

TIME TABLE

TIME	Monday June 21	Tuesday June 22	Wednesday June 23	Thursday June 24	Friday June 25
9.00 - 9.45	Registration	Zuazua	Puel	Zuazua	Zuazua
9.45 - 10.30	Asch	Zuazua	Puel	Zuazua	Bermúdez
11.00 - 11.45	Puel	Puel	Asch	Telega	Telega
11.45 - 12.30	Puel	Puel	Asch	Asch	Telega
14.30 - 15.15	Miara	Asch	Telega	Bermúdez	
15.15 - 16.00	Miara	Asch	Bermúdez	Bermúdez	
16.30 - 17.15	Zuazua	Bermúdez	Miara	Miara	
17.15 - 18.00	Telega	Bermúdez	Miara	Miara	

ADMISSION AND ACCOMMODATION

The registration fee is 450,00 € for students and participants on the regular staff of universities and research centres, or 650,00 € for other participants.

Applicants must apply at least one month before the beginning of the course. Application forms can be sent by post or on-line through our web site: <http://www.cism.it>. A letter of confirmation will be sent to accepted participants.

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. Requests should be sent to CISM Secretariat by **April 21, 2004** together with the applicant's curriculum and a letter of recommendation by the head of the department or supervisor confirming that the institute cannot provide funding. Preference will be given to applicants from countries which sponsor CISM.

The Deutsche Forschungsgemeinschaft offers scholarships to German students (please contact Mr Höfeld, DFG, Kennedyallee 40, 53175 Bonn, +49 (0) 228 885 2321, <http://www.dfg.de/>).

There is a possibility of financial support of young researchers by the "Research Training Network of the European Community, HPRN-CT-2002-00284".

This possibility is guaranteed by the coordinator of the Network, Prof. Bernadette Miara from France, who is one of the lecturers (miarab@esiee.fr).

A list of hotels in Udine is available at <http://www.cism.it>, or can be mailed upon request.

For further information please contact:
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 33100 Udine (Italy)
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<http://www.cism.it>



ACADEMIC YEAR 2004
 The Bjerknes Session

***CONTROL OF SOLIDS
 AND STRUCTURES***
***MATHEMATICAL MODELLING
 AND ENGINEERING APPLICATIONS***

Advanced School
 Coordinated by

J.J. Telega, Polish Academy of Sciences, Poland
E. Zuazua, Universidad Aut. de Madrid, Spain

Udine, June 21 - 25, 2004

**International Centre for Mechanical Sciences
 Centre International des Sciences Mécaniques**

CONTROL OF SOLIDS AND STRUCTURES MATHEMATICAL MODELLING AND ENGINEERING APPLICATIONS

The control of solids and structures covers a rapidly developing field of research ranging from advanced mathematical modelling to a rich variety of practical problems. During the Course those new and far-reaching developments will be reviewed covering mathematical aspects, numerical methods and appealing engineering applications. From the mathematical point of view, the problems of exact and approximate controllability are to be distinguished. In the first case one looks for a control driving, say a vibrating system, to a desired final state. The system studied may be described by parabolic-type, hyperbolic-type or a coupled system of various orders. The problem is relevant for vibrating structures like beams, plates or shells which should be driven to a desired final state. A good example of coupled systems is provided by structural acoustics systems (fluid-structure interaction) where mathematical models offer vast possibilities of application to active noise control and noise reduction. It is not always possible to exactly control the system under consideration. In this case one is naturally lead to analyze the property of approximate controllability: one is now interested to drive the solution arbitrarily close but not exactly to the target. Strongly linked with the problem of controllability is the issue of stabilisation or time-decay of solutions when time tends to infinity. This problem is of great importance from the engineering point of view since by applying the appropriate feedback controls, one can stabilise a vibrating system.

The aim of the Course is threefold:

- (i) To provide in-depth insight into significant aspects of controllability and stabilisation of solids and structures, including optimal control of structural acoustics systems.
- (ii) To present available numerical methods for solving complex mathematical problems of controllability and stabilisation of solids and structures.
- (iii) To show the importance of new mathematical tools to controllability of engineering structures like flexible

ones, strings, beams, plates, shells, vibrating piezocomposites, etc. Of great importance will also be the study of active noise reduction. The Course will be focused on currently important mathematical and numerical issues of controllability of great value to engineering practice.

INVITED LECTURERS

M. Asch - Université de Picardie J. Verne, France
6 lectures on: Description of different classes of control problems; exact controllability, approximate controllability, control algorithms; examples and applications: acoustics and vibration control, inverse problems.

A. Bermúdez de Castro - Universidade de Santiago de Compostela, Spain
6 lectures on: Mathematical modeling of structural acoustics problems including control problems related to noise reduction in enclosures, numerical methods, active noise reduction.

B. Miara - Ecole Supérieure d'Ingenieurs en Electrotechnique et Electronique, France
6 lectures on: Controllability of three-dimensional piezoelectric plates and shells, piezoelectric perforated structures.

J.- P. Puel - University de Versailles St. Quentin, France
6 lectures on: Carleman inequalities and applications to controllability and inverse problems, applications to wave - type equations, heat - type and diffusion - convection equations.

J.J. Telega - Polish Academy of Sciences, Poland
5 lectures on: Controllability and stabilisation of anisotropic solids and linear plates, stabilisation of nonlinear plates, exact and approximate controllability of linear shells, stabilisation of nonlinear shells, von Kármán plates excited by actuators made of piezoceramics and homogenization.

E. Zuazua - Universidad Autónoma de Madrid, Spain
6 lectures on: Control of flexible strings and beams, control and singular limits for classical models in elasticity, observability problem, spectral aspects of control, numerical aspects of control problems.

PRELIMINARY SUGGESTED READING

J.L. Lions, Optimal Control of Systems Governed by Partial Differential Equations, Springer (1971).

R. Glowinski and J.L. Lions, Exact and approximate controllability for distributed parameter systems, Part I and II in: Acta Numerica, Cambridge University Press (1994 & 1995).

J. Cooper, Introduction to Partial Differential Equations with MATLAB, Birkhäuser (1998).

D. Tataru, Carleman estimates and unique continuation for solutions to boundary value problems, J, Math. Pures Appl., 75, 367-408, 1996.

H.T. Banks, R.C. Smith and Y. Wang, Smart Material Structures: Modeling, Estimation and Control, Wiley Masson (1996).

V. Komornik, Exact Controllability and Stabilization: The Multiplier Method, Wiley Masson (1994).

J. Zabczyk, Mathematical Control Theory: An Introduction, Birkhäuser (1992).

H. J.-P. Morand and R. Ohayon, Fluid-Structure Interactions, Wiley (1995).

P.A. Nelson, S.J. Elliot, Active Control of Sound, Academic Press (1999).

E. Zuazua, Propagation, observation, control and numerical approximation of waves, Preprint, 2003 (<http://www.uam.es/enrique.zuazua>).

L. Leon and E. Zuazua, Boundary controllability of the finite - difference space semi-discretization of the beam, ESAIM: Convex Optim. Calc. Var., A Tribute to J.-L. Lions, 2, 827-862, 2002.

J.J. Telega. Topics on deterministic and stochastic controllability and stabilization of distributed parameter systems: theory and numerical approximations, in: Structural Control and Health Monitoring, ed. by J. Holnicki-Szulc, pp 213-340, AMAS Lecture Notes 1, IFTR, Warsaw 2001.

LECTURES

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

**CONTROL OF SOLIDS AND STRUCTURES
MATHEMATICAL MODELLING AND
ENGINEERING APPLICATIONS**

Udine, June 21 - 25, 2004

Application Form
(Please print or type)

Surname _____

Name _____

Affiliation _____

Address _____

E-mail _____

Phone _____ Fax _____

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

- I shall send a check of Euro 650,00 / 450,00
VAT (IVA) included and bank charges excluded
- Payment will be made to CISM - Bank Account N° 094570210900,
VENETO BANCA - Udine (CAB 12300 - ABI 05418 - SWIFT AMBPIT2M -
IBAN CODE IT83Z 05418 12300 09457 0210900).
Copy of the receipt should be sent to the secretariat
- I shall pay at the registration counter with check, cash or VISA Credit
Card (*Mastercard/Eurocard, Visa, CartaSi*)

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

Name _____
Address _____ _____ _____
C.F.* _____
VAT (IVA)* _____

(*) Only for EU residents or foreigners with a permanent business activity in Italy.

Privacy policy: I understand that, according to the Italian law 675/96 in defence of privacy, personal data will be used exclusively for CISM's activities; any other use will require my explicit authorisation.

Cancellation policy: I have read the "Admission and Accommodation" terms and conditions and agree to the policy.

Date _____ Signature _____

Please return to: CISM, P. Garibaldi 18 - 33100 UDINE (Italy)