

11th IFAC Symposium on Control in Transportation Systems (29th – 31st August 2006)

Report no:	4	Report initiator	Michael Levasseur
Date:	15 th September 2006	Compiled by:	Keith McCabe
Report area:	Relevance of projects presented to the Highways Agency		
Categories and level of relevance:	Traffic Control Centres	Very relevant	
	Traffic management technology	Very relevant	
	Pilots	Some relevance	
	Driver behaviour	Some relevant	
	Modelling	Very relevant	
	Traffic and travel Information	Very relevant	
	Technology solutions	Very relevant	
	Enforcement	Some relevance	
	Standards and policy	Some relevance	
	Safety	Some relevance	
	European developments	Some relevance	
	GPS / Satellites	Some relevance	
	EU development	Some relevance	
	Driver information	Some relevance	
Environmental issues	Some relevance		
Transferability to Highways Agency:	Meets Policy Objectives	Yes	
	Cost/Benefits Information	Limited availability	
	Development status	Some full deployments, some pilot projects and some models.	
	Innovative	Yes	
	UK legal issues	Possible Institutional, Legal and Privacy Issues	
Summary:	The symposium focused on control engineering issues in a range of transport modes (road, rail, air and marine). The presentations were fairly evenly split between results from real world implementations and modelling work. Of particular interest to the Highways Agency were the sessions on freeway monitoring and control, ramp metering, evacuation planning, vehicle control, regional traffic management and network modelling.		

Introduction

This document summarises some of the papers presented at the 11th IFAC Symposium on Control in Transportation Systems which are of particular relevance to topic areas being monitored by the ITS Radar initiative. An overview of the relevant papers, the country of origin for the 'project', the relevance of the work to the Highways Agency and the topic areas they are associated with are presented, in Table 1.

Extracts from the papers are included as an Appendix, with contact details for session moderators (for IBEC sessions) and authors, where available. Links are provided between Table 1 and the appropriate extract, via the paper reference number. Links are also provided back to Table 1, again via the paper reference number.

Attention is drawn to the 'Relevance to the HA' comments alongside each project overview in Table 1.

Copies of the complete abstract for each paper presented can be made available, if required.

ITS Radar Ad-hoc Report: 11th IFAC Symposium on Control in Transportation Systems - Papers of Particular Relevance to the HA

Table 1

Paper Reference	Subject	Overview (Summary Extracts From Papers Appended)	Country of Origin	Relevance to the HA	Relevant Topic Areas																				
					Traffic Control Centres	Traffic Management Technology	Pilots	Driver Behaviour	Tolling	Modelling	Traffic and Travel Information	Freight and Fleet Management	Technology Solutions	GPS / satellites	Enforcement	Standards and Policy	Monitoring	Safety	European Developments	Driver Information					
141	Network design for evacuation planning	Formulating the capacity addition problem as a mixed-integer network design problem.	USA	Helping to understand the evacuation aspects of security threats and natural disasters	✓			✓		✓															
174	Red light violations at ramp meters	Examination of types of violations at ramp meters and the causes that provoke them	Germany	Helping to understand the types and causes of red light violations at Motorway Access Management points	✓	✓		✓							✓							✓			
176	Feedback based coordinated ramp metering strategy	Evaluation of system-wide effects of online estimation methods.	USA	Motorway Access Management	✓	✓				✓			✓												
189	Bus operation planning during mega events	Bus operations planning tool used during the Athens 2004 Olympics	Greece	Bus operations for event management						✓						✓									

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193	Dynamic work zone merge metering	Dynamic merge metering approach for work zone traffic control	USA	Merge metering for work zones	✓	✓				✓				✓					✓		✓		
196	Adaptive control fuzzy logic based ramp metering algorithm	Field evaluation of ramp metering algorithm ACCEZZ	Germany	Lessons learned from implementing this Motorway Access Management algorithm	✓	✓				✓				✓							✓		
197	Ramp metering control in Amsterdam	Hierarchical nonlinear model-predictive ramp metering control	Netherlands	Lessons learned from implementing this Motorway Access Management system	✓	✓				✓				✓							✓		
208	Dynamic route guidance during maintenance works	Case study on dynamically dividing traffic over several alternative routes	Netherlands	Route guidance for maintenance works	✓	✓	✓			✓				✓							✓	✓	
239	Incident detection algorithms	An investigation of five Dutch algorithms	Netherlands	A key Technical component for some ITS deployments		✓				✓				✓									
240	Ramp metering controller design	Design of non-local feedback ramp metering controller	France	Motorway Access Management	✓	✓				✓													

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254	Network optimisation	Using traffic control as ramp metering	Netherlands	Motorway Access Management	✓	✓				✓			✓						✓	
260	Safety in transport systems design	Safety as a strategic aspect in transport systems design	Netherlands	A key policy area for the UK											✓			✓		
261	Automatic incident detection systems	Developing of a real-world test bed for incident detection systems	Canada	Possible lessons to be learnt from deployment of ITS														✓		
264	Ramp metering	Overview of ramp metering in the Netherlands	Netherlands	Motorway Access Management	✓		✓												✓	
265	Intelligent vehicles	Presentation and analysis of vehicle technologies for closed loop highway systems	USA	Helping to understand intelligent vehicles technologies		✓							✓					✓		
266	Local feedback ramp metering	Proposal for modification of ALINEA local actuated on-ramp control strategy	Netherlands	Motorway Access Management	✓	✓				✓										

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					Traffic Control Centres	Traffic Management Technology	Pilots	Driver Behaviour	Tolling	Modelling	Traffic and Travel Information	Freight and Fleet Management	Technology Solutions	GPS / satellites	Enforcement	Standards and Policy	Monitoring	Safety	European Developments	Driver Information
268	Regional traffic management	Methods and tools for regional traffic management	Netherlands	Key policy area for the UK	✓											✓			✓	
269	Regional traffic management	State of the art regional traffic planning methods used in The Netherlands	Netherlands	Key policy area for the UK	✓											✓			✓	
270	Ramp metering and variable speed limits	Linking ramp metering and variable speed limits in the UK	UK	Draws on work undertaken by HA	✓		✓										✓			
272	Traffic Modelling of large events	A summary of selected German events	Germany	Event management						✓										
273	Intelligent Infrastructure Systems	A summary of Smartdust and other wireless technology outputs and innovations	UK	Helping to understand future wireless outputs and innovations.		✓										✓				

Appendix – Summary Extracts From Papers

Paper Reference	Extract
141	Network Design for Evacuation Planning
<i>Return Table 1</i>	to Security threats and natural disasters (such as hurricanes and cyclones) are events that have historically led to large scale evacuations. Evacuation operations are strongly characterised by traffic volumes that substantially exceed the network capacity. This paper focuses on the planning aspects of evacuation by identifying contra-flow mechanisms integrated with the appropriate traffic signal control pattern, at the network level, that minimise the network clearance time. The study formulates the capacity addition problem as a mixed-integer network design problem. The cell transmission model is used to simulate the propagation of traffic flow. <i>Srinivas Peeter, Georgios Kalafatas, School of Civil Engineering, Perdue University.</i>
174	Amount and Motivation of Red Light Violations at Ramp Meters
<i>Return Table 1</i>	to Red light violations (RLV) at ramp meters undermine the purpose of controlling the number of vehicles entering a freeway and the goal of dispersing platoons of vehicles. The goal of this study was to examine the types of Red Light Violations (RLV) and the causes that provoke them. It was found that the most important influence is the variation of the length of the red interval. Most of the results can be transferred to ramp metering in general. Furthermore a high rate of false alarm of the automatic RLV-detection was revealed and examined. Recommendations for the examined entrances are given. <i>Roland Trapp, Road and Traffic Engineers, Höfchensweg, Germany, r.trapp@dr-ing-trapp.de, www.dr-ing-trapp.de.</i>
176	Evaluation of the System-Wide Effects of Online Estimation Methods of Feedback-Based Coordinated Ramp Metering Strategy
<i>Return Table 1</i>	to The critical density of a highway link is subject to changes over time owing to such circumstances as environmental conditions and traffic incidents. The critical density affects the performance of some ramp metering strategies that make use of it as a threshold value for control action. Therefore it is imperative to trace the real value of the critical density. The focus of this paper is to evaluate the effects of the novel online critical density estimation methods proposed by Ozbay et al. (2006) on the performance of the two new feedback-based coordinated ramp metering strategies, namely C-MIXCROS and D-MIXCROS. These explicitly consider ramp queues using microscopic simulation models on an 11-mile corridor of I-295 in South Jersey under various demand conditions. <i>Ilgin Yasar, Kaan Ozbay and Pushkin Kachroo, ilqinyasar@hotmail.com.</i>
189	Decision Support Systems for Planning Bus Operations During Mega Events: The Athens 2004 Summer Olympics.
<i>Return Table 1</i>	to Planning a public transportation network for accommodating mega events is a complicated process where various parameters such as significantly increased demand for transportation and irregular mobility patterns must be considered. Before and during mega events, planners and operators have to decide, on a number of occasions, regarding the system's operational characteristics on the basis of various assumptions and evolving parameters. This paper presents a decision support system especially developed to support planning and operations of a dedicated bus network for mega events. The decision support system includes a mathematical programming algorithm that can be used to jointly select optimal bus size and headways for all network lines. <i>Matthew G Karlaftis, Konstantinos Kepaptsoglou, Antony Stathopoulos, National Technical University of Athens, Greece, mgk@central.ntua.gr.</i>

Paper Reference	Extract
193 <i>Return Table 1</i>	<p>Concept of Dynamic Merge Metering Approach For Work Zone Traffic Control</p> <p>Several strategies have been developed to improve the flow of traffic at work zones. This paper presents the Dynamic Merge Metering (DMM) control strategy to integrate the Dynamic Late Merge control with a merge meter at the downstream taper area of a work zone. In this method, vehicles arriving at a work zone will be instructed in the advance areas of the work zone to stay in their lanes until they reach the beginning of the lane closure. Here the vehicles wait for a green signal like any signalised intersection. The delay penalty is distributed equally in both lanes. A simulation-based method is used with VISSIM to evaluate the performance of DMM. <i>Heng Wai, University of Cincinnati, heng.wai@uc.edu and Manojkumar Pavithran, Y.S. Mantri and Associates LLC, manoj@mantrieng.com.</i></p>
196 <i>Return Table 1</i>	<p>Field Evaluation of the Fuzzy Logic Based Ramp Metering Algorithm ACCEZZ</p> <p>The ACCEZZ ramp metering algorithm is an adaptive control approach based on Fuzzy Logic. Results from its calibration and validation as well as its evaluation using a microscopic simulation show how different control strategies can improve traffic conditions especially during peak hours. To evaluate the potential of ramp metering the ramp metering software TRANSRAMP has been developed, implemented and tested at a demonstration site in Munich (Germany). Since December 1st, 2005 TRANSRAMP controls traffic at two consecutive on-ramps successfully with the ACCEZZ algorithm. Data for a cross-algorithm (with ALINEA) and a cross-site evaluation will be collected until April 2006 within the European research project EURAMP. <i>Svetlana Vukanovic, Oliver Ernofer, TRANSVER GmbH, Germany.</i></p>
197 <i>Return Table 1</i>	<p>Hierarchical Nonlinear Model-Predictive Ramp Metering Control for Freeway Links</p> <p>This report presents a nonlinear rolling-horizon hierarchical coordinated ramp metering system. The hierarchical control structure consists of three layers: the estimation/production layer, the optimization layer and the direct control layer. Simulation results are presented for the Amsterdam ring-road. It is shown that control of all on-ramps including freeway intersections leads to the optimal utilisation of the available infrastructure. <i>A Kotsialos, Dynamic Systems and Simulation Laboratory, Technical University of Crete, Greece., I Papamichail, I Margonis and M Papageorgiou, School of Engineering, Durham University, UK.</i></p>
208 <i>Return Table 1</i>	<p>Dynamic Route Guidance During Maintenance Works, A Case Study</p> <p>During road maintenance works traffic often has to be diverted over alternative routes to reach their destinations, since their normal route is not available or has not enough capacity left. This can be done with static signs but this is often not optimal. A better option is to divide the traffic over several alternative routes dynamically. With a case study the use of dynamic route guidance during maintenance works is shown. By dynamically dividing the traffic over several alternative routes, the total flow in the network increases without deteriorating the traffic operation in the rest of the network. <i>B.H. Heutinck, M. van den Berg, J. Hellendoorn, Delft Center for Systems and Control, J.Hellendoorn@TUDelft.nl, Monique.vandenBerg@TUDelft.nl, L.H. Immers, TNO Mobility and Logistics, The Netherlands, Ben.Immers@TNO.nl.</i></p>

Paper Reference	Extract
239	Investigation of Five Dutch Incident Detection Algorithms
<i>Return Table 1</i>	to The Dutch national road authority Rijkswaterstaat continuously searches for detection schemes that allow the robust, timely and because of cost constraints preferably automated detection of incidents. The quality of such algorithms is measured against the dimensions of detection rate, false alarm rate and response time. The way in which the currently available loop detector data of traffic speed and flow can be used to detect incidents is investigated. A comparison of a previously presented Dutch algorithm with a number of different algorithms, specifically developed for the study is presented. It appears that one algorithm offers improvements over the original algorithm, and that another algorithm offers the potential of improvements. <i>Willem Jan Knibbe, Hans Bokma, Frans Middelham, Rijkswaterstraat AVV, Rotterdam w.j.j.knibbe@avvrws.minvenw.nl, Nanne van der Zijpp, Modelit, Rotterdam, Netherlands.</i>
240	Non-Local Feedback Ramp Metering Controller Design
<i>Return Table 1</i>	to This paper treats the problem of controlling large freeway systems through ramp metering to enhance their efficiency. Following a rigorous discretization methodology, an extension of the CTM model to inhomogeneous freeways with on and off ramps is proposed. Based on passivity theory and the piecewise affine formulation of this model, an LMI formulation is developed to design non-local feedback ramp metering controllers. <i>Denis Jacquet, denis.jacquet@lag.ensieg.inpg.fr, Jonathan Jaglin, Damien Koenig, Carlos Canudas de Wit.</i>
254	Network Optimisation by Using Traffic Control as Ramp Metering
<i>Return Table 1</i>	to This report looks at the A12 in The Netherlands which is highly congested during morning peak hours. Traffic from surrounding towns is concentrated on the A12 towards the City of Arnhem. In order to optimise the traffic flow on the A12 and on the neighbouring secondary roads a network control system has been developed and tested in the microscopic simulation model VISSIM. Using a real time decision model the amount of traffic entering highway A12 is continuously and automatically increased or decreased using the existing traffic controls near the on-ramps. Simulation results show a 25% decrease of travel time and a reduction of total delay time of 200 hours (-16%). <i>J.W. Goemans, Witteveen+Bos Consulting Engineers, The Netherlands J.Goemans@witteveenbos.nl, W.J.M. Traag, Ministerie van Verkeer en Waterstraat, The Netherlands, W.J.M.Traag@don.rws.minvenw.nl.</i>
260	Safety, A Strategic Aspect in Transport Systems Design
<i>Return Table 1</i>	to This report addresses the fundamental changes in transport system design and their relation to assessing a safe operating performance. Such changes should facilitate technological innovation and conceptual change. Integrating safety in fundamental changes requires a 'conceptual leap' in safety thinking. New actors and safety aspects put additional demands on engineering design concepts and consecutive schools of safety thinking. Changes in the design environment and in the engineering design process put demands on design assessment with respect to a system safety integrator role, failure mode identification, the role of the human factor, rescue and emergency throughout the various phases of the design process. <i>John A. Stoop, Wim R. Beukenkamp, Delft University of Technology, The Netherlands.</i>

Paper Reference	Extract
261	Developing A Real-World Testbed For Automatic Incident Detection Systems
<i>Return Table 1</i>	<i>to</i> This report presents a real-world testbed for Automatic Incident Detection (AID) systems that consists of an online data warehouse storing a month of traffic video, the corresponding traffic data and an operator log of incident start/end times. A proof-of-concept field evaluation is conducted whereby the test bed is used to calibrate, and then analyse the performance of four AID systems: California Algorithm 8, McMaster Algorithm, GAID Algorithm and Citlog-VisioPAD. The pilot evaluation shows considerable advantages of the test bed in its ability to analyse the performance of the AID systems. <i>R. Browne, F. Hall, McMaster University, S. Foo, A. Abdulhai, University of Toronto.</i>
264	Ramp Metering in The Netherlands: An Overview
<i>Return Table 1</i>	<i>to</i> In The Netherlands all kinds of measures have been implemented and assessed on the motorway network, such as the motorway traffic management system with speed limits and queue tail warning, ramp metering, variable message signs, dedicated lanes, peak lanes, incident management, etc. In this paper the focus is on ramp metering. History, principles, assessment studies and future plans are discussed. <i>Frans Middelham and Henk Taale, Traffic Modelling and Control, Rijkswaterstaat, f.middelham@avv.rws.minvenw.nl and h.taale@avv.rws.minvenw.nl.</i>
265	Intelligent Vehicles: Closing the Loop with the Highway
<i>Return Table 1</i>	<i>to</i> The purpose of this paper is to present and analyse vehicle technologies which could help close the loop with the highway system. Despite considerable research efforts in vehicle technologies, vehicles continue to be treated as passive users of the traffic network while highway traffic operates as an open loop dynamical system most of the time. The paper suggests that vehicle to road communication would allow vehicles to act as sensors and actuators by having the vehicles communicate to the roadway their speed, location, origin/destination and status and respond to the roadway by obeying speed limits and ramp metering lights. A description of the structure of the proposed controlled highway system and some preliminary results are given. <i>Professor Petros Ioannou, Centre for Advanced Transportation Technologies, University of Southern California, USA.</i>
266	A Modified Local Feed-Back Ramp Metering Strategy Based on Flow Stability
<i>Return Table 1</i>	<i>to</i> The report presents a modification of the ALINEA local on-ramp control strategy. In this modification a correction procedure is added, where the stability of the flow upstream of the merge area is used in order to fine-tune the metering rate, as well as the occupancy rate downstream of the merge area. Preliminary results from microscopic simulation show that this alternative strategy may yield a significantly higher throughput of on-ramp without deteriorating freeway operations. <i>Martijn Ruijgers, University of Twente, Eric van Berkum, Goudappel Coffeng, The Netherlands.</i>
268	Regional Traffic Management – Method and Tool
<i>Return Table 1</i>	<i>to</i> The paper discusses the alternative approach to traffic management adopted by The Netherlands, described in the handbook Sustainable Traffic Management. Together with this method, a tool was developed to support it which includes the dynamic traffic assignment model MARPLE, already in use in more than 20 projects. The paper comments on how traditional traffic management is in most cases used only on a local level and lacks an integrated and network wide approach. <i>Henk Taale, Traffic Modelling and Control, Rijkswaterstaat, h.taale@avv.rws.minvenw.nl.</i>

Paper Reference	Extract
269	State of the Art of Regional Traffic Management Planning in the Netherlands
<i>Return Table 1</i>	to In the Netherlands, Intelligent Transportation Systems are part of a more comprehensive Dutch national policy to cope with the growth of traffic mobility. Although the application of ITS in the past decades shows an impressive positive cost-benefit relation, it became more and more recognized that a shift from a technique-oriented approach to a result-oriented approach of ITS was needed to cope with the increasing traffic problems. To support this shift the Dutch Traffic Control Architecture (TCA) was developed. The TCA provides the user with a framework for setting up and using traffic management from a user perspective rather than from a technological perspective which is the focus of most ITS Architectures. The Dutch national TCA covers the entire process of traffic management, from the initial intent to improve a local traffic situation right up to an integrated traffic management concept. This process is described in the Handbook for Sustainable Traffic Management. This Handbook is applied throughout the Netherlands on a national, regional and local level resulting in a very structured and user oriented approach of traffic management in the Netherlands. <i>Frans Middelham and Henk J. Stoelhorst, Traffic Modelling and Control, Rijkswaterstaat, f.middelham@avv.rws.minvenw.nl and h.j.stoelhorst@avv.rws.minvenw.nl</i>
270	Linking Ramp Metering and Variable Highway Speed Limits
<i>Return Table 1</i>	to Pilot schemes for variable speed limits and ramp metering respectively have been implemented on the UK highway network since the mid 1990's. The outcomes of the pilot studies show that these traffic management techniques can assist in the reduction of accidents, traffic congestion and emissions. This paper suggests a new approach using the mainline speed as a control variable and investigates possible benefits and the feasibility of such a system. <i>Kieth McCabe, Thomas Charlton, Andy Riley, Atkins Transport Systems, keith.mccabe@atkinsglobal.com, Joanna White, Highways Agency.</i>
272	Traffic Modelling of Large Events - A Summary of Selected German Examples
<i>Return Table 1</i>	to This paper presents three modelling approaches applied in Germany over recent years. In Munich micro simulation is applied to evaluate access to parking facilities to the Allianz-Arena. A mesoscopic model has been used at the EXPO 2000 in Hanover to forecast travel times. A macroscopic traffic model supplemented by a new propagation algorithm is being used in Berlin during the FIFA World Cup for multiple purposes including traffic flow estimation. <i>Martin Fellendorf, Graz University of Technology.</i>
273	Future Intelligent Infrastructure: A Smart Future With Smart Dusts and Smart Markets
<i>Return Table 1</i>	to The UK Office of Science and Technology has just completed a project under its Foresight Programme to explore how science and technology might be applied over the next 20-50 years to the design and implementation of Intelligent Infrastructure Systems that are robust, sustainable and safe. The findings of the project were launched by the Minister of State for Transport and the Government Chief Scientific advisor on 19th January 2006. This paper provides a summary of some of the aspects of the study relating to the scenarios developed and some key outputs on wireless technology and new innovations in auction-based pay as you drive. <i>Professor Philip Blythe, Transport Operations Research Group, Newcastle University, p.t.blythe@ncl.ac.uk.</i>