

Preface

This book focuses on recent developments in dynamic network modeling (DNM) including aspects of route guidance and traffic control as it relates to transportation systems and other complex infrastructure networks. Dynamic network modeling is generally understood to be the mathematical modeling of time-varying vehicular flows on networks in a fashion that is consistent with established traffic flow theory and travel demand theory. Presently, we estimate that there are approximately 250 scholars around the globe actively involved in research, demonstrations, and applications pertaining to the body of knowledge related to various aspects of dynamic network modeling.

The area of DNM is a very active one. It is not only a purely research area but also an area with important social impacts because it can provide real-world solution that will improve the efficiency of our transportation systems without having to build new roads. Some of the important findings are:

1. There are many theoretical and practical aspects of the “Dynamic Route Guidance and Control” problem that are being addressed by academicians, private sector, and transportation agencies as evidenced from the list of presenters at the workshop.
2. Development of realistic and robust mathematical models of traffic flow, control, dynamic traffic assignment, and data processing needed for the development and deployment of effective route guidance and control systems remains as major challenges.
3. Different control strategies such as congestion pricing, traffic responsive signals, diversion during nonrecurrent congestion, and speed control for different transportation facilities are some important examples of real-time control strategies that are needed. However, it is important to ensure that the deployed control strategy would work in real time under real-world conditions. This requires extensive off-line evaluation of the capabilities of underlying control and guidance models and strategies.
4. Increasingly, the private sector is involved in the collection and dissemination of traffic information for real-time control of transportation systems throughout

the world. However, their current contribution to the research and development of advanced systems is rather limited. Better coordination between the private sector and academia will be very productive. Similarly, public agencies that are the owners of transportation systems also need to better interface with academia and the private sector to be able to expedite the deployment of these “Dynamic Route Guidance and Control” systems that will drastically improve the efficiency of their transportation networks.

5. Real-time collection of speed, travel time, flow, and other traffic data over very large transportation networks remains to be a major challenge that is being tackled by private companies and academicians. More work is needed to ensure reliability and accuracy of the collected traffic data.
6. This is a long-term and wide-ranging research area that spans between the control of individual vehicles and large multimodal transportation networks. Moreover, successful development of such real-time online control and guidance systems requires the interfacing of algorithms, software, and hardware in such a way that the resulting system is robust and reliable. Thus, major research, development, and deployment investment are needed to successfully implement dynamic network models.

Dynamic network modeling as a field has grown over the last 30 years with contributions from various scholars all over the field. The basic problem which many scholars in this area have focused is related to the analysis and prediction of traffic flows satisfying notions of equilibrium when flows are changing over time. In addition, recent research has also focused on integrating dynamic equilibrium with traffic control and other mechanism designs such as congestion pricing and network design. Recently, advances in sensor deployment, availability of GPS enabled vehicular data and social media data have rapidly contributed to better understanding and estimating the traffic network states and have contributed to new research problems which advance previous models in dynamic modeling.

This book mainly contains some of the papers presented at the National Science Foundation workshop on “Dynamic Route Guidance and Traffic Control” which was organized on June 7–8, 2010 at Rutgers University by Prof. Kaan Ozbay, Prof. Satish Ukkusuri, Prof. Hani Nassif, and Prof. Pushkin Kachroo. This workshop brought together various experts in this area from universities, industries, and federal/state agencies to present recent findings in this area. Various topics were presented at the workshop including dynamic traffic assignment, traffic flow modeling, network control, complex systems, mobile sensor deployment, intelligent traffic systems, and data collection issues. This book is motivated by the research presented at this workshop and the discussion that followed where a volume that summarizes recent advances in the aforementioned areas was seen as an important book. The organizers invited a select set of researchers to contribute chapters to this book. More than 15 scholars from U.S. universities and abroad have accepted to write manuscripts for this book. The book focuses on recent methodological advances and application of dynamic network modeling to transportation systems. The book is divided into four sections:

1. *Recent Algorithms in Dynamic Routing and Guidance*: A fundamental problem in dynamic modeling is to develop dynamic routing algorithms which consider various data sources and uncertainties in the system.
2. *Methodological Advances in Dynamic Network Assignment and Traffic Control*: In this section, various papers related to recent mathematical programming formulations for dynamic modeling will be compiled.
3. *Applications of Dynamic Network Modeling*: In this section, papers related to various applications from evacuation and simulation-based modeling will be compiled.
4. *Data Needs for Real-Time: Dynamic Route Guidance and Traffic Control*: In this section, papers related to data needs and availability for the successful implementation of real-time control and routing algorithms will be compiled.

The papers that were selected for this book were rigorously reviewed by various experts in this field. We thank all authors who submitted their work for consideration. In addition, we thank the dozens of referees for their important work in reviewing the papers. We would also like to acknowledge the financial support provided for the Dynamic Route Guidance and Traffic Control Workshop by NSF's Civil, Mechanical, and Manufacturing Innovation Division of the Directorate for Engineering under the award #0951147 and Professor Robert L. Smith who was the NSF program manager and made major contributions to the content and success of the workshop. Additional information about the NSF workshop is available at <http://ritslab.rutgers.edu/agenda.html>. Special thanks go to Prof. Terry Friesz and editors of Springer for graciously allowing us to edit this book.

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