

Clay Micromechanics 2022

24-27/01/2022 (part 1), online + 28-29/04/2022 (part 2) @ Lorentz Center Snellius/Hybrid

Scientific

The macroscopic response of geomaterials is controlled by the processes occurring at the microscale. Understanding these processes is key to interpret experimental data, to inform 'continuum' macroscopic constitutive models, and to develop quantitative predictive tools based on discrete approaches.

In clays, microscale processes are strongly affected by the complex pore-fluid-dependent interactions arising between particles, which cannot be easily investigated experimentally in a direct fashion due to the small size of clay particles. Despite 100 years of research on the macro-mechanical behaviour of clay, we are still largely ignoring underlying mechanisms at the particle scale.

The purpose of the workshop was to gather researchers working on various aspects of Clay Micromechanics, and researchers from other fields whose skills and know-how can contribute significantly to clay micromechanics research. In the workshop, we travelled across scales (nano, micro, meso to macro) and tackled the problem from different standpoints (theoretical, experimental, and numerical). This was aimed at creating an insight into unresolved issues, which will enable the future development of the field. Beyond the specific issues formulated above, the objective of the workshop was to establish an international, multi-disciplinary research community with the potential to contribute to the field of clay micromechanics.

The workshop was a great opportunity for all participants to learn about cutting-edge experimental techniques to explore clays at multiple scales, as well as theoretical approaches which can be borrowed from other fields (e.g. colloidal science, physics), and modelling approaches to link clay behavior at multiple scales. A few key-points came up multiple times during the workshop. For instance, the concept of a discrete elementary unit for both modelling and experimental investigation of clayey materials was discussed, and was found to be not unique. Depending on multiple factors (e.g. type of analysis, loading condition, fabric evolution), the discrete element governing the overall response might be a clay particle, a 'stack' of particles, an aggregate – there is no unique answer. This strongly influences the (discrete) approach to be taken for both modelling and experiments in clays. Furthermore, the synergy between simulations and experimental evidence was found to be crucial: on one hand, breakthroughs in experimental techniques to gain evidence at the particle scale is crucial to calibrate discrete models; on the other hand, numerical models may help inform experimental campaigns, or could be used to extrapolate data and reproduce conditions that are difficult to achieve in the laboratory. There is an urgent need to contribute to the development of both numerical models for clays and innovative experimental techniques to explore clays at the discrete scale, and to put them together to tackle unresolved issues within the field of Clay Micromechanics.

The main outcomes of this fruitful workshop can be listed as follows:

- **Part one** (online workshop): day-by-day summaries of the workshop's contents, reflections and discussion points, outlining an overview of the state of the art on Clay Micromechanics;
- **Part two** (hybrid event): 4x abstracts submitted to 'IS-PORTO 2023: 8th International Symposium on Deformation Characteristics of Geomaterials';
- **Future outcomes (ongoing)**: 4x full conference papers for submission to IS-PORTO 2023; 4x position papers for submission to the peer-reviewed scientific journal 'Open Geomechanics'.

Organization

Part one of the workshop ran online over 4 half-day sessions (9am-1pm). The format included: one or two keynote lectures given by experts within and outside the geotechnical community; an elevator-pitch-talk session; an extensive moderated discussion session. Both organizers and participants found this format particularly successful for an online event. Most presentations and discussion sessions were recorded, and made available online to participants.

Part two ran over 2 full days in a hybrid format (@ Lorentz Center Snellius & Zoom), including: collective sessions to discuss the main points and outcomes of part one; working-group sessions to write up 4 abstracts for IS-PORTO 2023, and the outline of 4 position papers. The amount of participants was restricted to 16 (as opposed to 43 in part one) to allow for a successful hybrid event, which could be engaging for all participants. As a lesson learned for future virtual events, we believe it is extremely important to keep online participants engaged throughout by making sure there is good audio and video quality, and by actively involving them in the discussion.

Our short-term plan for follow-up includes keeping up the collaborations among participants towards the completion of 4x conference papers and 4x journal publications. In the long-term, we aim at attracting more researchers to the IRCCM (International Research Centre of Clay Micromechanics) to foster collaborations, initiatives and training activities for the evolving Clay Micromechanics research community.

Lorentz Center (virtual) Support

The Lorentz Center team kindly and effectively assisted us throughout the event, by sending emails to participants, creating Zoom links, uploading recorded sessions to the Research Drive and more. For future hybrid events, it might be useful to equip the rooms with additional mics to ensure online participants are continuously able to engage with on-site participants.

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