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Some directions for traffic flow modeling, simulation and control in transportation networks.

Preface of the “Symposium on modeling, simulation and optimization of transportation networks” - Rhodes, 2014.

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This session of ICNAAM is devoted to traffic flow modeling, simulation and optimization in transportation networks. Thirteen long abstracts have been selected for presentation at ICNAAM 2014 in Rhodes, based on a peer review process. Most of the selected articles treat traffic models for road networks, and three streams are distinguished in the whole work of the contributions: A - traffic modeling, B- traffic simulation, and B- traffic control.

The key question in modeling, simulation and optimization of transportation networks is how to revise and renew the existing traffic flow models, in order to improve them and increase their relevance and applicability in the context of new technologies of information and communication, and of new advanced engineering software and grid computation technologies. In term of numerical simulation, the gains in computation speed and the improvements of the storage capacities, added to the advancements in the field of parallel computing, will permit the development of adequate sophisticated numerical schemes. The multiplicity of the sources of traffic data, their availability in big quantities, and the improvements in their reliability will facilitate the task of calibrating and validating the models. In term of traffic control, the trend will be the development of models interacting with real time measurements, including machine learning techniques. Moreover, the models will interact also with the users of transportation networks by taking into account their reaction to the control. The guidance of users in a road traffic network is probably the best example here.

Various approaches of traffic modeling are broached in this session. Kerner presents a criticism of generally accepted fundamentals and methodologies of traffic and transportation theory (LWR theory, General Motors model class, the understanding of highway capacity as a particular stochastic value, and equilibrium and social optimum principles). Chechina, Churbanova and Trapeznikova propose a 2D macroscopic model for multilane traffic with a high parallelization computation for numerical simulation. Nikolos, Delis and Papageorgiou present a relaxation-type second-order non-equilibrium traffic model for which neither Riemann solvers nor characteristic decompositions are needed. The authors demonstrate the simplicity and versatility of relaxation schemes as numerical solvers. Sossoe and Lebacque present a model of vehicular traffic flow for a multimodal transportation road network. The model describes the traffic on highways and network transit for public transportation, and introduces an Euler-Lagrangian-remap numerical scheme. Guerrouahane, Farhi, Aissani and

Bouallouche-Medjkoune propose a stochastic state-dependent queuing model for the road traffic. Yaroshenko presents a model for the traffic flow of particles on ring networks.

All contributions treat numerical simulation, but some of them address mainly simulation concerns. Lin, Zhang, Dong, Wong and Choi propose a second order model of traffic flow treating Riemann problem at a junction, demand and supply functions, as well as stop and go waves. Khelifi, Haj-Salem, Lebacque, Lotfi and Khaled present some simulation results of a Lagrangian discretization of the Generic Second Order Model (GSOM). Kurtca and Anufrieva propose a fast multirate numerical method for microscopic vehicular traffic models, for which they give an evaluation of the stability analysis of the numerical integration scheme.

Optimization of transportation networks is tackled here from two directions: i) guidance or routing of users and ii) ramp metering in the highway. Farhi, Haj-Salem and Lebacque present an adaptation of an existing model for the guidance of users in road traffic networks. The adaptation permits to obtain robust paths which are not likely to change during the travel, or which admit acceptable alternative detours in case of failure. Charansonney and Aguiléra consider the question of whether centralized traffic information systems are still relevant, in the current context where traffic management is becoming an intricate and complex system in which public authorities, private companies and user communities are intertwined. The authors give a comparative analysis of centralized traffic management policies in the cities of London and Paris, and present a short review of the new players in the traffic information and data collection market. Moreover, they propose a model to study how different classes of users interact in today's road networks. Atmani, Lebacque, Bhourri and Haj-Salem propose a simulation-based model for dynamic traffic assignment on guided vehicles. The model minimizes the total travel time of each vehicle by keeping the traffic in the network at a near-equilibrium state. Haj-Salem, Farhi and Lebacque present some off-line simulation results on the coordination of ramp metering in the French A4 motorway. The authors consider a multi-objective nonlinear optimization model where the criteria are traffic and safety.

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