

ALERT Geomaterials

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ALERT President Gioacchino (Cino) Viggiani



ALERT Director Frédéric Collin

Dear ALERT members,

this annual Newsletter of ALERT Geomaterials provides you with some information about our past and future activities, and shows the scientific vitality of our network. In 2022, our regular activities in Aussois took place without (almost) any constraints related to the pandemic: three Workshop sessions and a Doctoral School took place. All of them were very stimulating, and we thank all the organizers for their hard work. A detailed presentation of these events is provided in the following. Both the workshop and the school could be attended remotely. However, very few people were connected during the workshop this year and hybrid mode is increasing the complexity of organization. Therefore, the Board of Directors decided that remote attendance will only be possible during the school, and not for the workshop.

This year, ALERT welcomes two new member institutions: Université Savoie Mont Blanc (USMB), represented by Prof. François Nicot, and University of Salerno, represented by Prof. Sabatino Cuomo. The total number of member institutions is now 38 (!).

Concerning the forthcoming ALERT meeting, this year, the half-day workshop session (on Tuesday morning) has never been more aptly named the "exploratory

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session", because it is devoted to "Extraterrestrial geomechanics". The objective of this session is to explore how geomechanics can help to better understand the structure of Mars.

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The ALERT Doctoral school will deal with "Machine Learning in Geomechanics", and it will be organised by Ioannis Stefanou and Felix Darve. It should be highlighted that the idea is not only to provide stateof-the-art lectures on the main methods of machine learning but also to offer to the students the opportunity to suggest scientific problems/questions directly related to their own research!

The ALERT summer school will be held in Liege between August 28 and September 1st, 2023. It will be organised by University of Liège and TU Delft, and it will be devoted to Multiphysics and multiscale coupled processes in geomaterials. On the last day of the school, a visit to the HADES Underground Research Laboratory will be organised. The school will be organised in cooperation with two ongoing EURAD EU-projects.

See you all in Aussois, keep staying safe and long life to ALERT-Geomaterials!

Frédéric Collin and Cino Viggiani



In 2022 the annual ALERT Workshop was held from September 26th to September 28th in Aussois – with the possibility to also attend it remotely. The total number of participants was 202, of which only 11 attended remotely. This well illustrates to what extent the ALERT community cares about our annual meeting in Aussois. The regional distribution of the participants from the member institutions of ALERT Geomaterials is shown in the Figure below.

In 2022, 56% of the participants reached the Paul Langevin center by train, and 39% by car.

As always since 2013, the session on Tuesday lasted only half a day and was followed in the afternoon by the Board of Directors meeting, the PhD-prize ceremony, and the Special lecture in the afternoon.

The three topics of the 2022 ALERT Workshop are listed below:

- 1 Mechanics of hard-soils/soft rocks coord. C. Vitone, N. Benahmed & E. Charalampidou
- 2 Robot Ground Interaction coord. R. Fuentes & I. Einav
- 3 Multi-field approach of gravity-driven disasters in a global climate change context coord. F. Nicot, F. Magnin, S. Lambert & F. Calvetti

We thank all active participants and coordinators for their effort. Back to Contents



Figure 1. Participants of the ALERT Workshop 2022





Georgios Tzortzopoulos (EC-Nantes), Cino Viggiani and Miguel Molinos Perez (Universidad Politécnica de Madrid)

ALERT PhD Prize 2022

The jury of the ALERT PhD Prize 2022 was composed of G. Viggiani (President of ALERT), J. Andrade (ALERT Invited Lecturer for 2022), A.C. Dieudonne (chosen member) and J. Vaunat (chosen member). Only PhD students from one of the institutions belonging to ALERT are eligible candidates for the prize, which consists of a certificate and a reward of 1000 Euros.

The three finalists, Miguel Molinos Perez (Universidad Politécnica de Madrid), Georgios Tzortzopoulos (EC-Nantes), Zhongzheng Wang (University of Sydney) were selected by the jury out of 11 applicants.

The jury of the ALERT PhD Prize 2022 was composed of G. Viggiani (President of ALERT), J. Miguel Molinos Perez for his work entitled

> The Local Maximum-Entropy Material Point Method

and to Dr. Georgios Tzortzopoulos for his work entitled

Controlling earthQuakes (CoQuake) in the laboratory using pertinent fault stimulating techniques

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The ALERT Special Lecturer 2022 Prof. Jose Andrade

Special Lecture 2022: Prof. Jose Andrade

The ALERT Special lecture 2022 was delivered by Prof. Jose Andrade, George W. Housner Professor of Civil and Mechanical Engineering, Cecil and Sally Drinkward Leadership Chair, California Institute of Technology.

The title of the lecture was:

The force is strong with this one

An abstract of his presentation is available on the ALERT website:

http://alertgeomaterials.eu/alert-special-lecture///

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ALERT Doctoral School 2022

The ALERT Doctoral School 2022 was taught and attended face-to-face in Aussois or remotely by more than 100 participants. The topic of the school was

Advanced experimental geomechanics

This school was organized by Edward Andò (EPFL), Benjy Marks (University of Sydney) and Ryan Hurley (Johns Hopkins Whiting School of Engineering).

The lectures were presented by

- Edward Andò (EPFL)
- Benjy Marks (University of Sydney)
- Ryan Hurley (Johns Hopkins University)
- Joshua Dijksman (Wageningen)

Organising Institutions of the ALERT School 2022

The tools which we use to experimentally probe geomaterials have evolved rapidly in the past 20 years. It is now possible to see not only the outside of a sample as it is deformed, but also the internal displacement field. Other tools provide access to the forces and stresses experienced at every point in the sample. We will provide a rationale for the use of these techniques, guidance into their background, development and the state of the art, and hands-on experience with each tool. Participants will leave this workshop with the methodological, experimental and computational tools required to use these techniques in their own research.

Lectures were given on two days and a half and included the following topics, defining what is Advanced Experimental Geomechanics:

- Why even do experiments?
- Measurement Science crash course
- Introduction to 2D imaging from photos to DIC
- Measuring forces with photoelasticity
- Introduction to 3D imaging with RIMS
- Deeper into 3D with X-ray CT
- Towards 4D with deformation quantification

On behalf all the ALERT members we want to thank the lecturers and the organizers for their commitment.

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The accompanying book, containing articles referring to the lectures, as well as some books of previously held doctoral schools can be downloaded from the ALERT website.

http://alertgeomaterials.eu/publications/



JOHNS HOPKINS



ALERT Workshop 2023

The ALERT Workshop will be organized in 2023, from Monday, September 25th to Wednesday, September 27th. The workshop will take place at the Centre Paul Langevin in Aussois, France. Please note that only in-person attendance will be possible this year (no remote attendance).

The themes of the three sessions are listed below, along with the relevant coordinators:

1 Energy geomechanics

coord. J.M. Pereira, C. Santamarina & D. Manzanal

The use of the geological subsurface is gaining interest in various energy-related applications, covering energy recovery and storage. In these applications, the physical phenomena at play in the encountered porous materials include -often in a coupled manner- heat and mass transfers, multiphase flow, reactive transport of fluids, mechanics, etc.

The session will be devoted to the engineering of energy storage and recovery applications. Contributions focusing on a variety of scales, from the material to the reservoir ones, will be considered.

2 Extraterrestrial geomechanics coord. P. Delage & F. Prada

The InSight mission, which landed on Mars in 2018, is a geophysical mission with a seismometer (SEIS) supplied by France and a penetrometer (HP3) supplied by Germany as its main instruments for measuring the thermal gradient on the surface.

Thanks to the detection of Martian earthquakes (Marsquakes), the mission was able to improve the determination of the planet's structure (radius of the core, mantle and crust), as intended. The seismometer also detected large meteorite impacts. The Near Surface Working Group is also interested in the geological and mechanical properties of the surface. They have studied the interaction between a Martian regolith analogue and the seismometer, and estimated in advance the elastic properties, with values close to those measured on site.

The proposed session would be based on the participation of European scientists involved in the mission.

3 Anisotropy in geomaterials: theory, experiments and modelling

coord. E. Gerolymatou, C. Viggiani, & A. Amorosi

Anisotropy, i.e., the variation of any given property of the material with direction, can have a significant effect on the material response to loading. It is present in most types of geomaterials, ranging from granular soils to hard rocks.

Due to the significant effort required to determine in the laboratory the internal variables of the material and the additional difficulties linked to its constitutive description, it is in most applications ignored as a matter of fact. However, in the last years significant efforts have been made in both directions.

With the present topic suggestion the organizers would like to invite contributions from researchers working on anisotropy in geomaterials in the fields of constitutive law development, experimental testing and numerical simulation. The aim is to increase awareness of the significance of anisotropy, to stimulate scientific exchange and to provide a first exposure to its intricacies for younger researchers.

As always, these three sessions will include invited speakers as well as contributions selected from the abstract submission process.

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CHALMERS





Organising Institutions of the ALERT Workshop 2023



ALERT Doctoral School 2023

This year, the ALERT Doctoral School will be taught in Aussois from Thursday, 29th September to Saturday, 1st October. It will be possible to attend it either in-person or remotely,

The topic of the ALERT School is

Machine Learning in geomechanics

It will be organized by Ioannis Stefanou (Ecole Centrale - Nantes) and Félix Darve (Université Grenoble-Alpes).

The objective of this doctoral school is to explain what Machine Learning (ML) is, what its main methods are, and how can Machine Learning be used for solving real-case problems in geomechanics, in particular, and in solid mechanics, in general. Lectures and hands-on exercises using regression and classification ML methods, supervised and unsupervised ML techniques, Artificial Neural Networks, deep learning and model reduction techniques will be taught.

Lectures will be held on two days and a half and will have the following aims:

- Gain an understanding of what ML is
- Study the most important ML methods for regression, classification and model order reduction

- Follow the basic mathematical and geometric notions behind ML methods
- Use ML in simple examples, get aware of pitfalls and understand the need for physics/geomechanics-based ML methods

It is important to highligh that there are some requirements for the students:

- Python programming language (for those who are unfamiliar with Python we suggest the book "Python Crash Course: A Hands-On, Project-Based Introduction to Programming" by Eric Matthes, but many excellent tutorials can be found on the internet as well).
- Basic concepts in mathematics (algebra, analysis, elements of differential calculus and numerical analysis).
- Have some problems in mind in relation with their research and geomechanics that they believe that ML could help.

The lectures will be held by Félix Darve, Ioannis Stefanou, Filippo Masi, Noel Jakse, Steve WaiChing Sun, Filippo Gatti, and Konstantinos Karapiperis.

The online registration for the ALERT School will open in July and will be announced on the website.

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Organising Institutions of the ALERT School 2023



ALERT Olek Zienkiewicz Course 2023

The 13rd edition of the ALERT Olek Zienkiewicz Course will be organized from 28th August to 1st September 2023, in Liège, Belgium. The topic of the school is

Multiphysics and multiscale coupled processes in geomaterials.

Focus on thermal effects and gas transfer impact on the behaviour of geomaterials.

The school is organised by Frederic Collin (University of Liège, Belgium) and Anne Catherine Dieudonné (TU-Delft, The Nederlands).

Abstract: Geomechanics plays a significant role in the understanding of the multiphysics and multiscale processes taking place in a geological disposal facility for radioactive waste. The objective of the school is to introduce state-of-the-art understanding, concepts and methods related to thermohydro-mechanical coupled processes, the physical impacts of thermal loading and the mechanistic understanding of gas migration in geomaterials.

The school will be organized in cooperation with EURAD Gas and HITEC EU-projects. Results arising from the EURAD project will thus be integrated to the school and a half day will be dedicated to presentations by early-career researchers.

Lectures covering the following topics as well as practical sessions on some of them will be delivered:

- Fundamentals in thermo-hydro-mechanical processes in geomaterials
- Basics of experimental testing of geomaterials
- Constitutive modelling of thermo-hydromechanical processes in geomaterials
- Development, validation and maintenance of numerical codes
- Advanced multiphysics experimental testing and imaging of geomaterials
- Advanced multiphysics modelling of geomaterials: multiscale approaches and heterogeneities
- In situ THM and gas experiments

A visit to the HADES Underground Research Laboratory will be organised on the last day of the school.

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More details and registration:

http://alertgeomaterials.eu/category/ozcourse

UNIVERSITÉ SAVOIE MONT BLANC



UNIVERSITÀ DEGLI STUDI DI SALERNO

New institutional Member of ALERT

New Institutional Members of ALERT

In September 2022 there were two applications for ALERT membership: USMB (F. Nicot) and University of Salerno (S. Cuomo). The Board agreed on the fact that both USMB and University of Salerno are active members of ALERT, and thus both applications for membership were accepted.

Université Savoie Mont Blanc represented by prof. F. Nicot

University of Salerno represented by prof. S. Cuomo

With these decisions, the current number of member institutions of ALERT Geomaterials is 38!

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Organising Institutions of the ALERT Olek Zienkiewicz Course 2023





Special Lecture 2023: Prof. Catherine O'Sullivan

The ALERT Special Lecturer 2023 Prof. Catherine O'Sullivan

The ALERT Special lecture 2022 will be presented by Prof. Catherine O'Sullivan, Professor in the Geotechnics Section of the Department of Civil and Environmental Engineering at Imperial College, where she has been based for almost 20 years. She joined Imperial College in 2004 as a lecturer, following a two-year period at University College Dublin. She completed her PhD studies at the University of California, Berkeley in 2002.

Catherine's main research interest is in particulate soil mechanics. Her research uses discrete element modelling (DEM) as well as experimental techniques including micro-computed tomography (μ CT). Catherine has been applying these techniques to look at fundamental sand behaviour, behaviour of reservoir sandstones, internal erosion and interpretation of laboratory tests. Recognition for her research includes the 2015 Géotechnique lecture and the 2016 Shamsher Prakash Research Award.

She will talk about

How particle-scale simulations can underpin empiricism in soil mechanics

Observation of soil behaviour in well controlled element tests and in situ enabled engineers over the course of the 20th century to develop the field of soil mechanics. Over the course of the past twenty years particle-scale simulation has emerged as an important tool to complement laboratory experiments in particular. This talk will reflect on how these simulations can help us to examine key hypothesis that have been put forward about the fundamental, particle-scale interactions that lead to the highly complex mechanical response features we see at the macro scale. The presentation will also reflect on how this type of simulation can help us develop new experimental approaches, including novel ways to use experimental data to quantify soil fabric and predict soil behaviour. The reflections will consider sand, including mixtures of particle sizes, and clay and encompass mechanical loading and response to changes in temperature. Future challenges and opportunities will be suggested. Back to Contents

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Newsletter production Frédéric Collin