ADMISSION AND ACCOMMODATION

Applicants must contact CISM Secretariat 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.

The 700.00 Euro registration fee includes a complimentary bag, four fixed menu buffet lunches (Friday not included), hot beverages, on-line/downloadable lecture notes and wi-fi internet access.

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 10, 2013 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.
The goal of this course is to give a modern presentation of the mathematical theory of damage completed by various applications. Specifically, the course can be divided into three main parts:

Part I: General framework for developing damage models. This part will begin by a presentation of the physical aspects of damage in order to establish the basic ingredients required to model them at a macroscopic level. We do not intend to develop a full micromechanical approach. However, the main microstructural mechanisms of damage will be highlighted and a multi-scale approach will be used to make a link between damage and fracture. Then models of different types will be elaborated, each one being related to a particular class of materials or mechanisms: interfacial and cohesive zone models, local versus nonlocal models, discrete versus continuous damage models, concrete and geomaterial damage models with chemo-mechanical coupling, isotropic versus anisotropic damage models, modelling of the asymmetric behaviour in tension and compression, modelling of Mullins effect in elastomers, damage models in biological systems...).

Part II: Qualitative analysis of the evolution problem of damage. This part will be devoted to the mathematical study of the governing equations for the evolution of damage. In particular, we will emphasize the theoretical merits of the variational approach which allows to introduce in a natural and rational way the fundamental concepts of bifurcation and stability. We will show in particular that, in presence of softening, the classical approaches based on the equilibrium equations and the constitutive evolution laws are not sufficient to lead to well-posed problems while the introduction of stability conditions allows to rule out unphysical solutions. These concepts and their consequences will be illustrated by means of key examples.

Part III: Numerical implementation and various applications. In this last part various numerical methods will be presented and compared. Moreover, we will focus on the link between damage models and fracture mechanics. We will show how damage evolution can be used as a pre-cursor to crack propagation. Various numerical tests will illustrate the power of such an approach.

The course is addressed to a broad public: graduate students, young researchers and practicing engineers. Since a major part of the course will be devoted to theoretical and numerical modelling, a sound understanding of continuum mechanics and of elasticity theory is recommended.

Preliminary Suggested Readings


Variational Approaches to Damage in Continua and Interfaces

The application of gradient damage models to fracture. (Gradient damage models to approach brittle fracture; homogeneous solutions, loss of stability and limit stress; localized solutions, their energy and toughness; examples of damage models converging to fracture; unilateral effects; fracture and damage under thermal loads).

Antonio De Simone - SISSA, Trieste, Italy
6 lectures on: Damage of elastomers and application to biomechanics. (Polymers and Elastomers; large deformation hyperelastic models for rubber elasticity; Mullins effect in rubbers; outlook of applications of damage mechanics in biological systems).

Jean-Jacques Marigo - Ecole Polytechnique, Palaiseau, France
7 lectures on: The variational approach to damage modeling. (the basic concepts of damage mechanics; the standard local damage models for brittle materials; the evolution problem of damage in a structure; the variational approach to gradient damage models; stability and bifurcations issues).

Claudia Comi - Politecnico di Milano, Italy
6 lectures on: Damage models for concrete like materials. (inelastic behaviour of concrete and rocks; isotropic damage models; anisotropic damage models; fracture energy based pseudo-regularization and non-local formulation; multiphase modelling of chemo-mechanical degradation).

Marc Geers - Eindhoven University of Technology, The Netherlands
6 lectures on: Interface damage mechanics & multi-scale approaches. (interface mechanics; cohesive zones; basics, large deformations, multi-scale aspects; ductile damage and nonlocal large deformation approaches; multi-scale damage-to-fracture transition: from homogenization to localization).

Blaise Bourdin - Louisiana State University, Baton Rouge, LA, USA
6 lectures on: Numerical implementations of gradient damage models. (panorama of numerical models; limit models; gradient damage models seen as approximation of sharp interface fracture and damage models; Gamma convergence, Ambrosio-Tortorelli vs. Modica Mortolla; numerical implementation of Ambrosio-Tortorelli and examples; improving the implementations: effective toughness, backtracking, dynamic).

Corrado Maurini - Université Paris 6, France
6 lectures on: The application of gradient damage models to fracture. (gradient damage models to approach brittle fracture; homogeneous solutions, loss of stability and limit stress; localized solutions, their energy and toughness; examples of damage models converging to fracture; unilateral effects; fracture and damage under thermal loads).

INVITED LECTURERS

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VARIATIONAL APPROACHES TO DAMAGE
IN CONTINUA AND INTERFACES
Udine, June 10 - 14, 2013
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 of Euro 700,00 includes IVA/VAT tax and excludes bank charges

❏ I shall send a check of Euro

❏ Payment will be made to CISM - Bank Account N° 094570210900, VENETO BANCA - Udine (CAB 12300 - ABI 05035 - SWIFT/BIC VEBHT2MB - 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, cash 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 __________________________