TIME TABLE

TIME	Monday August 29	Tuesday August 30	Wednesday August 31	Thursday September 1	Friday September 2
9.00 - 9.45	Registration	Besselink	Nagai	Hrovat	Rill
9.45 - 10.30	Lugner	Besselink	Nagai	Hrovat	Rill
11.00 - 11.45	Lugner	Besselink	Gordon	Nagai	Rill
11.45 - 12.30	Lugner	Besselink	Gordon	Nagai	Rill
14.00 - 14.45	Lugner	Gordon	Gordon	Nagai	
14.45 - 15.30	Lugner	Gordon	Gordon	Nagai	
16.00 - 16.45	Besselink	Hrovat	Hrovat	Rill	
16.45 - 17.30	Besselink	Hrovat	Hrovat	Rill	

ADMISSION AND ACCOMMODATION

The registration fee is of 575,00 Euro + VAT taxes*, where applicable (bank charges are not included).

The registration fee includes a complimentary bag, four fixed menu buffet lunches (Friday subject to numbers), hot beverages, downloadable lecture notes and wi-fi internet access.

Applicants must apply at least one month before the beginning of the course. Application forms should be sent on-line through our web site: http://www.cism.it or by post.

A message of confirmation will be sent to accepted participants. If you need assistance for registration please contact our secretariat.

Applicants may cancel their course registration and receive a full refund by notifying CISM Secretariat in writing (by email) no later than July 29, 2016.

If cancellation occurs after July 29, 2016, a Euro 50,00 handling fee will be charged.
Incorrect payments are subject to Euro 50,00 handling fee.

A limited number of participants from universities and research centres who are not supported by their own institutions can be offered board and/or lodging in a reasonably priced hotel or students' dormitories, if available.

Requests should be sent to CISM Secretariat by **June 29, 2016** along with the applicant's curriculum and a letter of recommendation by the head of the department or a supervisor confirming that the institute cannot provide funding. Preference will be given to applicants from countries that sponsor CISM.

Information about travel and accommodation is available on our web site, or can be mailed upon request.

Please note that the Centre will be closed for summer vacation the first three weeks in August.

* Italian VAT is 22%.

For further information please contact:
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33100 Udine (Italy)
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CISM

VEHICLE DYNAMICS OF MODERN PASSENGER CARS

Advanced Professional Training
coordinated by

Peter Lugner
Vienna University of Technology
Austria

Udine *August 29 - September 2* 2016

VEHICLE DYNAMICS OF MODERN PASSENGER CARS

Driving an up-to-date passenger car you demand and expect – besides riding comfort – fine handling properties including electronic support in the background e.g. by dynamic stability control(DSC), torque vectoring, active stabilizer, active suspensions. What is behind these features and how are they applied and working?

In former times the development of a new car or better essential components and improvements was based mainly on tests and experiments and hardware adaptations; this is a time and material consuming process. The possibility to apply the mathematics of multibody system models via simulation programs for the prediction of the dynamics of a vehicle accelerates and shortens the development process. For this process it was necessary to develop mechanical models of the car and its components but also to find an appropriate mathematical-mechanical description of the tire behavior and also of other special car components. To improve handling behavior and driving security control schemes were integrated leading to such properties as generally avoiding wheel locking and today this is a common everyday feature of passenger cars. Future developments of control systems aim at automatic driving to relieve the stress of the driver and finally to replace part of his activities. Moreover the control of the suspension system will provide best ride comfort.

Today the application of vehicle and tire modeling, the application of control strategies and the simulation of the complex combined system open the door to investigate a large variety of configurations and select the desired one for the next passenger car generation. Only final tests are necessary to verify the simulation quality and to get the confirmation for a proper introduction to the market.

As a consequence of these developments this course aims to provide the essential features necessary to understand and apply the mathematic-mechanical characteristics and tools for the vehicle dynamics including control mechanism. An introduction to passenger car modeling of different complexities provides the basics for the dynamical behavior and presents vehicle models later used for the application of control strategies. The presented modeling of the tire behavior, also for transient changes of the contact patch properties, shows the necessary mathematical descriptions used for the simulation of the vehicle dynamics. The introduction to the control for cars and its extension to complex applications using e.g. observers and state estimators is a main part of the course. Finally the formulation of proper multibody codes for the simulation leads to the integration of all parts. Examples of simulations and corresponding test verifications will show the profit of such a theoretical support for the investigation of the dynamics of passenger cars.

PRELIMINARY SUGGESTED READING

Rajamani, Rajesh: Vehicle dynamics and control. Springer Science & Business Media, 2011.

H. Pacejka: Tire and vehicle dynamics. Elsevier, 2005.

G. Rill, Road Vehicle Dynamics – Fundamentals and Modeling. Boca Raton: Taylor & Francis, 2011.

H.E. Tseng, D. Hrovat: Sate-of-the-art survey: Active and Semi-Active Suspension Control. Vehicle System dynamics Vol.53/7, 2015.

G. Mastinu, M. Ploechl: Road and Off-Road Vehicle System Dynamics Handbook,Chapters 22 and 31. CRC Press, 2014.

A.G.Ulsoy, H. Peng, M.Cakmakci: Automotive Control Systems. Cambrige University Press, 2012.

M.Abe: Vehicle Handling Dynamics, 2.Edition Elsevier 2015.

LECTURES

All lectures will be given in English. Lecture notes can be downloaded from the CISM web site, instructions will be sent to accepted participants.

INVITED LECTURERS

Peter Lugner - Vienna University of Technology, Austria
5 lecture on: Vehicle Models. Introduction to vehicle modelling, models of increasing complexity (theoretical and practical aspects),presentation of vehicle component characteristics (e.g. wheel suspension), models used for vehicle control.

Igo Besselink - Eindhoven University of Technology, The Netherlands
6 lecture on: Tire Modeling. Steady state tire forces and moments, input quantities, results obtained from tire testing. Possibilities to formulate tire models. Simple physical tire modelling: the brush tire model. Empirical tire modelling: the Magic Formula, a worldwide used tire model. Tire dynamics: relaxation effects and belt vibrations. Tire enveloping: behavior on short wavelength unevenness's. Application of tire models.

Timothy Gordon - University of Lincoln, Brayford Pool Lincoln, UK
6 lecture on: Basic Control. Principles of vehicle dynamics control: necessary basics of control, kinematics and dynamics of road vehicles starting with simple models, straight-line stability. The effects of body roll and important suspension-related mechanics (this includes the Milliken Moment Method). Control methods describing steering control (driver models), antilock braking and electronic stability control.

Davor Hrovat - Ford Motor Company, Dearborn, MI, USA
6 lecture on: Optimal Active and Semi-Active Suspensions. Fundamental ride and handling aspects of active and semi-active suspensions are presented in a systematic way starting with simple vehicle models as basic building blocks. Optimal, mostly Linear Quadratic (H2) principles are used to gradually explore key system characteristics where each additional model DOF brings new insight into potential benefits and limitations. The lectures conclude with practical implications and examples including some that go beyond the traditional ride and handling benefits.

Masao Nagai - Japan Automobile Research Institute, Tokyo, Japan
6 lecture on: Advanced control and automatic driving. Recently various preventive safety systems have been developed and applied to the modern passenger cars, such as Electronic Stability Systems (ESC), Autonomous Emergency Braking (AEB), etc. In addition to such actually deployed systems, Adaptive Cruise Control (ACC) and Lane Keep Assistance System (LKAS) have been researched and developed among universities and companies as key technology of automated driving systems. This lecture will present the fundamental theories and principles.

Georg Rill - OTH Regensburg, Regensburg, Germany
6 lecture on: Multibody sytems and simulation for vehicle dynamic. The lecture begins with an introduction to Multibody Systems (MBS). It presents the elements of MBS and discusses different modeling aspects. Then, different methods to generate the equations of motion are presented. Solvers for ordinary differential equations (ODE) as well as differential algebraic equations (DAE) are discussed. Finally, techniques for „online" and „offline" simulations including real-time applications are presented like necessary for car development. Special examples show the connection between simulation and test results.

VEHICLE DYNAMICS
OF MODERN PASSENGER CARS

Udine, August 29 - September 2, 2016
Application Form
(Please print or type)

Surname _____

Name _____

Affiliation_____

Address_____

_____

E-mail _____

Phone _____Fax_____

Method of payment upon receipt of confirmation (Please check the box)

The fee is 575,00 Euro + 22% Italian VAT taxes, where applicable (bank charges are not included).

❏ *I shall send a check of Euro _____*

❏ *Payment will be made to CISM - Bank Account No. 094570210900, VENETO BANCA - Udine (CAB 12300 - ABI 05035 - SWIFT/BIC VEBHIT2M - IBAN CODE IT46 N 05035 12300 09457 0210900). Copy of the receipt should be sent to the secretariat*

❏ I *shall pay at the registration counter with check or VISA Credit Card (Mastercard/Eurocard, Visa, CartaSì)*

IMPORTANT: CISM is obliged to present an invoice for the above sum. Please indicate to whom the invoice should be addressed.

Name _____

Address _____

_____

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C.F.*_____

VAT/IVA* No _____
(*) Only for EU residents or foreigners with a permanent business activity in Italy.

Only for Italian Public Companies
❏ *I ask for IVA exemption (ex law n. 537/1993 - art. 14 comma 10).*

Privacy policy: I understand that data received via this form will be used only to provide information about CISM and its activities, within the limits set by the Italian legislative decree no. 196/2003 and subsequent amendments.
Complete information on CISM's privacy policy is available at www.cism.it.

I have read the "Admission and Accommodation" terms and conditions and agree.

Date _____ Signature _____