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Jaume Barceló
Editor

Fundamentals of Traffic Simulation

 Springer

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“When I use a word”, Humpty Dumpty said, in rather a scornful tone, “it means just what I choose it to mean – neither more nor less.”

“The question is”, said Alice, “whether you can make words mean so many different things.”

Lewis Carroll, *Through the Looking Glass*, (Chapter IV, Humpty Dumpty)

“¿Qué gigantes?” dijo Sancho Panza.

“Aquellos que allí ves,” respondió su amo, “de los brazos largos, que los suelen tener algunos de casi dos leguas.”

“Mire vuestra merced,” respondió Sancho, “que aquellos que allí se aparecen, no son gigantes sino molinos de viento, y lo que en ellos parecen brazos son las aspas, que, volteadas del viento, hacen andar la piedra del molino.”

Miguel de Cervantes, *El Quijote*, Capítulo VIII – Del buen suceso que el valeroso Don Quijote tuvo en la espantable y jamás imaginada aventura de los molinos de viento, con otros sucesos dignos de felice recordación.¹

¹ *“What giants?” said Sancho Panza.*

“Those you see there,” answered his master, “with the long arms, and some have them nearly two leagues long.”

“Look, your worship,” said Sancho. “What we see there are not giants but windmills, and what seem to be their arms are the vanes that turned by the wind make the millstone go.”

Miguel de Cervantes: *Don Quixote* (1605) Chapter VIII, Of the good fortune which the valiant Don Quixote had in the Terrible and Undreamed-of Adventure of the Windmills, with Other Occurrences Worthy to be Fitly Recorded

Preface

The increasing power of computer technologies, the evolution of software engineering and the advent of the intelligent transport systems has prompted traffic simulation to become one of the most used approaches for traffic analysis in support of the design and evaluation of traffic systems. The ability of traffic simulation to emulate the time variability of traffic phenomena makes it a unique tool for capturing the complexity of traffic systems.

In recent years, traffic simulation – and namely microscopic traffic simulation – has moved from the academic to the professional world. A wide variety of traffic simulation software is currently available on the market and it is utilized by thousands of users, consultants, researchers and public agencies. Microscopic traffic simulation based on the emulation of traffic flows from the dynamics of individual vehicles is becoming one the most attractive approaches.

However, traffic simulation still lacks a unified treatment. Dozens of papers on theory and applications are published in scientific journals every year. A search of simulation-related papers and workshops through the proceedings of the last annual TRB meetings would support this assertion, as would a review of the minutes from specifically dedicated meetings such as the International Symposiums on Traffic Simulation (Yokohama, 2002; Lausanne, 2006; Brisbane, 2008) or the International Workshops on Traffic Modeling and Simulation (Tucson, 2001; Barcelona, 2003; Sedona, 2005; Graz 2008). Yet, the only comprehensive treatment of the subject to be found so far is in the user’s manuals of various software products.

The purpose of this book is to fill in the gaps and to provide practitioners and researchers with a unified, comprehensive framework for the following:

- Simulation as a well-established and grounded OR technique and its specificities when applied to traffic systems
- The main approaches to traffic simulation and the principles of traffic simulation model building
- The fundamentals of traffic flow theory and its application to traffic simulation
 - Microscopic traffic modeling
 - Mesoscopic traffic modeling
 - Macroscopic traffic modeling

- The principles of dynamic traffic assignment and its application to traffic simulation
- The calibration and validation of traffic simulation models

To achieve these goals the main traffic simulator developers have been invited to contribute a chapter in which each of them describes the following:

Their approach to model building

Which are their fundamental core models – car following, lane changing, etc. – and how they have been implemented

How they deal with dynamic traffic assignment

The proposed methodology for the calibration and validation of traffic simulation models

Which extended modeling capabilities they have with user applications

Additionally, the material is complemented by a selected overview of advanced case studies and applications.

The list of contributions is not exhaustive; it would have exceeded the planned length of the book and there are a few significant missing software packages (Dynasmart and VISTA), due to reasons beyond our control, but all major players in this game are present. Microscopic approaches are represented by VISSIM, AVENUE, Paramics, Aimsun, MITSIM, SUMO, and DRACULA. Mesoscopic approaches are represented by Dynameq and Dynamit, and METANET as a conspicuous representative of macroscopic traffic modeling.

Barcelona, Spain

Jaume Barceló

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