Technical University of Crete
Dynamic Systems and Simulation Laboratory
http://www.dssl.tuc.gr
Chania 73100, Greece

9th Short Course 2010

DYNAMIC TRAFFIC FLOW MODELLING AND CONTROL

19-23 July 2010, Chania, Greece

Lecturer:	***Prof. Markos Papageorgiou***
Date:	***19-23 July 2010***
Location:	***Chania (Crete), Greece***
Fee:	• ***1.600 €*** • ***For graduate students: 1.200 €*** • ***20% reduction is granted in case of more than one participation from the same institution***

Scope

The design, analysis, and evaluation of several Intelligent Transportation Systems (ITS) requires a good knowledge of traffic flow modelling and control techniques as well as of powerful methodologies from the areas of optimisation, control, networks and dynamic systems. The purpose of the intensive 5-day course is to cover the basic theory and tools necessary for efficient design and evaluation of ITS on road and freeway networks. The course begins with traffic flow modelling and validation that includes a coverage of the various traffic flow models, the modelling of traffic networks, and simulation tools. Measurement devices and estimation problems in traffic networks, that include automatic incident detection and O-D estimation, are presented and discussed. The state-of-the-art techniques on freeway control, road traffic control, and integrated control employing ramp metering, signal control, variable speed limits and route guidance via application of modern optimisation, control, and estimation techniques, together with several case studies are presented. Some 50 exercises are used for consolidation of the provided knowledge. Extensive written materials, including all transparency copies, will be handed out.

Who Should Attend

Graduate students, engineers, researchers, consultants, and government employees who are interested in improving their understanding of advanced traffic flow modelling and control tools and in becoming familiar with their application in ITS.

Please forward the information about the Short Course to any of your colleagues who may be interested.

Course Contents

5.4 Route Information and Guidance
(General introduction and examples; Proposed approaches; Iterative, optimal control, and feedback (P, PI, LQI) approaches; Simulation examples)

5.5 Case Studies
(The Aalborg VMS information and guidance system; The interurban Scottish highway network system of VMS for driver information and guidance; Goals, characteristics, control strategy design, simulation tests, implementation and impact for both systems)

5.6 Integrated Freeway Network Traffic Control
(Optimal integrated freeway network control; AMOC; Simulation examples)

5.7 Merging and Mainstream Traffic Control
(Basic concept; Control Algorithms; Applications to freeway work zones and toll plazas; Microscopic simulations testing; Mainstream traffic flow control)

Exercises

6. ROAD TRAFFIC CONTROL

6.1 Introduction
(Basic definitions; Stages, split, cycle, and offset; Classification of control strategies)

6.2 Isolated Intersection Control
(Fixed-time strategies; Webster signal settings; SIGSET and SIGCAP; Phase-based approach; Application examples; Real-time strategies; Vehicle-interval method; Volume-density method; MOVA)

6.3 Fixed-Time Coordinated Control
(MAXBAND: Details of problem formulation and solution, extension to networks, examples, recent extensions; MULTIBAND; TRANSYT: Problem description, model, and optimisation approach; Signal control and traffic assignment)

6.4 Coordinated Real-Time Strategies
(SCOOT, OPAC; PRODYN, COP, CRONOS; Store-and-forward based approaches: Linear Programming, Quadratic Programming, LQ-regulation; TUC)

6.5 Public Transport Priority
(Aims, trade-offs and methods)

6.6 Parking Control Systems
(Design principles and examples)

6.7 Integrated Urban-Freeway Traffic Control
(Aims; Basic methodological approaches)

6.8 A Case Study
(Glasgow implementation and field evaluation of IN-TUC)

Exercises

APPENDIX A: KALMAN FILTER

A1. The Kalman Filter for Linear Systems
(Problem formulation; Filtering and one-step prediction; Recursive solution)

A2. Extended Kalman Filter
(Nonlinear problem and suboptimal solution)

Exercises

APPENDIX B: LINEAR-QUADRATIC OPTIMAL CONTROL

B1. Problem Formulation
(Linearisation; Problem Formulation)

B2. LQ and LQI Regulators
(LQ-regulator; Problem augmentation for LQI control)

B3. The Impact of Constant Disturbances
(Constant disturbances; Steady-state error)

Exercises

APPENDIX C: NONLINEAR OPTIMAL CONTROL

C1. Problem Formulation and Necessary Conditions

C2. Feasible-Direction Algorithm
(Reduced and constrained gradients; Algorithmic steps; Descent directions)

Exercises

About the Lecturer

Professor Markos Papageorgiou's general area of scientific interest is in modelling, optimisation and automatic control, and their applications to traffic and transportation systems, water networks, and further areas. Over the past 35 years, Prof. Papageorgiou has been involved with the development and validation of traffic flow models, and with the design, testing, and implementation of traffic control strategies for a variety of traffic control problems. He has taught regular and intensive courses on *Traffic Flow Modelling and Control* at numerous universities and institutions in many countries. He has been actively involved in national and international R&D projects and programs in different capacities and he has served as a consultant to industrial, research, and governmental institutions in various countries. He is the author of "*Applications of Automatic Control Concepts to Traffic Flow Modelling and Control*" (Springer, 1983) and "*Optimierung*" (Oldenbourg, 1991; 1996), the editor of "*Concise Encyclopedia of Traffic and Transportation Systems*" (Pergamon, 1991), and the author of numerous technical papers. He is

the Editor-in-Chief of *Transportation Research - Part C;* Prof. Papageorgiou is a Fellow of the IEEE. He was the first recipient (2007) of the *IEEE Outstanding ITS Research Award*.

Fee and Registration

Registration is limited to **40** participants on a **first-come-first-serve** basis. The fee is 1.600 € (for graduate students 1.200 €). A fee reduction of 20% is granted in case of more than one participation from the same institution. This fee includes:

- *Handout material (transparencies copies, reading material, exercises and solutions)*
- *Refreshments*
- *Daily lunch*
- *One course dinner.*

Method of Payment

Payment may be effectuated via:

- **check** (indication: "Short Course Prof. M. Papageorgiou") or
- **credit card**.

Location

The course will take place in the
Building of the former French School
(Department of Architectural Engineering)
of the Technical University of Crete,
127, E. Venizelou Str. (Halepa),
Chania 73132, Crete,
GREECE

Accommodation

Comfortable rooms in various hotels of Chania will be available at special prices (around 80 € / day) for the participants. Participants will have to arrange their reservations themselves. Detailed information on how to reach Chania, the city attractions, and hotel information and prices will be provided upon receipt of the registration.

Evaluation of the previous Short Courses

The eight previous Short Courses (3-7 May 1999, 29 May - 2 June 2000, 28 May - 1 June 2001, 27-31 May 2002, 9-13 June 2003, 20-25 September 2004, 17-21 July 2006, 21-25 July 2008) were attended by a total of 146 participants from 18 countries (from Germany 31, Greece 25, The Netherlands 24, Italy 18, Sweden 11, Belgium 9, UK 4, Israel 4, Canada 3, France 3, Portugal 3, Czech Republic 2, Finland 2, Hungary 2, Austria 2, Japan 1, South Korea 1, Yugoslavia 1). Participants were active in Universities and Research Centres (66%), Consultants and Industrial Companies (29%), and Authorities (5%). At the end of each course the participants completed an anonymous **Evaluation Form**, the average results of which are summarized in the following table:

Course Aspect	Oral Presentation	Reading Material	Lecture Transparencies	Organisation	Theoretical Aspects	Practical Aspects
Average evaluation*	4.7	4.1	3.8	4.5	4.3	3.8

* **5**: excellent, **4**: very good, **3**: good, **2**: fair, **1**: poor

Here are citations of some participants' overall impressions:

- *"I found this an extremely interesting course, very much what I was looking for. I learned a lot and I am very happy to have participated. Next time my company will send someone again".*
- *"It is a very good course giving an excellent overview. I would really recommend it to my colleagues".*
- *"I was impressed by the presenter's knowledge and technical depth as well as breadth. The introduction to Automatic Control was very useful and it definitely gave ideas that I'll try to explore in my own research".*
- *"I overcame my best expectations for the quality of the presentation and the great interest of the arguments. A really stimulating experience".*
- *"Excellent course, essential for any PhD student entering the realm of traffic control".*
- *"Excellent organisation, excellent food, perfect hospitality. Thanks for this great experience".*

To register
please complete and send (via mail, fax, or e-mail) the
following registration form

Registration Form

9th Short Course

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DYNAMIC TRAFFIC FLOW MODELLING AND CONTROL

Return to:

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TEL: +30-28210-37289 FAX: +30-28210-37584
E-MAIL: markos@dssl.tuc.gr

Please print

FIRST NAME: _____

SURNAME : **Mr/Ms** _____

POSITION: _____ **TITLE:** _____

ORGANISATION: _____

ADDRESS: _____

PHONE/FAX: _____

E-MAIL: .....

Fee: Please check one of the following:	**check the right box in case of reduction**	20% reduction
☐ Regular registration: 1.600 €		
☐ Graduate student: 1.200 € **(written confirmation of student status is sent by post)**		
	TOTAL AMOUNT =	€

Payment Method: Please check one of the following:

☐ Check enclosed or sent by post (with indication: Short Course Prof. M. Papageorgiou)

☐ Charge my credit card (**original form with my original signature is sent by post**)

☐ VISA ☐ MASTERCARD Exp. Date: ☐☐/☐☐

Card number: ☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐

Cardholder's name: .....

Cardholder's Signature ..... Date: .....