Preface

The increasing demand for mobility in the 21st century poses a challenge to researchers from several fields to devise more efficient traffic and transportation systems designs, including control devices, techniques to optimize the existing network, and also information systems. More than ever, interdisciplinary approaches are necessary. A successful experience has been the cross-fertilization between traffic, transportation, and artificial intelligence that dates at least from the 1980s and 1990s, when expert systems were built to help traffic experts control traffic lights. Also, information on how to combine parking and public transportation can be provided by intelligent systems, and transportation and logistics have also benefited from artificial intelligence techniques, especially those tied to optimization.

During the last decade, there has been a tremendous progress in traffic engineering based on agent technology. However, given the increasing complexity of those systems, a product of the modern way of life and new means of transportation, the individual choices must be better understood if the whole system is to become more efficient. Thus, it is not surprising that there is a growing debate about how to model transportation systems at both the individual (micro) and the society (macro) level. This may raise technical problems, as transportation systems can contain thousands of autonomous, intelligent entities that need to be simulated and/or controlled. Therefore, traffic and transportation scenarios are extraordinarily appealing for (multi-)agent technology.

Additionally, traffic scenarios became very prominent as test beds for coordination or adaptation mechanisms in multi-agent systems. Many examples of successful deployments of tools and system exist.

This book is a collection of contributions addressing topics that arose from a cross fertilization between traffic engineering and multi-agent system. Hence, this book summarizes innovative ideas for applications of different agent technologies on traffic and transportation related problems.

technology, and improving the management via control techniques. The set of all these measures is framed as Intelligent Transportation Systems (ITS).

Artificial intelligence and multi-agent techniques have been used in many stages of these processes. During the last decade, there has been a tremendous progress in traffic engineering based on agent technology. The approaches can be classified into three levels: integration of heterogeneous traffic management systems, traffic guidance, and traffic flow control.

The first of these levels is discussed in several papers, for example the platform called Multi-Agent Environment for Constructing Cooperative Applications - MECCA/UTS – (Haugeneder & Steiner, 1993), as well as in Ossowski et al. (2005), in Rossetti and Liu (2005), and in van Katwijk et al. (2005).

Regarding traffic guidance, it is generally believed that information-based ITS strategies are among the most cost-effective investments that a transportation agency can make. These strategies, also called Advanced Traveler Information Systems (ATIS), include highway information, broadcast via radio, variable message systems, telephone information services, Web/Internet sites, kiosks with traveler information, and personal data assistant and in-vehicle devices. Many other new technologies are available now to assist people with their travel decisions. Multi-agent techniques have been used for modeling and simulation of the effects of the use of these technologies, as well as the modeling of behavioural aspects of the drivers and their reaction to information. Details can be found in Balmer et al. (2004), Bazzan and Klügl (2005), Bazzan et al. (1999), Burmeister et al. (1997), Elhadouaj et al. (2000), Klügl and Bazzan (2004), Klügl et al. (2003), Paruchuri et al. (2002), Rigolli and Brady (2005), Rossetti et al. (2002), Tumer et al. (2008), and Wahle et al. (2002).

Regarding the third level mentioned above – traffic control – a traffic control loop was proposed by Papageorgiou (2003). It applies to any kind of traffic network if one is able to measure traffic as the number of vehicles passing on a link in a given period of time. With the current developments in communication and hardware, computer-based control is now a reality. The main goals of Advanced Transportation Management Systems (ATMS) are: to maximize the overall capacity of the network; to maximize the capacity of critical routes and intersections which represent the bottlenecks; to minimize the negative impacts of traffic on the environment and on energy consumption; to minimize travel times; and to increase traffic safety. In order to achieve these goals, devices to control the flow of vehicles (e.g. traffic lights) can be used. However other forms of control are also possible. For classical approaches please see: TRANSYT (Robertson, 1969; TRANSYT-7F, 1988), SCOOT (*Split Cycle and Offset Optimization Technique*) (Hunt et al., 1981), SCATS (*Sydney Coordinated Adaptive Traffic System*) (Lowrie, 1982), and TUC (*Traffic-responsive Urban Traffc Control*) (Diakaki et al., 2002). Regarding the use of multiagent systems, some work in this area can be found in Bazzan (2005), Bazzan et al. (2008), Camponogara and Kraus (2003), Dresner and Stone (2004), France and Ghorbani (2003), Nunes and Oliveira (2004), Oliveira et al. (2004), Oliveira et al. (2005), Rochner et al. (2006), Silva et al. (2006), Steingrover et al. (2005), Wiering (2000).

ORGANIZATION OF THE BOOK

The book is organized into three parts. The first is a collection of chapters that focus on agent-based simulation of transportation and traffic scenarios for traffic reproduction, both for vehicular traffic and pedestrian traffic. A second section is a compilation about traffic control and management, mainly using traffic lights. A third part deals with agent-based approaches for related themes such as air traffic management and logistics.

A brief description of each of the chapters follows, starting with those in Section I.