many researchers are seeking solutions to make a transportation system more efficient and improve the operations by using new technologies and new methodologies.

The analyzing, testing, modeling, and simulating of a transportation system and the state-of-the-art technologies will collectively improve the accidents, congestion, and pollution emissions problem of the transportation system.

This special issue aims at understanding the discrete state modeling the dynamic changes of the transportation system and finding a more reliable compensating approach to enhance the safety and efficiency of the transportation system. We believe that the papers in the special issue could be a representative study in the field of intelligent transportation system and help for a heuristic understanding of the current development in the field of transportation safety.

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