



ALERT Geomaterials

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EDITORIAL



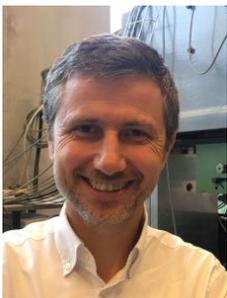
ALERT President
Gioacchino (Cino)
Viggiani

Dear ALERT members,

we are coming to the end of the two terms of the current Bureau that has managed our network over the last few years. We have faced many challenges, including the COVID-19 pandemic and the rockslide between Chambéry and Modane, to name but two. We were thus able to observe the resilience of our network, which continued to grow from 34 to 38 institutions. The pandemic also provided an opportunity to remotely organize our activities in Aussois. However, experience showed that if our workshop was to remain a place for exchange and debate, then it should be a face-to-face-only event. For the school, the possibility of attending it remotely means that more students can attend, although we encourage the younger generation to be physically present so to discover the spirit of Aussois.

The election of the new Board of Directors will take place in Aussois after the General Assembly. All permanent professors, researchers and technicians belonging to an ALERT member Institution are eligible candidates for the Board of Directors. You will find in this newsletter all the informations on the Election procedure.

Since last year, a poster prize has been organized. Only PhD candidates (*i.e.*, those who have not yet defended their PhD at the time of the Poster session) are eligible to this prize. We hope this initiative will be a great success.



ALERT Director
Frédéric Collin

Concerning the forthcoming ALERT meeting, this year the half-day workshop session (on Tuesday morning) is devoted to "Geomechanics at the submicron-scale". The objective of this session is to elucidate processes at the submicron scale either with numerical or experimental techniques that are important for geomechanics.

The ALERT Doctoral school will deal with "Numerical modelling in Geomechanics", and it will be organized by Claudio Tamagnini (University of Perugia), Lorenzo Sanavia (University of Padova) and Manuel Pastor (Universidad Politécnica de Madrid). The main goal of this School is to provide PhD students with a sound knowledge of computational Geomechanics.

The 14th ALERT Olek Zienkiewicz course was held in Aix-en-Provence, France, from April 22nd to April 26th 2024. The school was organized by Antoine Wautier (INRAE, France), Pierre Philippe (France) and Nadia Benahmed (INRAE, France). The topic of the school was "Hydro-mechanical behavior of Geomaterials for civil engineering structures".

This year, ALERT welcomes one new member institution: University College London (UCL), represented by Prof. Béatrice Beaudet. The total number of member institutions is now 38 (!).

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

Frédéric Collin and Cino Viggiani



ALERT Workshop 2023

In 2023 the annual ALERT Workshop was held from September 25th to September 27th in Aussois. The total number of participants was 197. The regional distribution of the participants from the member institutions of ALERT Geomaterials is shown in the Figure below.

In 2023, 56% of the participants reached the Paul Langevin center by train, and 30% 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 poster-prize and the PhD-prize ceremony, and the Special lecture in the afternoon.

The three topics of the 2023 ALERT Workshop are listed below:

- 1 Energy geomechanics**
coord. J. M. Pereira, C. Santamarina & D. Manzanal
- 2 Extraterrestrial geomechanics**
coord. P. Delage & F. Prada
- 3 Anisotropy in geomaterials : theory, experiments and modelling**
coord. E. Gerolymatou, C. Viggiani & A. Amorosi

We thank all active participants and coordinators for their effort.

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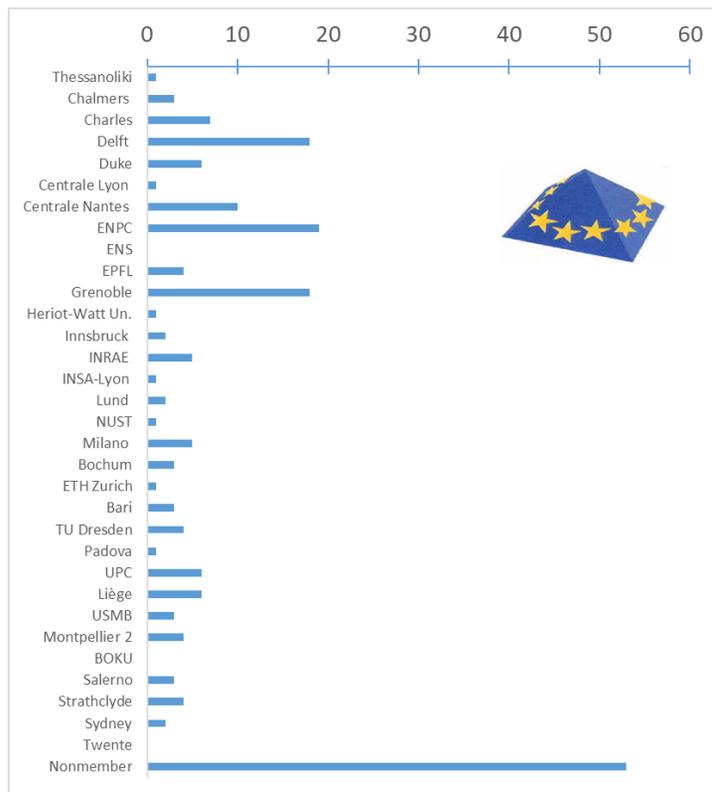


Figure 1. Participants of the ALERT Workshop 2023



ALERT PhD Prize 2023



The winner Katia Boschi (Politecnico di Milano), Cino Viggiani and the two other finalists Angela Casarella (Université Grenoble Alpes) and Siddharta Harsha Ommi (EC - Nantes)

The jury of the ALERT PhD Prize 2023 was composed of G. Viggiani (President of ALERT), C. O'Sullivan (ALERT Invited Lecturer for 2023), F. Radjai (chosen member) and L. Sanavia (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, Katia Boschi (Politecnico di Milano), Angela Casarella (Université Grenoble Alpes) and Siddharta Ommi (EC-Nantes) were selected by the jury out of 11 applicants.

The jury finally awarded the prize to Dr. Katia Boschi for her work entitled

Permeation Grouting in Granular Materials – from Micro to Macro, from Experimental to Numerical and Viceversa

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The winners Rana Al Nemer (EC-Nantes), Maxime Pierre (Ecole des Ponts - ParisTech) and Cino Viggiani

This year, ALERT Geomaterials has introduced a prize for the best poster. The jury of the ALERT Poster Prize 2023 was composed of N. Behnamed, A. Wautier, A.C. Dieudonné and F. Darve.

ALERT Poster Prize 2023

The jury finally awarded the 500€ prize to both Rana Al Nemer for her poster entitled

Multiphase Flow through Granular Material under Hydro-Mechanical Loading

and

Maxime Pierre for his poster entitled

Hydration-based multi-physics modelling of cementitious materials for 3D printing

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The ALERT Special Lecturer 2023
Prof. Catherine O'Sullivan

Special Lecture 2023: Prof. Catherine O'Sullivan

The ALERT Special lecture 2023 was delivered by Prof. Catherine O'Sullivan, Professor in the Geotechnics Section of the Department of Civil and Environmental Engineering at Imperial College

The title of the lecture was:

How particle-scale simulations can underpin empiricism in soil mechanics

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

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

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ALERT Doctoral School 2023

The ALERT Doctoral School 2023 was taught and attended by more than 170 participants (among which only 28 participants were following remotely the school). The topic of the school was

Machine Learning in geomechanics

This school was organized by Ioannis Stefanou (Ecole Centrale - Nantes) and Félix Darve (Université Grenoble-Alpes).

The lectures were presented by

- Félix Darve (Université Grenoble-Alpes)
- Ionnis Stefanou (Ecole Centrale de Nantes)
- Filippo Masi (University of Sydney)
- Noel Jakse (Université Grenoble-Alpes)
- Konstantinos Karapiperis (ETH Zürich)
- Steve Sun (Columbia University)
- Filippo Gatti (Université Paris-Saclay)

The objective of this doctoral school was 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 geome-

chanics, 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 were taught.

Lectures were given on two days and a half and included the following topics, and had 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
- Measuring forces with photoelasticity
- Use ML in simple examples, get aware of pitfalls and understand the need for physics/geomechanics-based ML methods

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/>



Organising Institutions of the
ALERT School 2023



ALERT Olek Zienkiewicz Course 2023



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

Multiphysics and multiscale coupled processes in geomaterials.

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

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

- Fundamentals in thermo-hydro-mechanical processes in geomaterials
- Basics of experimental testing of geomaterials
- Constitutive modelling of thermo-hydro-mechanical 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

Organising Institutions of the ALERT OZ Course 2023

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



Participants to the ALERT OZ Course 2023

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 was to introduce state-of-the-art understanding, concepts and methods related to thermo-hydro-mechanical coupled processes, the physical impacts of thermal loading and the mechanistic understanding of gas migration in geomaterials.

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

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

Lectures and tutorials were held by F. Collin (ULiege), A. Ferrari (EPFL), J.M. Pereira (ENPC), O. Kolditz (UFZ), L. Gonzalez-Blanco (UPC), D. Grigc (U Lorraine), J. Svoboda (CTU), A. Wiseall (BGS), P. Bésuelle (UGA), A.C. Dieudonné (TU Delft), A. Dizier (Euridice), E. Stopelli (TBC), C. Plua (ANDRA), M.V. Villar (CIEMAT).

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Election of a new Board of Directors

Following the ALERT Statute, this year a new Board of Directors will be elected. The elections will be organized in Aussois, or if we will not meet in Aussois, they will take place by email (further information will be given in due time). Elections include three different phases:

1. Election of the new members of the Board of Directors
2. Election of the new ALERT President by the Board of Directors
3. Appointment of the new members of the Bureau by the ALERT President

The Board of Directors is composed by 15 members, elected during General Assembly,

together with the members of the Bureau (President, Director, Vice Director for Administration, Vice Director for Economy). A specific Jury composed by three scrutineers will be appointed by the outgoing ALERT President to manage the election procedure. All permanent professors, researchers and technicians belonging to an ALERT member Institution are eligible candidates for the Board of Directors. Candidatures must be sent by email to director@alertgeomaterials.eu before September 15th. The list of candidates will be then advertised on the ALERT website. Each Institution belonging to ALERT has one vote, cast by the named representative. The ballot

will contain the list of candidates in alphabetical order. Each voter must tick no more than fifteen candidates, and the 15 names which receive the largest number of votes are elected. In case of a tie, the youngest candidate is chosen.

The list of ALERT members is available on <http://alertgeomaterials.eu/alertgeomaterials/members/>

During its first meeting, the new Board of Directors elects the new ALERT President, who finally chooses the new members of the Bureau. For any further detail, the complete rules for the election are available on the ALERT website. [Back to Contents](#)



ALERT Workshop 2024

The ALERT Workshop will be organized in 2024, from Monday, September 30th to Wednesday, October 2nd. The workshop will take place at the Centre Paul Langevin in Aussois, France. Please note that only in-person attendance will be possible (no remote attendance).

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

1 Emerging properties in geomaterials across the scales

coord. A. Wautier, F. Radjai & F. Froio

Geomaterials exhibit a wide range of complex behaviors that are of crucial interest for engineering scale applications or for mitigating natural risk hazards. Such behaviors are often accounted for through continuum mechanics concepts such as constitutive behavior, yield surfaces, hardening law, permeability, shear or compaction bands. . . Given the complexity of the macroscopic behavior of geomaterials, a current strategy is to use a multi-scale approach either in the lab or in the virtual lab (with DEM, molecular dynamics, X-ray tomography, SEM. . .), to identify sub-components with simpler behavior. However, in the change of scale, some properties are lost and some emerge. Working on the micro to macro link is probably the key for a wise use of phenomenological constitutive models (e.g. physics based justification of the parameters) and for an efficient use of multiscale strategies. In addition, fundamental knowledge on the micro/macro link may prove crucial to anticipate future use of geomaterials subjected to unprecedented loading conditions.

2 Geomechanics at the submicron-scale

coord. K. Ioannidou & G. Pijaudier-Cabot

Geomaterials usually exhibit complex mechanical behavior across several length and time scales. The submicron scale is relevant for understanding the microstructure and mechanical response of various geomaterials such as rocks, soils, sediments etc. Such materials are usually porous or granular and have been formed under different environmental conditions. At the submicron scale, nanoscale effects become significant. This includes phenomena such as surface roughness, intermolecular forces, pore structure, and distribution of defects which can influence the mechanical behavior of geomaterials. More-

over, processes such as fluid flow through nanopores, adsorption and desorption of fluids on mineral surfaces, and chemical reactions at mineral-fluid interfaces are important for the formation and aging of the microstructure of geological materials. This session aims to elucidate processes at the submicron scale either with numerical or experimental techniques that are important for geomechanics.

3 Continuum-based particle methods

coord. C. Tamagnini, L. Sanavia, M. Cianta, & A. Laresse

Until relatively recently, most of the mathematical formulations proposed for modeling multiphysics geomechanical problems relied on the assumption of linearized kinematics, i.e., the deformation of the soil mass is sufficiently small such that the current and the reference configurations of the soil body are virtually indistinguishable. However, geometric non-linearity may play an important role in some practical applications. A number of important failure and flow problems are indeed characterized by significant changes in the soil mass geometry and very high deformation levels. A non-exhaustive list of practical applications which require both mechanical and geometrical non-linear characterization of soil behavior include: the evaluation of pile bearing capacity of offshore platforms; the modeling of subsidence phenomena associated to hydrocarbon extraction and sink-hole formation; the study of the effects of pile driving; the interpretation of cone penetration tests under undrained or partially drained conditions; the modeling of slow slope deformations in presence of significant modifications of the slope geometry. The workshop intends to bring together researchers working in these fields to provide an overview of a number of relatively recent numerical methods (for example: MPM, PFEM, Peridynamics, SPH) capable of dealing with extreme deformations as well as non-linear material behavior of the soil mass, still remaining within the realm of continuum mechanics of porous granular materials.

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

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Organising Institutions of the
ALERT Workshop 2024



ALERT Doctoral School 2024

This year, the ALERT Doctoral School will be taught in Aussois from Thursday, 3rd October to Saturday, 5th October. It will be possible to attend it either in-person or remotely,

The topic of the ALERT School is

Numerical methods in geomechanics

It will be organized by Claudio Tamagnini (University of Perugia), Lorenzo Sanavia (University of Padua) and Manuel Pastor (Universidad Politécnica de Madrid).

The main goal of this School is to provide PhD students with a sound knowledge of computational Geomechanics. The School will include lectures on:

- (1) Basic: providing the fundamentals of the numerical techniques used
- (2) Advanced and research: the students will learn special techniques to deal with non linear problems, dynamics, integration of constitutive equations.
- (3) Practical. We believe that practise is fundamental when learning a computational technique. Therefore, we will provide a group of sessions where the students, with the help of instructors, will practise with the finite element code GeHoMadrid.

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

- (1) Basic
 - Introduction to FEM: Elliptic problems. Elasticity
 - Transient problems of parabolic and hyper-

bolic type

- Practical aspects of FEM computations
- Constitutive modelling in plasticity
- Hydro-mechanical coupling in saturated materials

(2) Advanced and Research topics

- Hydro-mechanical coupling in unsaturated materials
- Computational Plasticity (I)
- Computational Plasticity (II)
- FEM modelling of non isothermal variably saturated soils
- Viscoplasticity in soils
- Generalized Plasticity for unsaturated soils
- Introduction to Isogeometric analysis

(3) Practical sessions (PM, DM, MP)

- Introduction to GeHoMadrid. Pre and Post processing
- Choosing the right element: element technology. Bending and locking
- Introduction to Plasticity: plastification of a homogeneous specimen
- Introduction to localization. Formation of a shear band in a simple 2D specimen
- Footing on a purely cohesive soil layer. Initial conditions. FoS
- Water in soil. 1D consolidation
- Footing on an elastic saturated soil

The lectures will be held by Claudio Tamagnini, Lorenzo Sanavia, Manuel Pastor, Claudio di Prisco, Diego Manzanal and Pablo Mira.

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 2024



ALERT Olek Zienkiewicz Course 2024

The 14th ALERT Olek Zienkiewicz course was held in Aix-en-Provence, France, from April 22nd to April 26th 2024. It was organized by the research unit RECOVER from Aix-Marseille University, INRAE in relation with the doctoral school 353 “Engineering sciences: Mechanics, Physics, Micro et Nano-electronics”.

The topic of the school was

Hydro-mechanical behavior of geomaterials for civil engineering structures

The school was organised by Antoine Wautier (INRAE, France), Pierre Philippe (France) and Nadia Benahmed (INRAE, France).

Abstract: The content of the course addressed the characterization and the modeling of the hydro-mechanical behavior of geomaterials from the microscale to the structure scale. It covered both theoretical models, simulations, lab testing and risk analysis aspects.

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

- Hydraulic actions on soil: erosion, hydro-mechanical instabilities
- Mechanical behavior of granular materials
- Mechanical instabilities and failure in granular materials
- Mixing properties in granular media
- The Discrete Element Method (DEM): a numerical modeling approach adapted to geomaterials
- Practical session: Implementation of a 1D minimal DEM code and introduction to YADE
- Multi-phase Lattice Boltzmann Method (LBM) and its Application to Partially Saturated Granular Soils (Theory and Practice)
- Simulating large displacement problems in Continuum Mechanics with the Material Point Method (MPM) and CB-Geo MPM – PyCBG softwares
- Safety assessment of civil engineering structures
- Uncertainty propagation and reliability analysis
- Practical session: Mechano-fiabilistic computations for the risk assesment of the rupture of a dam

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More details and registration:

<http://alertgeomaterials.eu/category/oz-course>

New Institutional Members of ALERT

In September 2023 there were two applications for ALERT membership: TU Klausthal (Eleni Gerolymatou) and UCL (Béatrice Baudet).

The Board agreed on the fact that TU Klausthal has of course a very good application but the research group still have to demonstrate its implication in the ALERT activities. Its application will be considered again in the future. The BoD has asked the Bureau to strongly suggest to Eleni Gerolymatou to immediately become a member, through individual affiliation to a member institution. The application of UCL is accepted.

The Board also decided to remove the ALERT membership of University of Thessaloniki. In 2024, University of Thessaloniki will participate to the ALERT activities as a non-member institution.

University College London represented by prof. B. Baudet

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 2024



New institutional Member of ALERT



Special Lecture 2024: Prof. Antonio Gens



The ALERT Special Lecturer 2024
Prof. Antonio Gens

The ALERT Special lecture 2024 will be presented by Prof. Antonio Gens, Professor at the Technical University of Catalonia in Barcelona. He is a Civil Engineer graduate of the Technical University of Madrid and received M.Sc. and Ph.D. degrees from Imperial College, London. He has been involved in geotechnical research, consulting and education for over 40 years and has made significant contributions in several areas of soil mechanics and geotechnical engineering. He was ISSMGE Vice-President for Europe in the period 2013-2017 and he is the current President of the Spanish Society for SMGE.

He is a Fellow of the UK Royal Academy of Engineering and holds Doctorates Honoris Causa by the University of Grenoble and by the Technical University of Civil Engineering of Bucharest. He has received numerous awards such as the UK ICE's Telford Medal (twice) and the George Stephenson Medal (twice), the R.M. Quigley Award by the Canadian Geotechnical Society, the Case History Award by the American Rock Mechanics Association and the Outstanding Contributions Award by IACMAG. He was awarded the Kevin Nash Gold Medal of the ISSMGE and he has been named Laureate Engineer by the Royal Academy of Engineering of Spain. He was the 2007 Rankine Lecturer and, in 2022, he delivered the 10th Terzaghi Oration at the International Conference of SMGE in Sydney.

He will talk about

The development of G-PFEM for the simulation of penetration problems

Penetration of rigid bodies into the ground are ubiquitous in geotechnical engineering. Characteristic examples are in-situ tests (full flow penetrometers, cone penetration test, Marchetti dilatometer, SPT), tube sampling, driven piles or foundations of offshore structures (monopiles, jacketed platforms, suction buckets, spudcans). Their numerical modelling involves significant challenges because of strong nonlinearities arising from large deformations/displacements, contact formulations and soil behaviour. The lecture describes the Particle Finite Element Method for geotechnical applications (G-PFEM) developed to tackle this type of problems. G-PFEM is based on a Lagrangian description of motion, the use of low-order finite elements and the constant regeneration of the finite element mesh. The formulation has been extended to deal with coupled hydromechanical analyses for a proper simulation of geotechnical problems in terms of effective stresses. In order to make the analyses more robust and practical, a number of formulation enhancements, involving the stabilization and regularization of the solution, have been introduced. The application of the method to geotechnical problems is illustrated by a number of penetration problems including the indentation of a footing, the penetration of a cone into brittle soils and the insertion of a tube sampler. [Back to Contents](#)

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