SEVENTH MACHINE LEARNING IN GEOTECHNICS DIALOGUE (7MLIGD) ON "TRUSTWORTHY DATA-CENTRIC GEOTECHNICS"

Date: 16 October 2025

Time: 17:45 – 19:45

Venue: Auditorium, Nana Bianca Innovation Center - Piazza di Cestello 10 - Florence (Italy)

Moderator: Luigi Pinchiaroglio
Speakers: Patrizia Vitale, Kok-Kwang Phoon, Takao Murakami
Panel: Patrizia Vitale, Kok-Kwang Phoon, Takao Murakami, Next Gen representatives, and the Audience

ABSTRACT
Data-centric geotechnics is emerging as a pivotal interdisciplinary domain, integrating geotechnical engineering with machine learning (ML) and artificial intelligence (AI). While applications of ML and AI in geotechnics remain largely at the proof-of-concept stage, there is growing recognition that their responsible and safe deployment is both an opportunity and a necessity. To achieve this, geotechnical engineers must remain at the forefront of these developments, ensuring that innovations are technically sound, ethically robust, and compliant with evolving regulatory frameworks.

The 7th Machine Learning in Geotechnics Dialogue (7MLIGD) will explore the critical theme of "trustworthy data-centric geotechnics", addressing technical, ethical, and regulatory questions central to the future of the field. Panellists will engage with pressing issues such as data confidentiality, the creation and validation of trustworthy datasets, the readiness of design codes to accommodate AI/ML tools, and the broader acceptability of data-driven methods in engineering practice.

A particular focus of the dialogue will be the emerging role of standardisation in bringing clarity to the use of ML and AI in geotechnics. In this context, the European Union is taking a global lead through its comprehensive regulatory and standard-setting efforts, most notably the EU Artificial Intelligence Act and the development of harmonised European standards (e.g., through CEN and ISO working groups). These initiatives aim to define risk levels, set requirements for transparency and accountability, and establish clear obligations for AI use across sectors. While these frameworks are not yet

geotechnics-specific, they lay the groundwork for sector-specific guidance, helping to define what constitutes trustworthy datasets, explainable models, and acceptable risk profiles in geotechnical applications. The panel will reflect on how such regulatory efforts might influence the acceptability of ML/AI tools in design, their future integration into codes and standards, and their alignment with ethical and professional responsibilities. This broader European perspective may also serve as a catalyst for other regions and professional communities navigating similar challenges.

In a context marked by both opportunity and uncertainty, 7MLIGD offers a dynamic, interactive forum for engineers, researchers, and students to reflect on the pathways toward a responsible, trustworthy, and inclusive adoption of AI/ML in geotechnics.

PROGRAMME OF 7MLIGD

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1. Opening
   - Introduction and live polling

2. Talks
   - 3 talks highlighting the multi-perspective of this issue, to balance conceptual-technical-ethical aspects:
     1. Patrizia Vitale: "Intellects vs. Machines: La Cosa Mentale"
     2. Kok-Kwang Phoon: "Trustworthy data-centric geotechnics"
     3. Takao Murakami: "Challenges in Privacy-Preserving Geotechnics"
   - We invite the audience to engage with the speakers after the dialogue and during the conference, for questions and to bring the dialogue forward.

3. Next-Gen dialogue
   - A dialogue with 1-2 representatives from the NextGen group

4. Closing

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MODERATOR'S BIOGRAPHY

Luigi Pinchiaroglio – Civil engineer - Head of the Civil Infrastructure Department at *TELT – Tunnel Euralpin Lion Turin* – The Italian – French company responsible for designing, constructing and operating of the cross-border section of the Lyon-Turin freight and passenger railway line extends over a stretch of 65 km between Susa in Piedmont and Saint-Jean-de-Maurienne in Savoy (main feature of the work are the 57.5km long Mont Cenis by tube base tunnel with other 50km of cross-passages and service tunnels).

Specialised in tunnelling, Luigi has developed an international background in railway, road and metro projects during his 40-years of professional activity. AI, IoT, and smart city paradigm, applied to design, construction, and maintenance of infrastructures represent his areas of study and research both in the professional and non-professional domains.

Luigi firmly believes that synergy between technical-scientific and humanistic disciplines is essential to guarantee digital ethics aimed at ensuring sustainable economic, social and environmental development. Whit this awareness, he is active in international scientific and cultural associations.

TALKS AND SPEAKERS' BIOGRAPHIE

(see following pages.)

Title: Intellects vs. Machines: La Cosa Mentale

Speaker: Patrizia Vitale

Abstract:

Artificial intelligence is reshaping how we think, design, and decide — challenging long-held distinctions between intellect and execution. This talk explores how perceptions of AI differ across generations and what that means for collaboration in engineering practice. Drawing parallels between art, ethics, and technology, it examines how AI is redefining intellectual work in geotechnics, from data interpretation to design automation. Finally, it reflects on the emerging European framework for AI standardization — from the EU AI Act to harmonized technical standards — arguing that the future of our profession will depend not on how fast machines learn, but on how wisely humans agree on what they should learn for.

Patrizia Vitale

Norwegian Geotechnical Institute (NGI)
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Bio: Patrizia is Head of Offshore Geotechnical Design Section at the Norwegian Geotechnical Institute (NGI).

With extensive experience in geotechnical design, consulting, and verification for both onshore and offshore projects, Patrizia leads the section's development in people, knowledge, competencies, business, and strategy.

In recent years, she has been increasingly engaged in advancing data-driven geotechnics, exploring how machine learning and statistical methods can enhance ground modelling, design verification, and risk assessment. Her work is driven by the importance of uncertainty quantification, trustworthiness of data, and the interplay between engineering judgment and algorithmic intelligence.

She is particularly engaged in international dialogues on the role of data in geotechnical practice, with a particular focus on how ethics, transparency, and cross-disciplinary collaboration can shape a trustworthy data-centric future for the field.

Title: Unpacking trustworthy data-centric geotechnics

Speaker: Kok-Kwang Phoon

Abstract:

AI is currently developing rapidly in at least 2 dimensions: (1) rising cognitive power (AI to AGI to ASI) and (2) going physical. The realization of one dimension alone will change the way we live, play, and work in fundamental ways. Data-centric geotechnics was proposed to ensure that AI is developed for geotechnical engineering in a sensible way that pays attention to data, geotechnical context, and value to practice. However, this is not sufficient, because trust is needed for effective human-machine teaming. Trustworthy AI is mentioned explicitly in the EU AI Act, the first comprehensive regulation on AI by a major regulator anywhere. The speaker argues that our professional ethics that include safeguarding public interest require us to over-react to prepare ahead for a radically different future.

Kok-Kwang Phoon

Singapore University of Technology and Design (SUTD)
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Bio: PHOON Kok-Kwang is President, Singapore University of Technology and Design (SUTD), as well as Cheng Tsang Man Chair Professor.

Prof Phoon is a world leader in the development of reliability and data-centric geotechnics. He was bestowed the ASCE Norman Medal twice in 2005 and 2020, the Humboldt Research Award in 2017, the Harry Poulos Award in 2023, and the Alfredo Ang Award in 2024 among other accolades. Prof Phoon is the Founding Editor of Georisk and Founding Editor-in-chief of Geodata and AI.

Title: Challenges in Privacy-Preserving Geotechnics

Speaker: Takao Murakami

Abstract:

DP (Differential Privacy) is now recognized as the de facto standard for data privacy and has the potential to protect confidential data in geotechnical engineering. In this talk, the speaker will pose several challenges and research questions in privacy-preserving geotechnics, such as: (i) how can we achieve both high accuracy and privacy with small databases? (ii) how can we analyze privacy and confidentiality risks in geotechnical data? (iii) how is a mathematical notion like DP related to legal requirements such as the GDPR? The speaker will also introduce some recent studies and activities related to these questions.

Takao Murakami

The Institute of Statistical Mathematics (ISM)
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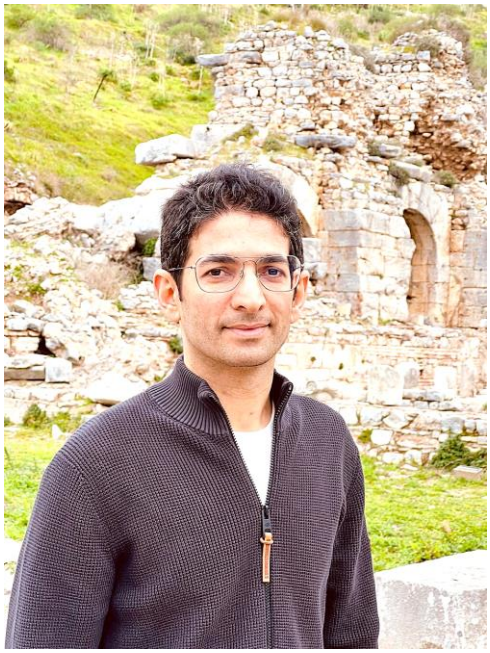
Bio: Takao Murakami is an Associate Professor at the Institute of Statistical Mathematics (ISM). His research interests lie in privacy-preserving technologies for data analysis and machine learning. Over the last decade, he has been working on differential privacy (DP), which is widely recognized as the gold standard for data privacy, and has published several papers on this topic at top-tier conferences in information security and privacy. He has also served on the program committees of these conferences. He received the IEEE TrustCom 2015 Best Paper Award in 2015. He also received the Dean's Award of Graduate School of Information Science and Technology from the University of Tokyo, for his Ph.D. thesis in 2014.

NEXT GEN REPRESENTATIVES



Mohammad Sadegh Farhadi

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Bio: Mohammad Sadegh Farhadi, currently as University Instructor at Geo group of TERRA Research Center, Built Environment Faculty, Tampere University, Finland. He is currently studying the interpretation of Cone Penetration Testing (CPTu) through AI. He studied clay and silts mainly via the field and lab experiments. More, he gained experiences with Evolutionary optimization algorithms, FDM and FEM programming, Game theory models, Agent-based and Multi-Agent approaches, Supervised learning algorithms, Cognitive and Mind mapping, image-processing, and also meta-Modeling of aquifers and groundwater management. He has now inter-disciplinary experiences from micro-scale to project-scale tasks. He's still trying to dig deeper in geo-sciences! Sports and talks are fascinating to him! 😉

Alireza Duzandeh

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Bio: Alireza Duzandeh is a Ph.D. candidate in Geotechnical Engineering at the University of Florence, Italy. His research focuses on integrating numerical modeling with machine learning–based metamodeling algorithms for the quantitative estimation of seismic basin effects. During his M.Sc. in Earthquake Engineering, he conducted a reliability-based seismic site classification study that combined the horizontal-to-vertical spectral ratio (HVSR) method with geostatistical analysis and incorporated in situ downhole testing for enhanced site characterization. His research interests include the application of machine learning and deep learning to geotechnical and earthquake engineering, seismic site response analysis, landslide susceptibility assessment, slope stability and reliability analysis, and geostatistical modeling. He has expertise in Python, MATLAB, and advanced geotechnical modeling tools such as OpenSees and QGIS.