

Vehicle Dynamics and Control 2009

A one-day seminar to explore recent developments
in the design and analysis of vehicle dynamic behaviour

Programme and Registration

Thursday 2 April 2009

Cambridge, UK

www.vehicledynamicsevent.info



UNIVERSITY OF
CAMBRIDGE
Department of Engineering

Vehicle Dynamics and Control 2009

A one-day seminar to explore recent developments in the design and analysis of vehicle dynamic behaviour will be held in Cambridge on 2 April 2009. The seminar will be of benefit to engineers working in many branches of vehicle and component engineering including research, design, development, testing and competition. The topics covered are relevant to a broad range of vehicles including road and racing cars, motorcycles and trucks. Eleven presentations in three sessions will cover vehicle vibration, steering dynamics, tyre dynamics, vehicle dynamics, and path following control.

For enquiries about the programme please contact Dr David Cole, djc13@eng.cam.ac.uk

For enquiries about registration, travel, accommodation please contact Anita Clayson, ac651@eng.cam.ac.uk

Details of the venue will be sent to delegates nearer the time.

Programme (subject to amendment)

10.00 Arrival and refreshments

10.30 Welcome by Prof. Robin Langley, Head of Mechanics Division, University of Cambridge

Session 1 - Vehicle vibration, steering dynamics

10.35 Characterisation of longitudinal response for a full-time four wheel drive vehicle

Jasjit Pawar and Sean Biggs (Jaguar and Land Rover)

Dr Peter Jones (University of Warwick)

Driveability is primarily concerned with the longitudinal dynamics of a vehicle in response to engine induced torque transients under sudden changes in driver demand. A non-linear full vehicle dynamics model has been developed and validated against measurements. The model is used to examine the contribution of individual vehicle subsystem parameters on the vibration transfer paths controlling the quality of torque delivery and the longitudinal response at the driver's seat-rail, as the driveline torques are distributed between the front and rear tyres in four-wheel drive mode.

11.00 New directions for vehicle dynamics using passive network synthesis

Prof. Malcolm Smith (University of Cambridge)

The talk will report on recent work on the synthesis of general passive mechanical impedances and its application to vehicle suspension. The need for a new modelling element (the inerter), its mechanical construction, and the advantages it can provide, will be discussed. The recent deployment of the inerter in Formula One racing cars will be described.

11.25 Steering feedback: modelling its effect on driver and vehicle

Will Hoult and Dr David Cole (University of Cambridge)

Steering feedback to the driver is known to be an important aspect of vehicle dynamic quality, but there has been little theoretical understanding of its effect. A mathematical driver model is presented that can account for the effect of steering feedback. An application of the model is given. Progress towards delivering a predictive design tool for steering quality is outlined.

11.50 Driver perception of steady-state steering feel

Dr Anna Speed (Jaguar and Land Rover)

Steering feel is a sought after attribute yet remains one of the most elusive for car manufacturers. This presentation shows how quantification of driver perception (in terms of the descriptions of sensations of sequential turns of the steering wheel) can be used to investigate steering feel. An understanding of the relationship between actual and perceived steering system parameters allows engineers to determine how a steering system will feel from vehicle models.

12.15 Invitation to the 10th International Symposium on Advanced Vehicle Control, AVEC 2010

Dr Matthew Best (Loughborough University)

12.30 Lunch

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Session 2 - Tyre and vehicle dynamics

13.30 Tyre modelling: current state-of-the-art, future trends and loose ends

Dr George Mavros (Loughborough University)

A brief account of the most frequently used state-of-the-art approaches in physical and empirical tyre modelling is provided. The focus is then directed towards the representation of rubber-road friction in tyre models and its relation to handling-related tyre behaviour. Our lack of understanding of rubber friction is highlighted and possible ways forward are discussed.

13.55 Tyre and vehicle model identification using identifying Kalman filters

Dr Matthew Best (Loughborough University)

Kalman filters rely on good models in order to provide maximum state estimation accuracy. In this talk two methods for adapting and/or identifying model parameters using a Kalman filter structure are reviewed. Some important details regarding the design matrices of the filter are discussed, and results on the optimisation of model parameters, including direct identification of a tyre model from vehicle test data, are presented.

14.20 Multi-axle active steering of lorries

Dr Richard Roebuck, Dr Andrew Odhams and Prof. David Cebon (University of Cambridge)

An active steering controller has been developed for articulated heavy goods vehicles that achieves 'perfect' path-following under all conditions. This strategy reduces cut-in, tail swing and tyre wear on low speed corners and improves rearward amplification and dynamic stability at high speeds. An experimental vehicle with two actively-steered trailers has been built and this talk will be the first presentation of experimental results.

14.45 Four-wheel vehicle models in the control loop for ESP and torque distribution

Malcolm Burgess and Richard Hurdwell (Lotus Engineering)

The use of four-wheel vehicle models in stability control and torque distribution control is investigated. Input data requirements are discussed. Application to four-wheel drive, regenerative torque distribution and rear steer is presented. Comparisons are made with a 'bicycle' model approach.

15.10 Refreshments

Session 3 - Path following control

15.35 Autonomous vehicle dynamics testing

Dr Andrew Pick and Mat Hubbard (Anthony Best Dynamics)

Anthony Best Dynamics has developed a driverless test system including steering, brake and accelerator robots. The system can be used to carry out potentially dangerous vehicle dynamics tests in a controlled and repeatable way. In addition the risk to the driver is eliminated. The talk discusses some of the challenges faced in developing the system and the methods used to achieve accurate control.

16.00 Applications of nonlinear dynamics to stability analysis of motorcycles, and predictive control in rider feedback

Dr Atanas Popov (Univ. of Nottingham), Dr Jacob Meijaard (Univ. of Twente) and Dr Stuart Rowell (Romax Ltd)

The talk presents results obtained at Nottingham University between 2003 and 2008. As the title suggests, it has two distinct parts: calculation and analysis of bifurcations and instability phenomena in motorcycle dynamics, and modelling of rider steering control by model predictive control methods.

16.25 Modelling a racing driver

Prof. Robin Sharp (University of Surrey)

A racing driver can be thought of as an optimal nonlinear controller. The use of optimal linear preview control theory to represent a driver will be described and example results will be shown. To deal with the nonlinear limit-maneuvring problem, gain scheduling will be illustrated and a scheme for iterative improvement of performance by learning from past experience will be outlined.

16.50 Closing remarks

17.00 Finish

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Registration

Title, first and last names:

Address:

Telephone:

Fax:

Email: (Your details will only be used for organizing the seminar)

Do you have any special requirements (diet, access)?

The cost of attending the seminar is £65 inclusive of lunch, refreshments and a copy of the papers. One author of each paper may attend free of charge, but should still complete a registration form. Refunds will only be given if notice of cancellation is received by noon 23 March 2009.

You may pay by: 1.Cheque 2.Card 3.BACS 4.Invoice 5.Author F.O.C (circle your chosen method)

1. Cheques should be made payable to 'University of Cambridge'

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3. BACS transfers can be made to the 'University of Cambridge' account at Barclays Bank, IBAN GB96 BARC 2017 1910 9210 84. A copy of the draft must accompany this form.

4. Provide a purchase order and order number, or provide an invoice request on company letterhead.

Contact name:

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Complete and post or fax this form (one per delegate) to:

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