TIME TABLE

TIME	Monday	Tuesday	Wednesday	Thursday	Friday
	October 1	**October 2**	**October 3**	**October 4**	**October 5**
9.00 - 9.45	Registration	Dascalu	Osovski	Rittel	Dascalu
9.45 - 10.30	Rittel	Dascalu	Osovski	Rittel	Dascalu
11.00 - 11.45	Rittel	Rodríguez-Martínez	Vadillo	Vadillo	Rodríguez-Martínez
11.45 - 12.30	Vadillo	Rodríguez-Martínez	Vadillo	Vadillo	Rodríguez-Martínez
14.00 - 14.45	Vadillo	Czarnota	Rodríguez-Martínez	Osovski	
14.45 - 15.30	Osovski	Czarnota	Rodríguez-Martínez	Osovski	
16.00 - 16.45	Osovski	Rittel	Dascalu	Mercier	
16.45 - 17.30	Czarnota	Rittel	Dascalu	Mercier	
18.00	Welcome Aperitif				

ADMISSION AND ACCOMMODATION

The registration fee is 600.00 Euro + VAT*, where applicable (bank charges are not included). The registration fee includes a complimentary bag, four fixed menu buffet lunches (on Friday upon request), 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 the following web site: http://www.cism.it. A message of confirmation will be sent to accepted participants. Applicants requiring assistance with the registration should contact the secretariat at the following email address cism@cism.it.

Applicants may cancel their course registration and receive a full refund by notifying CISM Secretariat in writing (by email to cism@cism.it) no later than two weeks prior to the start of the course.

Cancellation requests received during the two weeks prior to the start of the course will be charged a 50.00 Euro handling fee. Incorrect payments are also subject to a 50.00 Euro handling fee.

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

Requests should be sent to CISM Secretariat by **July 27, 2018** 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 the web site www.cism.it, or can be mailed upon request.

* Italian VAT is 22%.

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Centre International des Sciences Mécaniques
International Centre for Mechanical Sciences

ACADEMIC YEAR 2018

DAMAGE AND FAILURE OF MATERIALS UNDER EXTREME CONDITIONS

Marie Curie ITN
Joint Advanced School
coordinated by

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France

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University Carlos III of Madrid
Spain

Udine *October 1 - 5* 2018

DAMAGE AND FAILURE OF MATERIALS UNDER EXTREME CONDITIONS

CISM – OUTCOME Project (Marie Sklodowska Curie ITN) propose a joint advanced School on "Damage and failure of materials under extreme conditions". Members of the consortium OUTCOME will lecture on advanced experiments, analytical models and numerical simulations specifically derived to understand damage and failure mechanisms in aerospace and defense structures subjected to extreme loading conditions. Aerospace and defense structures have two common and interlinked denominators: (1) the extreme nature of the thermal and/ or mechanical loads they face during their service life; (2) the development of specific processes of damage and failure caused by such extreme loads.

From a mechanical standpoint, the integrity of structural elements is determined by the onset and evolution of damage which reduces the strength of the material and leads to failure. The specificities of damage and failure processes, linked not only to the extreme nature of the loads, but also to the character of the different materials used by the defense and aerospace sectors make this course especially attractive since physical aspects which develop in (both) ductile and brittle materials will be handled. While damage in ductile and brittle materials is mainly caused by the growth of microscopic voids and microcracks, the nature and characteristics of the failure are highly dependent on the specific material. In ductile materials, failure is mainly driven by the nucleation and growth of (micro) voids which lead to plastic flow localization. On the other hand, in brittle materials the fracture process is mainly caused by the development and interaction of cracks.

In this school, special attention will be paid to the influence of stress state, loading rate, inertial effects, material properties, thermal effects and microstructural evolutions on damage and failure of engineering materials. Modeling damage and failure of engineering materials including all these key parameters is, still today, an open challenge for the Solid Mechanics community which is being faced by the lecturers of this course within the project OUTCOME. Thus, our aim is to show experimental, numerical and analytical results which help to explain the mechanical conditions of failure in structural elements used in aerospace and defense industries.

The joint advanced school is especially suitable for students and young researches working in the field of dynamic constitutive modelling, damage and failure of engineering materials. After the course, the participants will be able to: (1) identify the specific features which characterize the response of materials under dynamic loading, (2) determine the requirements for constitutive models used to describe the dynamic behaviour of solids, (3) verify models predictions based on dedicated experiments, (4) have an overview of problems faced, within the domain of intense loading, in the aerospace and defense sectors.

PRELIMINARY SUGGESTED READINGS

Antoun, T., Seaman L., Curran D.R., Kanel G., Razorenov S, Utkin A. Spall fracture, Springer.

Meyers M.A, Dynamic behavior of materials, Wiley.

Freund, L.B., 1998. Dynamic Fracture Mechanics. Cambridge University Press.

Czarnota C., Jacques N., Mercier S., Molinari A. Modelling of dynamic ductile fracture and application to the simulation of plate impact tests on tantalum. Journal of the Mechanics and Physics of Solids. 2008; 56:1624-1650.

Fressengeas C., Molinari A. Inertia and thermal effects on the localization of plastic flow. Acta Metallurgica. 1985; 33: 387-396.

Keita O., Dascalu C., François B. A two-scale model for dynamic damage evolution. Journal of the Mechanics and Physics of Solids. 2014, 64: 170-183.

Gurson A. L. Continuum theory of ductile rupture by void nucleation and growth part I. yield criteria and flow rules for porous ductile media. Journal of Engineering Materials Technology. 1977; 99: 2-15.

Rodríguez-Martínez J.A., Vadillo G., Fernández-Sáez J., Molinari A. Identification of the critical wavelength responsible for the fragmentation of ductile rings expanding at very high strain rates. Journal of the Mechanics and Physics of Solids. 2013; 61: 1357-1376.

Vadillo G., Reboul J., Fernández-Sáez J. A modified Gurson model to account for the influence of the Lode parameter at high triaxialities. European Journal of Mechanics - A/Solids. 2016; 56: 31-44.

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

Christophe Czarnota - Université de Lorraine, Metz, France
3 lectures on:
*D*ynamic ductile damage. Plate impact test. Propagation of shock waves. Numerical simulations.

Cristian Dascalu - Université de Lorraine, Metz, France
6 lectures on:
Multiscale modeling of dynamic damage in brittle materials. Asymptotic homogenization method. Effective damage laws for solids with microcracks. Microstructural size effects. Thermal influences on damage evolution. Dynamic failure simulations.

Sébastien Mercier - Université de Lorraine, Metz, France
2 lectures on:
Dynamic damage model with micro inertia. Void shape effect on effective behavior.

Shmuel Osovski - Technion - Israel Institute of Technology, Haifa, Israel
6 lectures on:
Dynamic fracture mechanics. Specimens and loading techniques. Experimental techniques for fracture parameters determination. Energy dissipation sources and their influence on measured fracture parameters.

Daniel Rittel - Technion - Israel Institute of Technology, Haifa, Israel
6 lectures on:
Experimental techniques for dynamic testing. Presentation of dedicated specimens. Infrared sensing and thermomechanical coupling. Adiabatic shear failure, from the macro to microscopic scales.

José A. Rodríguez-Martínez - University Carlos III of Madrid, Spain
6 lectures on:
Plastic instabilities. Dynamic necks and adiabatic shear bands. Fundamentals of flow localization. Linear stability analyses. Numerical modelling of multiple localization patterns.

Guadalupe Vadillo - University Carlos III of Madrid, Spain
6 lectures on:
Static ductile fracture. Fundamentals for porous ductile solids. Homogeneization procedure. Gurson model. Extensions of the Gurson model. Finite-element implementation.