Editorial

James Tannock

Nottingham University Business School,
Business School Centre, Jubilee Campus,
Nottingham NG8 1BB, UK
E-mail: James.D.Tannock@nottingham.ac.uk

Cheng-Lung Wu

Department of Aviation,
University of New South Wales,
Kensington NSW 2052, Australia
E-mail: C.L.Wu@unsw.edu.au

Biographical notes: James Tannock is Reader in Quality and Operations Management at Nottingham University Business School. An engineer with industrial experience in manufacturing, his research interests include quality management, supply networks and simulation. He is involved in major international research projects in supply chain simulation, working with leading aerospace manufacturers. He has authored more than 120 published works, acts as reviewer for many leading international journals and is member of the editorial boards of journals including the *Journal of Manufacturing Technology Management* and *World Review of Intermodal Transportation Research*.

Cheng-Lung Wu is a Senior Lecture in the Department of Aviation at the University of New South Wales, Sydney Australia. He has worked for transport authorities and airports before joining UNSW and has provided consultancy services to the aviation industry in the fields of operations and delay management since 2001. His research interest includes airline operations research, airport operations research, airline network modelling, and aviation-related tourism issues. He teaches airline operations, scheduling and airline resources management for undergraduate students.

Transportation networks studies have been challenging both the transportation industry and academia for decades. The challenge is rooted in the complexity and characteristics of man-made transportation networks such as large network scale, interactions between networks and vehicles, individual user/vehicle behaviour, dynamic and stochastic flows in the network, limited (and expensive to grow) network capacity and congestion management. It is often difficult or impossible to experiment with real transportation systems, to determine improved or optimal solutions. Analytical models of transportation problems can only partially explain and solve real-world problems and this is usually only achieved with significant simplifications to the models, which make them less representative of the real world.

However, with advances in computing, computer simulation has been widely used in recent years to model and solve large-scale transportation problems. Advanced simulation modelling techniques have been developed and widely employed in transportation. Applications of simulation vary widely and present a fascinating range of scenarios and techniques. Hence, this special issue of WRITR presents a number of papers selected to explore the latest trends in the development and application of computer simulation for transportation studies. The papers describe the development and use of simulation techniques, simulation methodologies and case studies in the application of simulation, to solve key types of real-world transportation problems.

In recent years, port capacity has become a major factor in international maritime trade. The paper by Lee et al. addresses the capacity constraint faced by many busy ports around the world, in particular the impact on the port capacity (measured by the throughput of the system) placed by the constraints of vessel movements in the port access channels. The definition of the channel impact is the throughput loss due to vessel movement constraints due to the 'marine guidelines' of a port. Two performance measures are developed to evaluate the port system performance with and without movement constraints in port channels. The former scenario is the current system under marine guidelines and the latter is the 'naive scenario' in which no constraints are imposed on vessel movements in a port channel. A simulation model is developed to model the complex interaction between vessels in the channel under different scenarios of marine guidelines and berthing prioritisation rules for different vessel types. This work demonstrates how the port capacity can be measured (or estimated) using a simulation model and further be used to evaluate how the 'relaxation' of some key components in the system may help identify the loss due to constraints on those components.

Continuing the maritime theme, the paper by Huynh and Walton is focused on modelling marine container terminals that use yard cranes to stack containers. The growing concern over the constrained container terminal capacity and ways to reduce container processing delays are addressed by using a simulation model developed using a commercial simulation package, Arena. Unlike other analytical models on container terminal processes, Huynh and Walton utilise the simulation model as a decision-support tool to assist in answering operational questions, such as the number of cranes needed to reduce truck turn time to a satisfactory level. Often missing in the literature of simulation modelling, are the details of designing and implementing the simulation model. In this paper, the authors have provided us with details to assist researchers and practitioners to develop their own models, including: specifying individual components of the simulation model, logic flows of simulation, truck processing flows at the terminal, and simulation parameter validation. The latter is provided in the Appendix, at the request of reviewers. Though the detail now given in the paper, it is hoped that this paper will not only demonstrate how simulation models are utilised in maritime decision-making and operational modelling, but also disseminate key details needed by the researchers and practitioners to efficiently deploy simulation models.

Simulation is an important technique in the study of ground transportation, and the paper by Yang et al. demonstrates how a simulation model can be utilised to estimate the cost effectiveness of the Freeway Service Patrols, a key component of Incident Management approach to swiftly react to incidents on freeways and mitigate the negative impacts on road users. In this paper, CORSIM is utilised as the foundation of the simulation. In particular, the authors explain the input parameters to CORSIM, as well as how these input parameters can potentially change the model output, if CORSIM were treated as a 'black-box' simulation tool. This extra effort helps clarify some important perennial issues in simulation model building, namely model specification and validation. The developed simulation model is used to generate simulated traffic and its response under the 'with-incident' scenario and the without-incident one. This paper, together with the papers by Lee et al. and by Huynh and Walton has shown the advanced use of simulation models, not only in representing complex interactions among system components, but also the value in conducting sensitivity analysis and supporting decision making.

Road traffic transportation, but considered on a different scale, is also the topic of Vladisavljevic et al., who illustrate the use of simulation to study the topic of driver impairment – in particular, the impairment due to distraction caused by the use of a cellphone while driving. This is a topical issue which has generated much public concern and literature in recent years. This paper focuses on car-following behaviour, and illustrates a type of highly-detailed study in which psychological research is used to inform a 'microscopic' simulation of human behaviour while driving an individual vehicle. VISSIM is used as the simulation software. To examine and improve the validity of the simulation, much attention is paid to simulation model calibration through parameter setting, with the use of Genetic Algorithms to optimise the model parameters. Results are provided which confirm the simulation validity and illustrate that the impaired driver may not be well modelled by current microsimulation tools.

Inland waterway transportation is the topic of the paper by Wang, a valuable work that addresses two goals: namely network generality in building a simulation model and application generality in deploying the model. Usually, a simulation model is built on an ad-hoc basis for specific conditions due to model assumptions and aimed at specific targets. When one needs to transfer the built model to, say a new target with different attributes, one needs to reconfigure by modifying the model itself. This is time-consuming and requires expensive simulation expertise. Hence, the immediate contribution of this paper by Wang is the data-driven nature of the model-building approach. This is achieved by the separation of the system configuration from simulation model development. Much detail is provided, including the network labelling and numbering system, simulation flows, statistically sampling by Monte Carlo and computer memory management during the run time of the simulation. The methodology is employed by Wang on modelling an inland waterway system in the USA that has lock and dam structures, creating stepped pools for navigation. As with other work described in this special edition, the simulation model is used to help decision making by improving the system performance (reducing delays) and evaluating potential lock expansion projects.

Railways remain one of the most important modes of transportation, world-wide, for passengers, freight and bulk raw materials. It is the last of these which concern Saranen and Hilmola: their paper addresses timber transportation from the forests of Finland to pulp and paper mills. The paper explains the use of simulation to evaluate the business competitiveness of a new service concept in timber transportation. This simulation study is firmly placed in the economic and business context of the increasing de-regulation of the European railway systems. The discrete-event simulation software Quest, popular in Europe, is used to prepare models of a 'unit-train' concept, which incorporates structure and traffic management, route planning and dispatching rules and a cost model, for which detailed costs are provided. Results show a simulated cost breakdown and utilisations of trains. This simulation shows how simulation models may be used to examine new transportation business opportunities which do not currently exist and to compare these with current methods and other modes of transportation.

The paper by Lundell et al. approaches the area of transportation simulation from another angle – that of computer science. This paper does not focus upon a particular transportation mode, although it outlines possible applications in several fields. Instead, it focuses upon simulation design for Sense and Respond Logistics (SARL); an inherently intermodal concept. The authors see the primary application of their work in military logistics, in which multi-agent simulation offers the opportunity to deal with the complexity, uncertainty and heterogeneity. The authors present a formal approach to the design of SARL simulation which provides, for example, for the simulation to encompass issues of communications uncertainty and encryption. The approach used is briefly described in terms of an architectural description language represented in eXtensible Markup Language (XML). The editors thought long and hard before including this paper, having concerns about whether the WRITR readership would appreciate the technical content in the final section. However, we decided that readers should be interested in a reasonably accessible contribution from computer scientists, describing the issues which must be considered in the basic design of an increasingly popular modern simulation technology.

This special issue aimed to present a range of new and current approaches to simulation of transportation systems. It has not been possible to provide coverage of all of the many transportation modes which are available, and the editors were not offered any papers specifically describing intermodal simulation studies. Indeed, despite the attention currently paid to this area, it would be valuable if a larger group of transportation researchers were prepared to apply the many powerful techniques of simulation in an intermodal context.