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A Multi-Agent Simulation of Collaborative Air Traffic Flow Management 357

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Section I Reproducing Traffic

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<i>Takeshi Takama, University of Oxford, Stockholm Environment Institute, UK</i>	

This chapter discusses congestion and adaptation by means of a multi-agent system (MAS) aiming to analyze real transport and traffic problems. The chapter contribution is both a methodological discussion and an empirical case study. The latter is based on real stated-preference data to analyze the effect of a real road-user charge policy and a complimentary park and ride scheme at the Upper Derwent Valley in the Peak District National Park, England.

Chapter II

A Multi-Agent Modeling Approach to Simulate Dynamic Activity-Travel Patterns	36
<i>Qi Han, Eindhoven University of Technology, The Netherlands</i>	
<i>Theo Arentze, Eindhoven University of Technology, The Netherlands</i>	
<i>Harry Timmermans, Eindhoven University of Technology, The Netherlands</i>	
<i>Davy Janssens, Hasselt University, Belgium</i>	
<i>Geert Wets, Hasselt University, Belgium</i>	

The authors discuss an agent-based modeling approach focusing on the dynamic formation of (location) choice sets. Individual travelers learn through their experiences with the transport systems, changes in the environments and from their social network, based on reinforcement learning, Bayesian learning, and social comparison theories.

Chapter III

MATSim-T: Architecture and Simulation Times	57
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Michael Balmer, IVT, ETH Zürich, Switzerland

Marcel Rieser, VSP, TU Berlin, Germany

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Kai Nagel, VSP, TU Berlin, Germany

This chapter tackles micro-simulation by discussing design and implementation issues of MATSim, as well as an experiment in which this simulator is used to study daily traffic in Switzerland.

Chapter IV

TRASS: A Multi-Purpose Agent-Based Simulation Framework for Complex Traffic

Simulation Applications	79
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Ulf Lotzmann, University of Koblenz, Germany

Continuing the discussion around microscopic simulation, in this chapter, the TRASS simulation framework, a multi-layer architecture, is presented and evaluated in the context of several application scenarios.

Chapter V

Applying Situated Agents to Microscopic Traffic Modelling	108
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Paulo A. F. Ferreira, University of Porto, Portugal

Edgar F. Esteves, University of Porto, Portugal

Rosaldo J. F. Rossetti, University of Porto, Portugal

Eugénio C. Oliveira, University of Porto, Portugal

In this chapter, a multi-agent model is proposed aiming to cope with the complexity associated with microscopic traffic simulation modelling. Using a prototype with some of the features introduced, the authors discuss scenarios using car-following and lane-changing behaviours.

Chapter VI

Fundamentals of Pedestrian and Evacuation Dynamics	124
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Andreas Schadschneider, Universität zu Köln, Germany

Hubert Klüpfel, TraffGo HT GmbH, Bismarckstr, Germany

Tobias Kretz, PTV AG, Germany

Christian Rogsch, University of Wuppertal, Germany

Armin Seyfried, Forschungszentrum Jülich GmbH, Germany

The authors of this chapter investigate the behaviour of pedestrians and human crowds, focussing on aspects related to physical movement. It thus starts with a review of methods and approaches, and continue with a discussion around validation issues, aiming at reducing the gap between the multi-agent and pedestrian dynamics communities.

Chapter VII

“Social Potential” Models for Modeling Traffic and Transportation..... 155

Rex Oleson, University of Central Florida, USA

D. J. Kaup, University of Central Florida, USA

Thomas L. Clarke, University of Central Florida, USA

Linda C. Malone, University of Central Florida, USA

Ladislau Boloni, University of Central Florida, USA

This chapter discusses the “Social Potential” model for implementing multi-agent movement in simulations by representing behaviors, goals, and motivations as artificial social forces.

Chapter VIII

Towards Simulating Cognitive Agents in Public Transport Systems 176

Sabine Timpf, University of Augsburg, Germany

In this chapter, Sabine Timpf presents a vision for simulating human navigation within the context of public, multi-modal transport, showing that cognitive agents require the provision of a rich spatial environment. She introduces spatial representations and wayfinding as key components in the model. She illustrates her vision by a case study that deals with multi-modal public transport.

Section II

Intelligent Traffic Management and Control

Chapter IX

An Unmanaged Intersection Protocol and Improved Intersection Safety for Autonomous Vehicles 193

Kurt Dresner, University of Texas at Austin, USA

Peter Stone, University of Texas at Austin, USA

Mark Van Middlesworth, Harvard University, USA

This chapter presents two extensions of a system for managing autonomous vehicles at intersections. In the first, it is demonstrated that for intersections with moderate to low amounts of traffic, a completely decentralized, peer-to-peer intersection management system can reap many of the benefits of a centralized system without the need for special infrastructure at the intersection. In the second extension, it is shown that the proposed intersection control mechanism can mitigate the effects of catastrophic physical malfunctions in autonomous vehicles.

Chapter X

Valuation-Aware Traffic Control: The Notion and the Issues..... 218

Heiko Schepperle, Universität Karlsruhe (TH), Germany

Klemens Böhm, Universität Karlsruhe (TH), Germany

Providing services and infrastructure for autonomous vehicles at intersections is also the topic of this chapter in which the authors describe an agent-based valuation-aware traffic control system for intersections. Their approach combines valuation-aware intersection-control mechanisms with driver-assistance features such as adaptive cruise and crossing control.

Chapter XI

Learning Agents for Collaborative Driving 240

Charles Desjardins, Laval University, Canada

Julien Laumônier, Laval University, Canada

Brahim Chaib-draa, Laval University, Canada

Collaborative driving is the focus of this chapter. The authors describe an agent-based cooperative architecture that aims at controlling and coordinating vehicles, also showing that reinforcement learning can be used for this purpose.

Chapter XII

Traffic Congestion Management as a Learning Agent Coordination Problem 261

Kagan Tumer, Oregon State University, USA

Zachary T. Welch, Oregon State University, USA

Adrian Agogino, NASA Ames Research Center, USA

The authors of this chapter tackle the issue of how road users can learn to coordinate their actions with those of other agents in a scenario without communication. Further, the authors explore the impacts of agent reward functions on two traffic related problems (selection of departure time and selection of lane).

Chapter XIII

Exploring the Potential of Multiagent Learning for Autonomous Intersection Control 280

Matteo Vasirani, University Rey Juan Carlos, Spain

Sascha Ossowski, University Rey Juan Carlos, Spain

In this chapter, the authors discuss multiagent learning in the context of a coordination mechanism where teams of agents coordinate their velocities when approaching the intersection in a decentralized way, improving the intersection efficiency.

Chapter XIV

New Approach to Smooth Traffic Flow with Route information sharing 291

Tomohisa Yamashita, National Institute of Advanced Industrial Science and Technology (AIST), Japan

Koichi Kurumatani, National Institute of Advanced Industrial Science and Technology (AIST), Japan

The authors of this chapter propose a cooperative car navigation system with route information sharing, based on multi-agent simulation. They use a scenario from Tokyo in which drivers can share information about their route choices. Results have confirmed that the mechanism has reduced the average travel time of drivers sharing information and that the network structure influenced the effectiveness of the mechanism.

Chapter XV

Multiagent Learning on Traffic Lights Control: Effects of Using Shared Information 307

Denise de Oliveira, Universidade Federal do Rio Grande do Sul, Brazil

Ana L. C. Bazzan, Universidade Federal do Rio Grande do Sul, Brazil

Exchange of information is also tackled in this chapter, this time by traffic signal agents. Authors show that these agents can learn better than independent ones, by sharing information about their environment.

Section III Logistics and Air Traffic Management

Chapter XVI

The Merit of Agents in Freight Transport 323

Tamás Máhr, Almende/TU Delft, The Netherlands

F. Jordan Srouf, Rotterdam School of Management, Erasmus University, The Netherlands

Mathijs de Weerd, TU Delft, The Netherlands

Rob Zuidwijk, Rotterdam School of Management, Erasmus University, The Netherlands

In this chapter, the authors apply agent-based solutions to handle job arrival uncertainty in a real-world scenario. This approach is compared to an on-line optimization approach across four scenarios, with the results indicating that the agent-based approach is competitive.

Chapter XVII

Analyzing Transactions Costs in Transport Corridors Using Multi Agent-Based Simulation 342

Lawrence Henesey, Blekinge Institute of Technology, Sweden

Jan A. Persson, Blekinge Institute of Technology, Sweden

This chapter deals with the use of agent-based simulation for modelling the organisational structure and mechanisms in the context of regional transport corridors. A special focus is put on the accurate conceptualization of costs.

Chapter XVIII

A Multi-Agent Simulation of Collaborative Air Traffic Flow Management	357
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Shawn R. Wolfe, NASA Ames Research Center, USA

Peter A. Jarvis, NASA Ames Research Center, USA

Francis Y. Enomoto, NASA Ames Research Center, USA

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*Bart-Jan van Putten, USRA-RIACS/Delft University of Technology, The Netherlands and
NASA Ames Research Center, USA*

Kapil S. Sheth, NASA Ames Research Center, USA

Collaborative air traffic flow management is the topic of this chapter. This chapter describes the design and methodology of a multi-agent simulation for this problem. This is then used to evaluate several policies for the management of air traffic flow.

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