



Dynamic Systems and Simulation Laboratory at the Technical University of Crete, Greece

Mission

The Technical University of Crete (TUC) was established in 1977 in Chania, Greece, and admitted its first students in 1984. The mission of the institution is to develop modern Engineering specialties, to place emphasis on research in fields of advanced technology as well as to establish close cooperation with the industry. Technical University of Crete is ranked amongst the most prominent research institutions in Greece.

The Dynamic Systems and Simulation Laboratory (DSSL) within TUC's School of Production Engineering and Management was founded in 1988 and is located at the campus of the Technical University of Crete. Since 1994, DSSL has been directed by Prof. Markos Papageorgiou. The staff of DSSL includes some 20 professors, lecturers, researchers, graduate and undergraduate students and has profound knowledge and broad experience in the theories of modelling, simulation, optimiza-

tion, automatic control, and their practical application to traffic and transportation systems, water networks, production systems, and further areas.

Research Areas

DSSL has been involved in numerous research, development, and demonstration projects at a national, European, and international level. Funding has been received mainly from the European Commission but also from the Greek Secretariat of Research & Technology, the Greek

Quick Facts



Director: Prof.
Markos Papageorgiou

Lab name: Dynamic Systems and Simulation Laboratory (DSSL)
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Markos Papageorgiou received the Diplom-Ingenieur and Doktor-Ingenieur (honors) degrees in Electrical Engineering from the Technical University of Munich, Germany, in 1976 and 1981, respectively. He was a Free Associate with Dorsch Consult, Munich (1982-1988), and with Institute National de Recherche sur les

Transports et leur Sécurité (INRETS), Arcueil, France (1986-1988).

From 1988 to 1994 he was a Professor of Automation at the Technical University of Munich. Since 1994 he has been a Professor at the Technical University of Crete. He was a Visiting Professor at the Politecnico di Milano, Italy (1982), at the Ecole Nationale des Ponts et Chaussées, Paris (1985-1987), and at

MIT, Cambridge (1997, 2000); and a Visiting Scholar at the University of California, Berkeley (1993, 1997, 2001, 2011) and other universities.

Dr. Papageorgiou is author or editor of 5 books and of over 400 technical papers. His research interests include automatic control and optimization theory and applications to traffic and transportation systems, water systems and further areas. He was the Editor-in-Chief of Transportation Research – Part C (2005-2012). He also served as an Associate Editor of IEEE Control Systems Society – Conference Editorial Board, of IEEE Transactions on ITS and other journals. He is a Fellow of IEEE (1999) and of IFAC (2013).

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National Education Ministry, and many R&D contracts by companies or authorities from European countries, Israel, North America, Brazil, Australia. Beyond theoretical and methodological developments, DSSL has gained remarkable experience through the implementation in real conditions, testing, and evaluation of its several developed techniques and tools. Over the years, DSSL has had a pivotal role in the introduction and exploitation of classical, modern and advanced feedback and optimal control methods in traffic and transportation research and practice. The traffic-related research areas of the Laboratory are outlined here below:

Traffic Flow Modelling - Development and validation of macroscopic modeling and simulation tools for urban, freeway and mixed networks (e.g. METANET, METANET-DTA, METACOR). METANET was actually the first generic macroscopic traffic flow simulator for freeway networks and is still the most widespread one with some 100 users worldwide.

Traffic Flow Estimation - Development of surveillance, estimation and prediction algorithms for freeway networks based on Extended Kalman Filtering. RENAISSANCE is a comprehensive surveillance tool for freeway networks that was applied in a Bavarian freeway (DE), Napoli (IT) and Antwerp (BE).

Freeway Traffic Control - Development of control strategies for local (ALINEA) and coordinated (METALINE, HERO) ramp metering, variable speed limits, and mainstream traffic flow control on freeways. Development of an advanced nonlinear optimal control tool for integrated freeway traffic control (AMOC). ALINEA was field-tested or is operational in Paris (FR), Amsterdam (NL), Glasgow and England motorways (UK), Bavarian freeways (DE), Tel Aviv (IL), Victoria and Queensland (AT) and has meanwhile some 400 installations in several countries in Europe, Israel, Australia, U.S.A. HERO is an award-winning feed-



FIG 1 Current and former members of DSSL at the 93rd TRB Meeting in Washington, DC, in January 2014.

back-based coordinated ramp metering strategy implemented in Victoria and Queensland (AT), while other implementations are in progress.

Road Traffic Control - Development of control strategies for urban traffic signal control (TUC and variants) and integrated traffic control strategies for mixed highway networks (IN-TUC). Successful field installations of TUC have been realized in Chania (GR), Glasgow (UK), Southampton (UK), Munich (DE), Tel Aviv and Jerusalem (IL) (feasibility studies), Macae, Maoua and Santos (BR).

Route Guidance - Development of control strategies for Variable Message Signs (AUTCON), and route guidance (AMOR), based on feedback, predictive feedback or optimal control methods. Field installations in Paris (FR), Scottish Highway Network (UK), Aalborg (DK).

Traffic Management for the 21st Century - Prof. Markos Papageorgiou was recently awarded an Advanced Investigator Grant from the European Research Council (ERC). The main objective of TRAMAN21 (Traffic Management for the 21st Century - <http://www.traman21.tuc.gr/>) is the development of fundamental concepts and tools that will pave the way towards a new era of future freeway traffic management research and practice in presence of VACS (vehicle automation and communication systems).

Recent Awards and Distinctions

DSSL received the 2011 *IEEE ITS Institutional Lead Award* by the IEEE ITS Society “for outstanding contributions and successful implementations in traffic flow modelling and control”.

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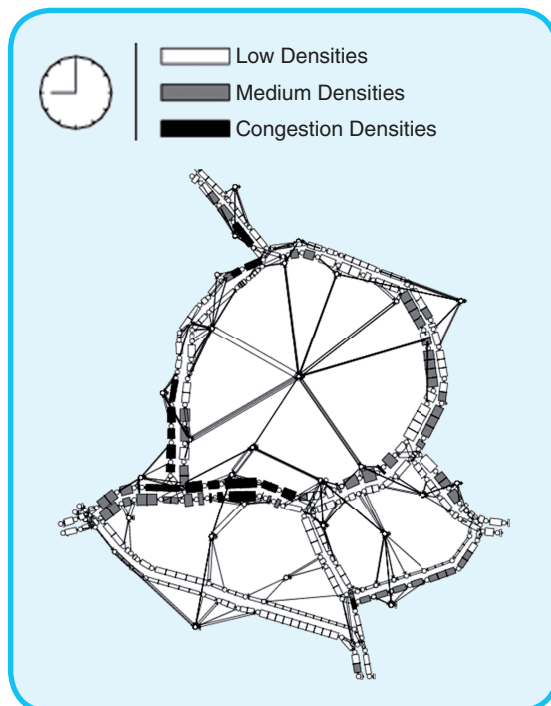


FIG 2 Traffic flow simulation for the motorway network around Amsterdam with METANET.

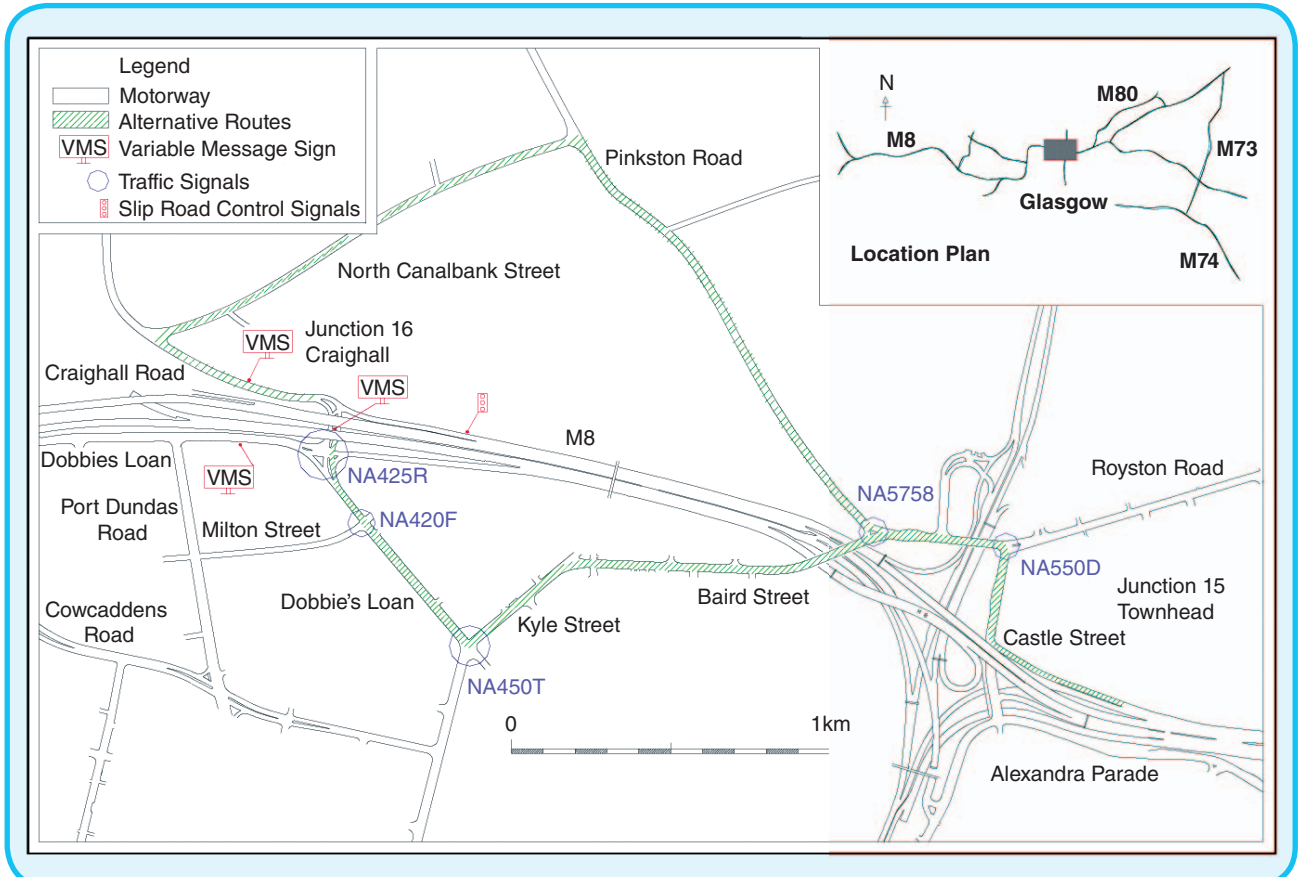


FIG 3 The Glasgow site of IN-TUC field implementation involving local ramp metering (ALINEA), feedback-based route guidance and urban signal control (TUC).

Dr Anastasios Kouvelas and Dr Mehdi Keyvan-Ekbatani (ex-PhD students of the Laboratory) received 2nd prizes of the *Best Dissertation Award* of the IEEE ITS Society in 2012 and 2014, respectively.

Members of DSSL co-authored papers that received the Best Paper Award for Pillar II (Transport, Mobility and Infrastructure) of Transport Research Arena (TRA) 2012; and the Best Transportation Research Board

(TRB) Freeway Operations Paper in 2014 Award.

Prof Markos Papageorgiou received the 2007 *IEEE Outstanding ITS Research Award* by the IEEE ITS Society “for outstanding contributions to traffic flow modeling and control”; and, jointly with Prof Ioannis Papamichail, the 2010 *Transition to Practice Award* by the IEEE Control Systems Society “for the development and implementation of ramp metering algorithms, in particular at the Monash Freeway, Melbourne, Australia”. In 2010, Prof Papageorgiou was proclaimed Visiting Professor of the Faculty of Transport and Traffic Engineering of the University of Belgrade, Serbia, “in profound appreciation for



FIG 4 Short Course participants, Chania, Greece, October 8-12, 2012.

many years of significant leadership and outstanding scientific contributions"; while in 2015 he became a Fellow of IFAC (International Federation of Automatic Control) "for seminal contributions to modelling, control and optimization of transport systems and water networks". In 2014, Prof Papageorgiou was the recipient of the Highest Cited Author Award by the Committee of Traffic Flow Theory and Characteristics of TRB; and the Research Excellence Award by the Technical University of Crete.

Other Activities and Achievements

Starting in 1999, Prof Papageorgiou established the 5-day "Short Course on Traffic Flow Modelling and Control" that he taught 11 times since then in Chania. The course became very popular with international researchers and has attracted a total of 219 participants from 24 countries. He was also invited and taught the Short

Course in other countries repeatedly (Netherlands, Italy, USA, China).

Members of DSSL have received numerous invitations for conference IPC membership; for plenary and keynote presentations at international conferences; for seminars at universities, companies or authorities; and for lecturing at international courses. Since 1994, DSSL has published 3 books, 137 articles in scientific journals or book chapters and 214 articles in conference proceedings.

On the occasion of completing its first 10 years, IEEE Transactions on ITS published in June 2010 a bibliographic analysis (<http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=5467214>) for its 405 published articles. The article by M. Papageorgiou and A. Kotsialos "Freeway ramp metering: an overview" ranked 5th in ISI citations. Both authors ranked 7th and 8th, respec-

tively, in the top ten of authors with most citations per published article in the journal. Technical University of Crete ranked 7th in the top ten of institutions with most citations per published article in the journal.

"Coordinated ramp metering for freeways" (M. Papageorgiou, I. Papamichail) was included in the Milestone Report "The Impact of Control Technology" (May 2011) of IEEE Control Systems Society as one out of 25 selected Success Stories in Control.

The article by M. Papageorgiou and A. Kotsialos, "Freeway ramp metering: an overview," IEEE Transactions on ITS, vol. 3, no. 4, pp. 271–281, December 2002, won an award as one of the top 3 Best Survey Papers in the decade 2000–2009 in the journal (<http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=6585827>).

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PRESIDENT'S MESSAGE *(continued from page 3)*

in-vehicle energy management, EV route planning, and even energy pricing. In addition, we are now starting to see papers dealing with not only electric vehicles and transportation systems, but also those dealing with smart grids and intelligent energy systems.

I believe that transportation electrification will be an increasingly important part of ITS for many years. Transportation systems as a whole greatly affect the operation of electric vehicles, and vice versa. Because today's EVs often suffer from range limitations, we need to be able

to identify the transportation systems where they can best operate. We need to know how and where to place distributed public charging infrastructure. Further, roadway electrification may be a common thing in the future. Specific EV routing algorithms will likely be commonplace. Hybrid energy management based on transportation factors will also be critical. Lastly, wireless communication with electric vehicles will be increasingly valuable, since real-time operational data will help in the design and improvement of these

vehicles as they emerge as a larger sector of our vehicle fleet.

This year, at ITS Conference in September, we will have a keynote talk on this TEC effort, provided by Professor Philip Krein from the University of Illinois. I look forward to seeing the IEEE Transportation Electrification Community grow, and I am proud that the ITS Society is part of it.

Matt Barth
IEEE ITSS President, 2014–2015

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