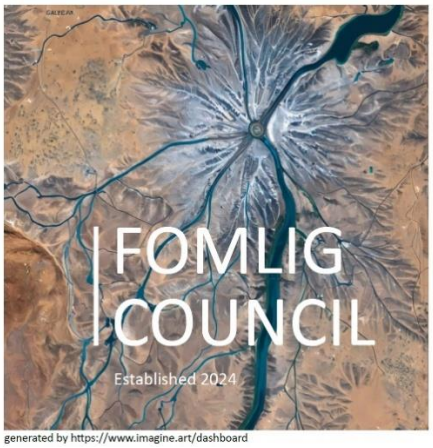

The FOMLIG Council *is the governing body of the Future of Machine Learning in Geotechnics (FOMLIG). It promotes data-centric geotechnics, nurtures young talent, and connects academia, industry, and policymakers to lead the digital transformation of geotechnical engineering.*

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3FOMLIG Short Course

State-of-the-art in Data Centric Geotechnics 2025

Organized by Prof. Takayuki Shuku (tshuku@tcu.ac.jp) and Dr. Yuanqin Tao (taoyuanqin@zjut.edu.cn)

Date: 15 October 2025

Time: 9:00 – 13:00

Venue: Auditorium, Nana Bianca Innovation Center - Piazza di Cestello 10 - Florence (Italy)
***Short course is offered in hybrid mode. The online meeting link is as follows:**
https://zoom.us/j/91087151858?pwd=lr20OKvvwcrdaa6GJVkhI4zfsjqCAi.1

****Professor Phoon and/or Tang would be signing a postcard of their latest books "Databases for Data-centric Geotechnics". This postcard can be inserted in the books as a momento. The books can be ordered online at: https://www.routledge.com/Databases-for-Data-Centric-Geotechnics-Two-Volume-Set/Phoon-Tang/p/book/9781032388731**

Registration: Free but please contact to register for limited slots

Program:

Time	Title	Speaker
09:00-09:45 09:45-09:52	Improving site recognition using data-driven site demarcation Q/A	Kok-Kwang Phoon
09:53-10:38 10:38-10:45	Role of databases in data-centric geotechnics Q/A	Jianye Ching
10:45-11:15	Break	
11:15-12:00 12:00-12:07	Accelerating problem-solving in geotechnical engineering with LLM-based agentic AI Q/A	Stephen Wu
12:08-12:53 12:53:13:00	Application of LLMs to landslide investigations Q/A	Andy Leung

Invited FOMLIG Council Lectures

Lecture 1: Improving site recognition using data-driven site demarcation

Abstract: One important challenge in data-driven site characterization (DDSC) is the "site recognition challenge". It shares some similarities with the facial recognition challenge. The purpose of recognizing "similar" sites is to allow a target site data to be supplemented by relevant data collected elsewhere to improve decision making at the target site. This is already widely adopted in geotechnical engineering practice. The key difference is that "similar" sites are identified based on judgment. The problem with judgment is that it is restricted to local/regional data that an engineer is familiar with arising from prior experience working under similar ground conditions. It is impractical to exercise judgment on big data, say to process a trillion soil records. Judgment is arguably less applicable to ground conditions outside of an engineer's experience base.

The tailored clustering has been shown to be more effective than classical clustering (reference solution) in identifying "similar" sites from big indirect data (BID). However, all DDSC methods face a fundamental limitation: their reliance on geotechnical project boundaries as the primary site definition. This definition is purely based on convention as it is evident that project boundaries are not related to geology or geotechnical properties. This lecture shows that it is possible to redraw the boundaries of "similar" sites based on geology/geotechnical data so that decision making at a target site is optimized. The concept of a data-driven demarcated site is novel and may open new research directions for DDSC

Kok-Kwang Phoon

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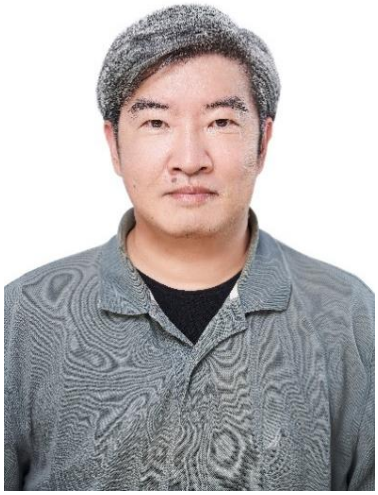
Bio: PHOON Kok-Kwang is President, Singapore University of Technology and Design (SUTD), as well as Cheng Tsang Man Chair Professor. Concurrently, he is serving as the Deputy Chair of AI Singapore and a member of the Committee of Government Scientific Advisors. He has also served as the Deputy Chief Scientific Advisor (DCSA) to the National Research Foundation, Prime Minister's Office, Singapore.

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.

Lecture 2: Role of databases in data-centric geotechnics

Abstract: First, this lecture demonstrates some databases (i.e., big indirect data, BID) available in the literature. The databases are classified into two categories: soil/rock property databases & geotechnical performance databases. Second, this lecture demonstrates how to assist site-specific prediction using a generic database. In geotechnical engineering, site-specific prediction is challenging because site-specific data are usually very sparse. However, data from another site cannot be directly implemented to the target site due to site uniqueness. A central challenge in data-centric geotechnics (called site-recognition challenge) is how to make use the knowledge learned from a generic database to assist site-specific prediction.

In this lecture, two examples will be used to demonstrate how to make use a database to address this site-recognition challenge. One example is a soil database with joint data of USCS categories and soil properties. It will be illustrated that this database can be used to assist site-specific soil-layer-delineation and soil-property-simulation simultaneously. The other example is an excavation database with wall deflection and ground settlement data. It will be illustrated that this database can be used to assist site-specific predictions for wall deflection and ground settlement when excavating a clay site.



Jianye Ching
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Bio: CHING Jianye is Distinguished Professor in Dept. of Civil Engineering at National Taiwan University. His main research interests are geotechnical risk & reliability, random fields & spatial variability, probabilistic site characterization & geotechnical data analytics. He has published more than 150 papers in international journals.

Prof Ching is the recipient of the Outstanding Research Award (2011, 2014), the Wu-Da-Yu Award (2009) from the Ministry of Science and Technology of Taiwan, and the Outstanding Professor Award (2024) from the Chinese Institute of Engineers. He was elected as the 7th ISSMGE Suzanne Lacasse Lecturer in 2022. He served as President of Chinese Taipei Geotechnical Society (a member society of ISSMGE), served as Chair of TC304 (risk) in ISSMGE, and Chair of Geotechnical Safety Network (GEOSNet). He is Managing Editor of Georisk, Editor of Geodata & AI, Associate Editors of ASCE Journal of Geotechnical and Geoenvironmental Engineering, Canadian Geotechnical Journal & Editorial Board Member of Structural Safety.

Lecture 3: Accelerating problem-solving in geotechnical engineering with LLM-based agentic AI

Abstract: Recent developments in large language models (LLMs) are enabling a new paradigm of problem-solving through agentic AI, where models function as adaptive agents that integrate reasoning, data access, and task automation. This lecture explores how such systems can contribute to geotechnical engineering practice. Topics include Model Context Protocol (MCP) for standardization of agent architecture, streamlined user interfaces (e.g., Streamlit) for accessible deployment, and use of robust backend databases to ensure reliability and reproducibility. The lecture also discusses multi-agent collaboration for workflow emulation, domain-specific fine-tuning to adapt LLMs to geotechnical contexts, and strategies for validation, transparency, and safe adoption. Together, these elements illustrate a pathway toward accelerating geotechnical problem-solving while ensuring meaningful and responsible contributions to the field.

Stephen Wu
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Bio: Stephen Wu is Associate Professor at the Institute of Statistical Mathematics, Tokyo, Japan. His research focuses on applying Bayesian machine learning and AI technologies across diverse fields including materials science, analytical chemistry, seismology, and civil engineering. In geotechnical engineering, his recent contributions include probabilistic modeling of soil properties, addressing small data challenges through foundation models and transfer learning, and pioneering the use of LLM-based agentic AI to accelerate research progress. He also leads the GeoTechathon event series, organized in connection with FOMLIG, to foster innovation and collaboration at the intersection of geotechnics and AI. In 2023, he received the Young Scientists' Award from the Ministry of Education, Culture, Sports, Science and Technology (MEXT), Japan for his contributions to statistical machine learning research across multiple scientific fields.

Lecture 4: Application of LLMs to landslide investigations

Abstract: This presentation showcases some recent developments on the application of agentic artificial intelligence (AI) systems, powered by large language models (LLMs), to automate key components of post-landslide investigations. Several core tasks are addressed: (i) extracting technical information from layman witness reports in the aftermath of a landslide, using a customized Retrieval-Augmented Generation (RAG) pipeline; (ii) estimating landslide geometry from site images via fine-tuned YOLO segmentation model combined with chain-of-thought (CoT) prompting in a multimodal LLM; and (iii) automated extraction of regional geotechnical and topographically data to formulate analysis models to support landslide investigations. Validation with historical

landslide events shows that the information extractor produces accurate, source-attributed summaries that align closely with professional engineering reports, while the geometry estimation workflow infers landslide dimensions and debris volumes consistent with official records. By leveraging pre-trained foundation models and tool-based reasoning, agentic AI systems offer a solution to the challenge of applying data-hungry deep learning frameworks in the domain of geotechnics. The results highlight the potential of agentic LLM-based systems to support efficient, interpretable, and scalable geohazard investigations, advancing automation in geotechnical engineering.

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Bio: Andy Leung is currently Associate Head (Partnership) and Associate Professor at the Department of Civil and Environmental Engineering, The Hong Kong Polytechnic University. He is also the Immediate Past President of the Hong Kong Geotechnical Society. His research interests include soil-structure interaction, reliability of geotechnical and structural systems, probabilistic analysis approaches and novel geotechnical instrumentation technologies. He has been a member of various technical committees (TC) of the International Society for Soil Mechanics and Geotechnical Engineering (ISSMGE), including TC 212 Deep Foundations, TC 304 Engineering Practice of Risk Assessment and Management and TC 309 Machine Learning and Big Data. He is also a member of the Future of Machine Learning in Geotechnics (FOMLIG) Council.