



WHERE GEODATA MEETS MACHINE LEARNING

KOK-KWANG PHOON

*SINGAPORE UNIVERSITY OF TECHNOLOGY AND
DESIGN*

OPENING IS NOT PREPARED
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I'm not a robot



ReCAPTCHA

GEODATA

GEODATA

- DATA RELEVANT TO GEO-DISCIPLINES



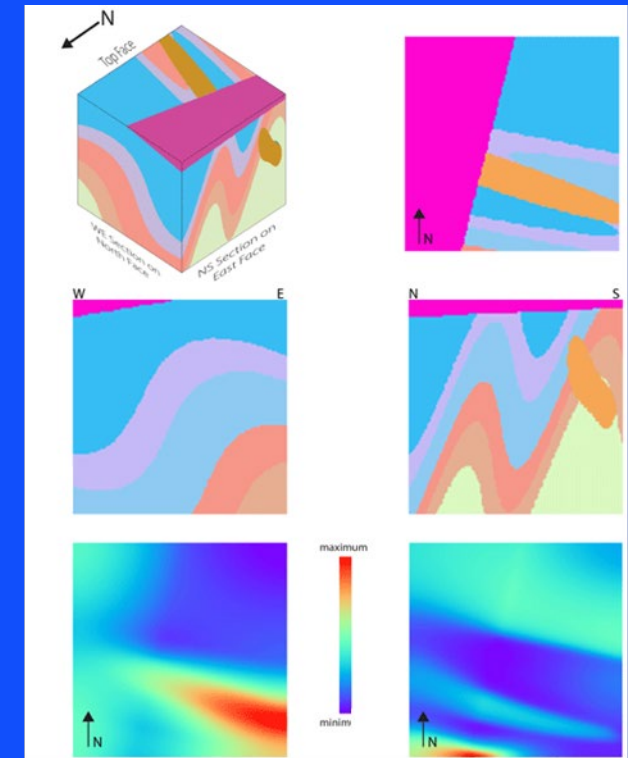
CHARACTERIZATION

VALIDATION INFERENCE

NATURAL

GEOSCIENCE DATA

- SPATIAL-TEMPORAL STRUCTURE
- HETEROGENEITY IN SPACE & TIME
- HIGH DIMENSIONALITY
- LACK OF CONCISE OBJECT DEFINITIONS
- RARE CLASSES
- MULTI-SOURCE MULTI-RESOLUTION DATA
- POOR DATA QUALITY
- SMALL SAMPLE SIZE
- PAUCITY OF GROUND TRUTH



<https://essd.copernicus.org/articles/14/381/2022/>

Karpatne, A., Ebert-Uphoff, I., Ravela, S., Ali Babaie, H., and Kumar, V. 2018. Machine learning for the geosciences: challenges and opportunities. IEEE Transactions on Knowledge and Data Engineering, 31(8), 1544–1554.



GEOTECHNICAL DATA

MULTIVARIATE

SPARSE

CORRUPTED/BAD

MUSIC - 3X

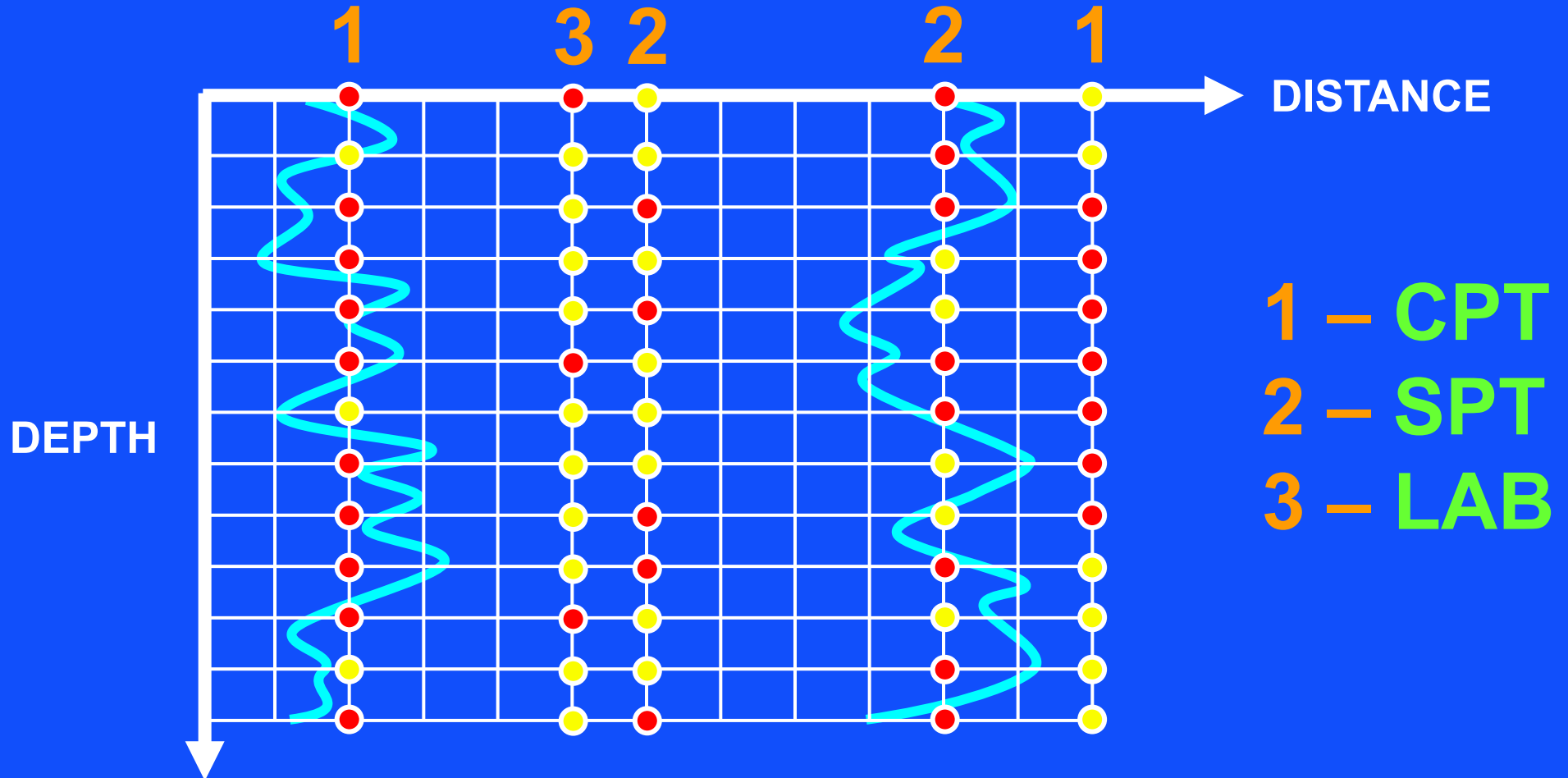
UNCERTAIN &
UNIQUE

INCOMPLETE

3D SPATIAL
VARIATION

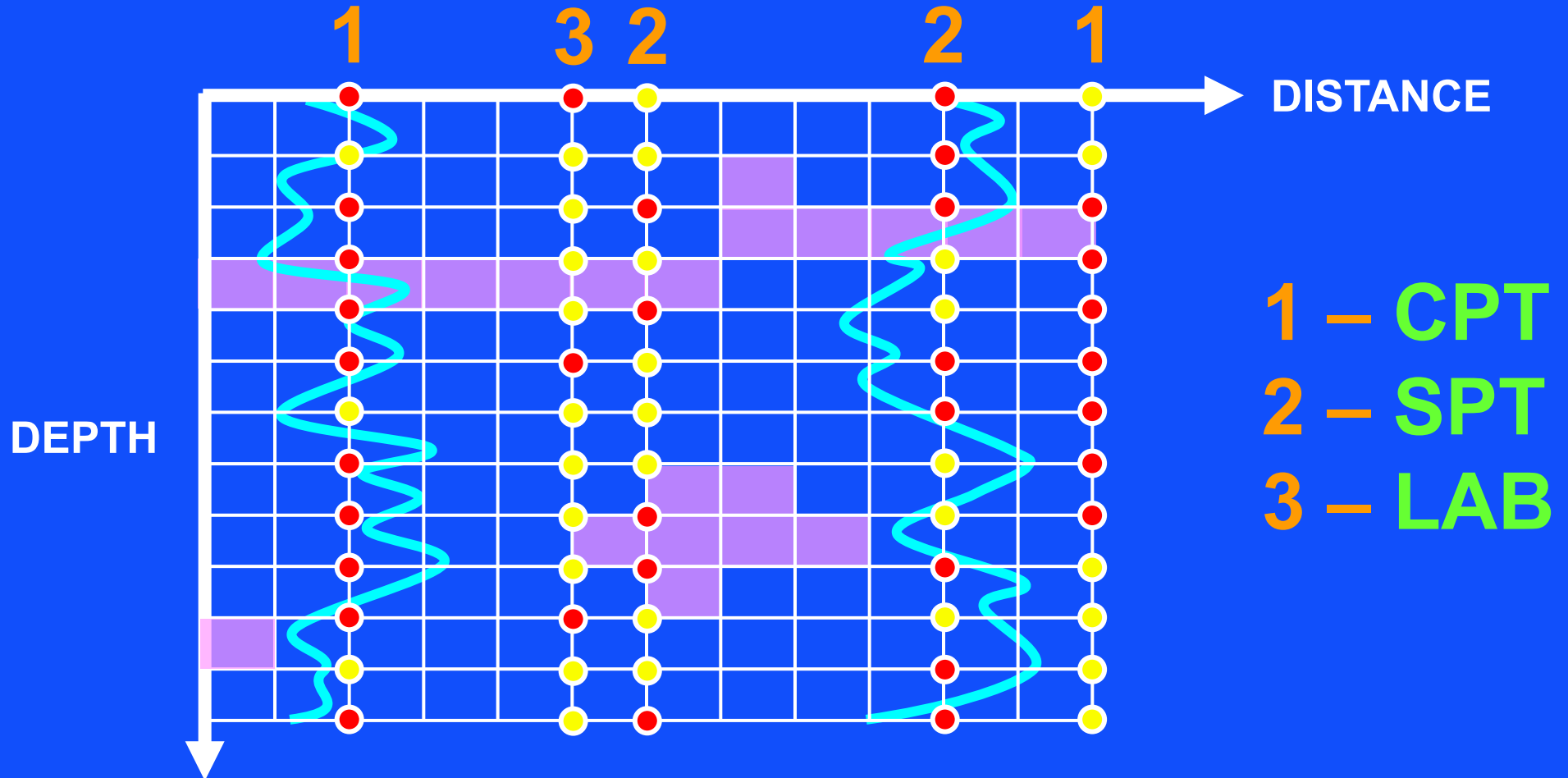


MUSIC-3X





MUSIC-3X-G



TRUSTWORTHY DATA-CENTRIC GEOTECHNICS



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Underground Space

Unpacking data-centric geotechnics

Kok-Kwang Phoon^{a,*}, Jianye Ching^b, Zijun Cao^c

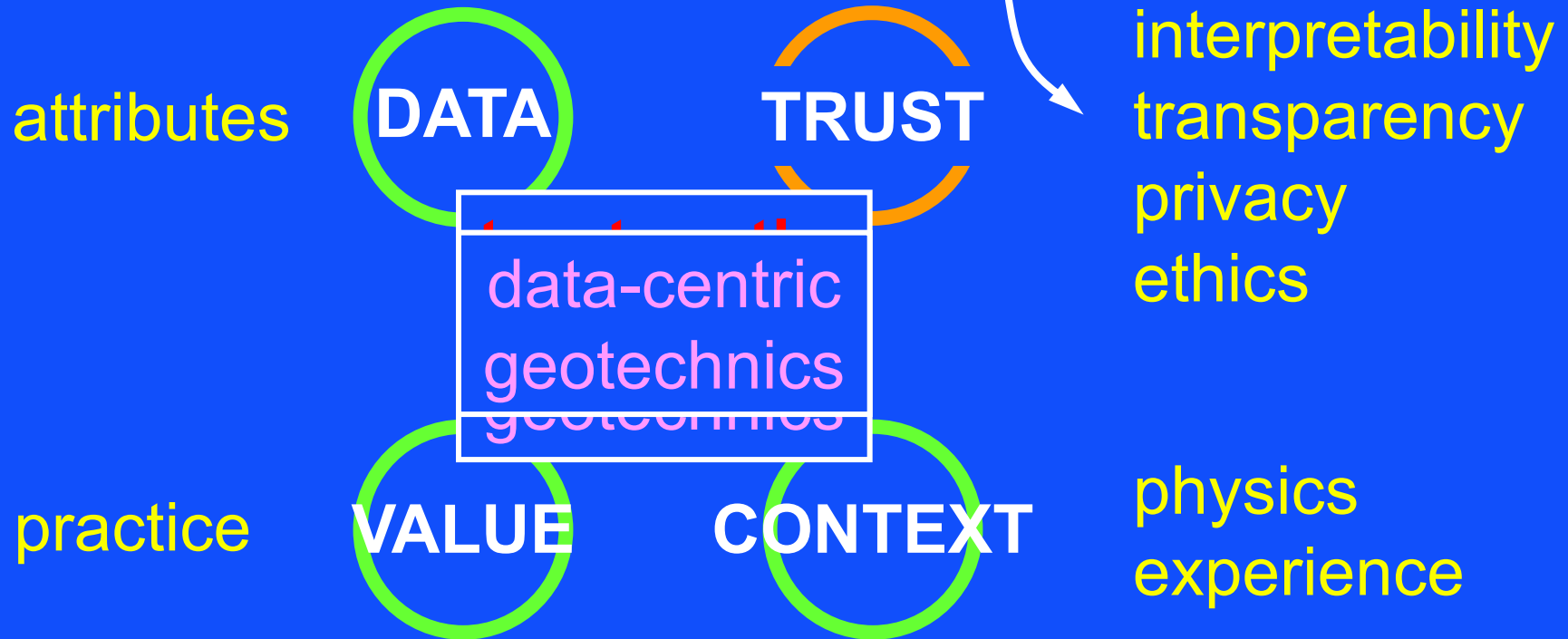
^a Singapore University of Technology and Design, 487372, Singapore

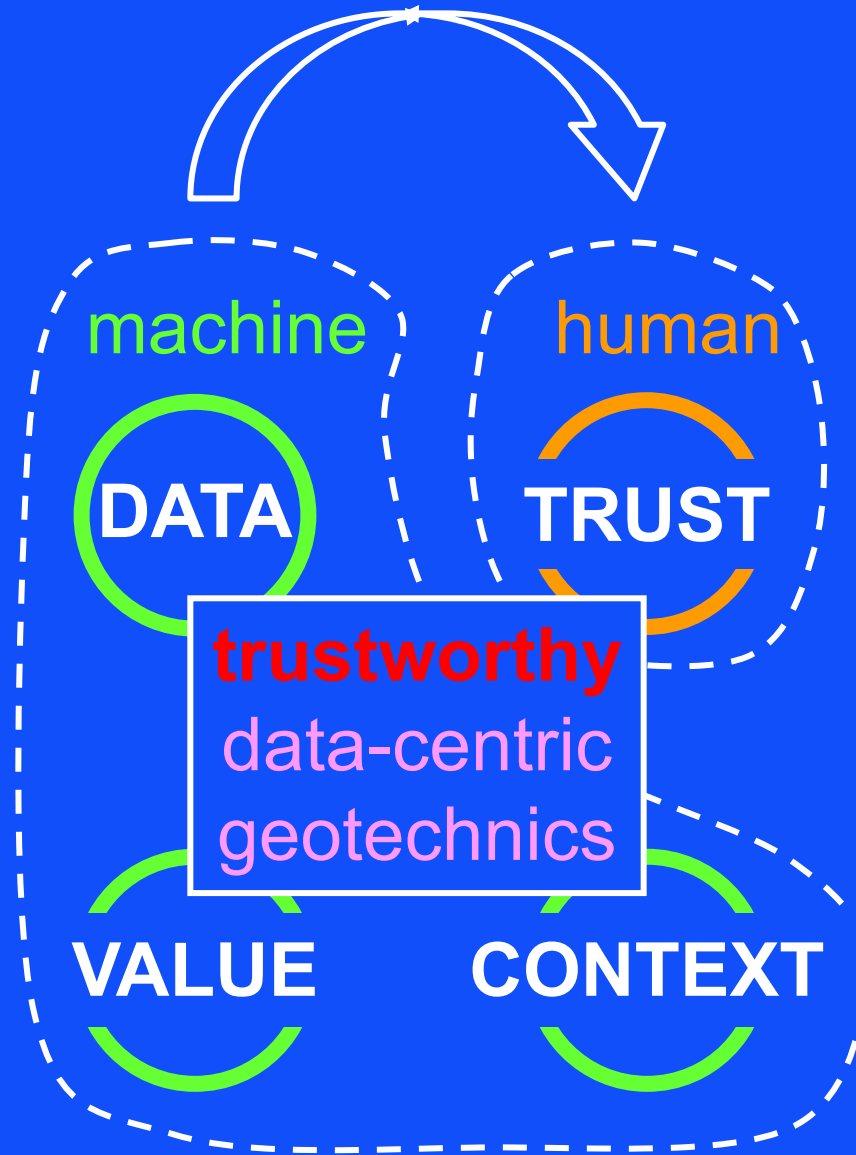
- ... source of data can also go beyond site investigation and the type of data can go **beyond numerical such as categorical, text, audios, images, videos, and expert opinion**.
- Although current geotechnical practice has been very successful in taking “calculated risk” informed by limited data, imperfect theories, prototype testing, observations, among others and exercising judicious caution and engineering judgment, there is **no clear pathway forward to leverage on big data** and digital technologies ... to meet more challenging needs such as sustainability and resilience engineering.

data-informed decision support as well. One part of DDSC that addresses numerical soil data in a site investigation report and soil property databases is pursued under Project DeepGeo. In principle, the source of data can also go beyond site investigation, and the type of data can go beyond numbers, such as categorical data, text, audios, images, videos, and expert opinion. The purpose of Project DeepGeo is to produce a 3D stratigraphic map of the subsurface volume below a full-scale project site and to estimate relevant engineering properties at each spatial point based on actual site investigation data and other relevant Big Indirect Data (BID). Uncertainty quantification



All data-driven answers
are **uncertain**





In search of an optimal quasi-local transformation model

Oct 14, 2024 (Beijing Time), 14:00-15:00 p.m.

Venue: Room 1236, Jiuli Campus 九里校区1236会议室

Presentation Introduction

This lecture discusses novel DDSC (data-driven site characterization) methods for constructing quasi-local transformation models based on small site data and BID (big indirect data). Only MUSIC (M = multivariate; U = uncertain and unique; S = sparse; I = incomplete; C = potentially corrupted) attributes are considered. The lecture covers outlier detection (relevance of BID to a target site), tailored clustering, dimension reduction, and dictionary learning. Prediction of a design parameter from these quasi-local transformation models is shown to be less biased and more precise (in terms of root mean square error) compared to a generic or a local model. The ability to detect an outlier in the context of MUSIC is already extremely valuable to practice, because all databases must contain corrupted entries when they are big enough and engineers are naturally wary of “garbage in garbage out”. The engineering value of a quasi-local transformation model is illustrated using reliability-based design of a footing installed in a sandy site in Texas.



Prof. Kok-Kwang Phoon
Singapore University of
Technology and Design

Speaker Introduction

ANNOUNCEMENTS

2024-2025

JOURNALS

- **GEODATA AND AI (ELSEVIER)**

<https://www.sciencedirect.com/journal/geodata-and-ai>

- **MACHINE LEARNING AND DATA SCIENCE IN GEOTECHNICS (EMERALD PUBLISHING)**

<https://www.emeraldgrouppublishing.com/journal/mlag>

- **INTELLIGENT GEOENGINEERING (CHINESE SOCIETY OF ROCK MECHANICS AND ENGINEERING)**

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Interested in proposing a book for



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Databases for Data-Centric Geotechnics forms a definitive reference and guide to databases in geotechnical and rock engineering, to enhance decision-making in geotechnical practice using data-driven methods. This second volume pertains to geotechnical structures. The opening chapter presents a ...



Databases for Data-Centric Geotechnics: Site Characterization

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Databases for Data-Centric Geotechnics forms a definitive reference and guide to databases in geotechnical and rock engineering, to enhance decision-making in geotechnical practice using data-driven methods. This



Databases for Data-Centric Geotechnics: Two Volume Set

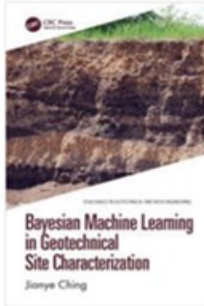
1st Edition

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Edited By **Kok-Kwang Phoon, Chong Tang**

November 22, 2024

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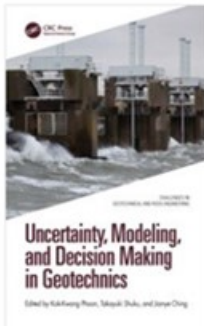
Bayesian Machine Learning in Geotechnical Site Characterization

1st Edition

By **Jianye Ching**

August 07, 2024

Bayesian data analysis and modelling linked with machine learning offers a new tool for handling geotechnical data. This book presents recent advancements made by the author in the area of probabilistic geotechnical site characterization. Two types of correlation play central roles in geotechnical ...



Uncertainty, Modeling, and Decision Making in Geotechnics

1st Edition

Edited By **Kok-Kwang Phoon, Takayuki Shuku, Jianye Ching**

December 11, 2023

Uncertainty, Modeling, and Decision Making in Geotechnics shows how uncertainty quantification and numerical modeling can complement each other to enhance decision-making in geotechnical practice, filling a critical gap in guiding practitioners to address uncertainties directly. The book helps ...

DIALOGUES

1. 2ND INTERNATIONAL WORKSHOP ON MACHINE LEARNING AND BIG DATA IN GEOSCIENCE, 28 JUL 2019
2. ISSMGE TC304/TC309/TC210 2ND MACHINE LEARNING IN GEOTECHNICS DIALOGUE (2MLIGD), TAIPEI, 14 DEC 2019
3. ISSMGE TC309/TC304/TC222 3RD MACHINE LEARNING IN GEOTECHNICS DIALOGUE (3MLIGD), NGI, 3 DEC 2021 (ONLINE)
4. ISSMGE TC309/TC304/TC222 4TH MACHINE LEARNING IN GEOTECHNICS DIALOGUE (4MLIGD), OKAYAMA, 5 DEC 2023
5. 5TH MACHINE LEARNING IN GEOTECHNICS DIALOGUE (5MLIGD), CHENGDU, 13 OCT 2024

FOMLIG

1. FUTURE OF MACHINE LEARNING IN GEOTECHNICS (FOMLIG), 5-6 DEC 2023, OKAYAMA, JAPAN (CHAIR: TAKAYUKI SHUKU)
2. 2FOMLIG & 5MLIGD, 11-13 OCT 2024, CHENGDU, CHINA (CHAIR: ZIJUN CAO)
3. 3FOMLIG, 15-17 OCT 2025, FLORENCE, ITALY (CHAIR: MARCO UZIELLI)
4. 4FOMLIG, 2026, SEOUL, SOUTH KOREA (CHAIR: HYUNKI KIM)
5. 5FOMLIG, 2027, NEWCASTLE, AUSTRALIA (CHAIR: JINSONG HUANG)

ISSMGE TC309

- 1. 1ST INTERNATIONAL WORKSHOP ON MACHINE LEARNING AND BIG DATA IN GEOSCIENCE, OSLO NORWAY, 2018**
- 2. 2ND INTERNATIONAL WORKSHOP ON MACHINE LEARNING AND BIG DATA IN GEOSCIENCE, SHANGHAI CHINA, 28-30 JUL 2019 (CHAIR: HONGWEI HUANG)**
- 3. 3ND INTERNATIONAL WORKSHOP ON MACHINE LEARNING AND BIG DATA IN GEOSCIENCE, WROCLAW, POLAND, 25-28 OCT 2021(CHAIR: WOJCIECH PULA)**
- 4. 4ND INTERNATIONAL WORKSHOP ON MACHINE LEARNING AND BIG DATA IN GEOSCIENCE, CORK IRELAND, 29 AUGUST-01 SEPT 2023 (CHAIR: ZILI LI)**



3FOMLIG FLORENCE ITALY 15-17 OCT 2025

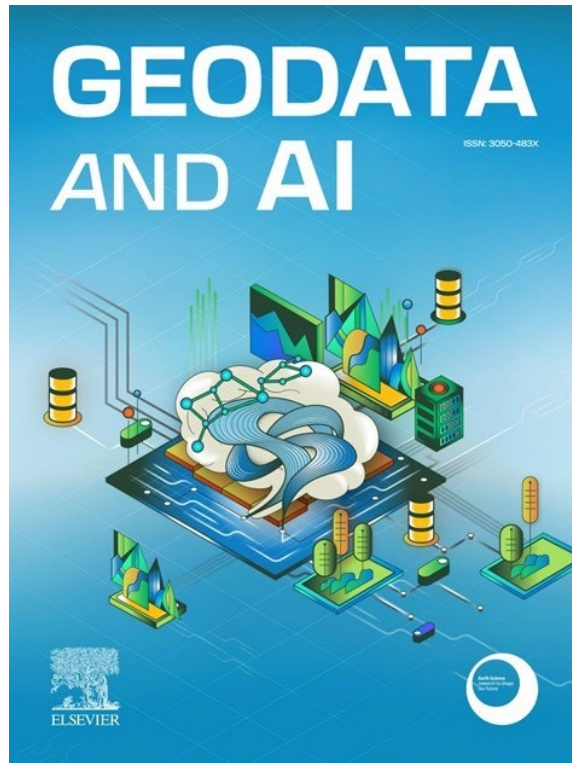
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on innovative visions and technological improvements

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- MAKE FOMLIG A TRUSTED PARTNER TO WORK WITH GOVERNMENTS TO DEVELOP ML/AI IN ACCORDANCE WITH NATIONAL/INTERNATIONAL AI LAWS
- SUSTAIN AND GROW FOMLIG
- DEVELOP PARTNERSHIPS
- NURTURE YOUNG TALENTS



GEOAI

Distinguished Lecture

DIGITAL TWINS AND ITS APPLICATION FOR UNDERGROUND SPACE

PROF. HEHUA ZHU, TONGJI UNIVERSITY, CHINA



Biography: Prof. Hehua Zhu is an expert in tunnels and underground space. He is currently the Distinguished Professor of Tongji University and Academician of the Chinese Academy of Engineering. Prof. Zhu was the former dean of the School of Civil Engineering, Tongji University, and now serves as the director of State Key Laboratory of Disaster Reduction in Civil Engineering. He is also the chairman of the Data Standards Committee of the International Geotechnical Engineering Union, the vice chairman of the China National Group of the International Society of Rock Mechanics. Prof. Zhu established the international academic journal Underground Space (JCR Q1). He won honors such as the second prizes of the National Science and Technology Progress Award, the German Humboldt Research Prize, the T. Pian Medal for International Academic Contribution, the Outstanding Contribution Award for the Implementation of the “Eleventh Five-Year Plan” Science and Technology