TIME	Monday October 3	Tuesday October 4	Wednesday October 5	Thursday October 6	Friday October 7
9.00 - 9.45	Wriggers	Stupkiewicz	Geers	Geers	Stupkiewicz
9.45 - 10.30	Molinari	Stupkiewicz	Geers	Geers	Stupkiewicz
11.00 - 11.45	Molinari	Wriggers	Geers	Stupkiewicz	Popp
11.45 - 12.30	Molinari	Wriggers	Geers	Stupkiewicz	Popp
14.00 - 14.45	Popp	Zohdi	Molinari	Zohdi	
14.45 - 15.30	Popp	Zohdi	Molinari	Zohdi	
16.00 - 16.45	Popp	Zohdi	Molinari	Wriggers	
16.45 - 17.30	Popp	Zohdi		Wriggers	

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 two weeks prior to the start of the course.

If cancellation occurs less than two weeks prior to the start of the course, 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 **August 3, 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:
CISM
Palazzo del Torso
Piazza Garibaldi 18
33100 Udine (Italy)
tel. +39 0432 248511 (6 lines)
fax +39 0432 248550
e-mail: cism@cism.it

COMPUTATIONAL CONTACT AND INTERFACE MECHANICS

Advanced School
coordinated by

Alexander Popp
Technische Universität München
Germany

Peter Wriggers
Leibniz Universität Hannover
Germany

Udine *October 3 - 7* **2016**

COMPUTATIONAL CONTACT AND INTERFACE MECHANICS

The main objective of this course is to convey modern techniques and the latest state-of-the-art with regard to the most fundamental aspects of computational contact mechanics. However, since contact can readily be interpreted as a special type of interface problem, it seems advisable not to isolate contact mechanics, but rather to address it in the context of a broader class of problems denoted as computational interface mechanics. Apart from the computational treatment of contact interaction and friction, computational interface mechanics also comprises other related physical phenomena such as wear, fracture and phase boundaries. Put in short terms, computational contact and interface mechanics are concerned with the treatment of complex interface effects at different length scales ranging from atomistic models to micro- and meso-scale models and

further to classical continuum models at the macro-scale. The nature of many interface phenomena even requires a multi-scale perspective and associated models to bridge the spectrum of relevant length scales.

Therefore, the aforementioned aim of the course has been expanded towards firstly conveying a clear understanding of the underlying physics of interfaces, and secondly giving a comprehensive insight into the current state-of-the-art and selected cutting-edge research directions in the computational treatment of interface effects. With regard to the first aim, the course will focus on the modeling of friction, wear, lubrication, cohesive interfaces, grain boundaries, phase boundaries, fracture, thermo-mechanics and particulate contact (e.g. granular media). In view of the second objective, the most

important computational aspects will be addressed, including discretization techniques for finite deformations, solution algorithms for single- and multi-processor computing environments, multi-scale approaches, discrete element models and multi-physics problems including contact and interface constraints. Among the computational techniques covered in this course are finite element (FEM) and boundary element (BEM) methods, atomistic models, molecular dynamics (MD), discrete element methods (DEM), coupling approaches for multi-scale simulations, and tools for an efficient automated FEM code generation.

Each set of lectures will start from the respective basics of physical modeling and computational techniques, but will then quickly move on to an in-depth treatment of cutting-edge research topics. While some attention to practical applications

will of course be given, the main focus of all lectures is to convey sound theoretical formulations with regard to the underlying mathematics and mechanics. The lectures are primarily designed for doctoral students of applied mathematics, mechanics, engineering and physics with a strong interest in the modeling and simulation of complex interface phenomena using high-performance computing environments.

However, they are equally suited for young and senior researchers in the above-mentioned and neighboring fields, who have only little experience with regard to the computational treatment of interface effects and who would like to gain a compact yet comprehensive overview of the field. Last but not least, the course might also be interesting for practicing computational engineers working on high-level industrial applications of contact and interface mechanics.

PRELIMINARY SUGGESTED READINGS

M.J. van den Bosch, P.J.G. Schreurs, M.G.D. Geers, On the development of a 3D cohesive zone element in the presence of large deformations, Computational Mechanics, 42, 171-180 (2008).

J. Lengiewicz, J. Korelc, S. Stupkiewicz, Automation of finite element formulations for large deformation contact problems, International Journal for Numerical Methods in Engineering, 85, 1252-1279 (2011).

A. Popp, W.A. Wall, Dual mortar methods for computational contact mechanics: Overview and recent developments, GAMM-Mitteilungen, 37, 66-84 (2014).

P. Wriggers, Computational Contact Mechanics, 2nd ed., Springer, (2008).

V.A. Yastrebov, G. Anciaux, J.-F. Molinari, From infinitesimal to full contact between rough surfaces: evolution of the contact area, International Journal of Solids and Structures, 52, 83-102 (2015).

T.I. Zohdi, Additive particle deposition and selective laser processing – A computational manufacturing framework, Computational Mechanics, 54, 171-191 (2014).

INVITED LECTURERS

Marc Geers - Eindhoven University of Technology, The Netherlands
6 lectures on: Multi-scale Approaches in Interface Mechanics. Modeling and simulation of cohesive interfaces: short overview on cohesive zones, multi-scale models, fibrillating interfaces. Modeling and simulation of metallic interfaces: crystal plasticity, grain boundary plasticity, phase boundary plasticity.

Jean-François Molinari - École Polytechnique Fédérale de Lausanne, Switzerland
6 lectures on: Physics of Contact Across Scales: Nano-, Meso- and Macro-scale. Numerical methods for analyzing contact across scales: molecular dynamics, finite element method, cohesive-zone models, boundary element method, multi-scale approaches. Modeling of friction and wear: rough surfaces, slip weakening friction, rate and state friction, wear mechanisms, analogies with fracture mechanics.

Alexander Popp - Technische Universität München, Germany
6 lectures on: Computational Methods for Finite Deformation Contact Mechanics. Finite element methods for finite deformation contact and friction: mortar methods, efficient constraint enforcement techniques, scalable parallel algorithms and solvers, inclusion of complex interface effects. Contact of beams and rods.

Stanisław Stupkiewicz - IPPT PAN, Warsaw, Poland
6 lectures on: Wear, Lubrication and Micromechanics of Interfaces Modeling and simulation of contact with wear, elastohydrodynamic lubrication, micromechanics of interfaces, interfaces in martensitic microstructures, automation of finite element code generation for computational contact mechanics.

Peter Wriggers - Leibniz Universität Hannover, Germany
5 lectures on: Emerging Computational Techniques in Contact and Interface Mechanics. Smooth contact discretizations: isogeometric analysis for contact mechanics, isogeometric mortar methods. Emerging computational techniques: contact formulations using a third medium, contact formulations using Nitsche's method.

Tarek Zohdi - University of California, Berkeley, CA, USA
6 lectures on: Multiphysics, Discrete Elements and Granular Media. Coupling discrete element methods to continua involving thermo-mechanical, optical and acoustical contact, applications motivated by advanced manufacturing. The lectures are geared towards exposing the audience to non-standard coupling involving discrete and continuum formulations and widely disparate physics.

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.

COMPUTATIONAL CONTACT AND INTERFACE MECHANICS

Udine, October 3 - 7, 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, 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* 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 _____