Welcome Message

Forensic engineering is the application of engineering knowledge to the investigation of failure, collapse and other performance problems of construction facilities and built environments.

Hyper-converged Forensic Research Center for Infrastructure (funded by National Research Foundation of Korea) is intended to develop integrated Industry-4.0-based forensic technologies to make three major infrastructures (underground, structure and hydro-environment) converged and well withstand, react and respond under various large-scale complex disasters.

With the great success of the first conference, we are pleased to invite you to the 2nd International Conference on Architectural, Civil, and Environmental (ACE) Forensic Engineering held at Korea University in South Korea through online during January 10-12, 2023.

2nd International Conference on

ACE Architectural, Civil, and Environmental Forensic Engineering

January 10-12, 2023

Webinar (Zoom)
Korea University, South Korea

Online registration begins on **December 20, 2022**

Free Registration

To register, please scan the QR code or go to
https://bit.ly/ACEforensic2023

+82-2-3290-4728, 4729
fPHI.conference@gmail.com
http://fphi.korea.ac.kr

Organized by

f-PHI Hyper-converged Forensic Research Center for Infrastructure
KOREAN GEOTECHNICAL SOCIETY
KSSC KOREAN SOCIETY OF STEEL CONSTRUCTION
KOSHAM KOREAN SOCIETY OF HAZARD MITIGATION

Sponsored by

Ministry of Science and ICT
NRF National Research Foundation of Korea

Day 1 Challenges in Geotechnical Engineering (Jan 10)

09:30–09:45	Registration
09:45–09:50	Welcome address Jong-Sub Lee (PI, Hyper-converged Forensic Research Center for Infrastructure, South Korea)
09:50–10:00	Complimentary address Moonkyung Chung (President, Korean Geotechnical Society, South Korea)
Session 1	**Underground Geosystems Stability Assessment** Chair : Prof. Jong-Sub Lee
10:00–10:30	On the Mechanical Behavior of Underground Pipeline Rehabilitated by Cured In Place Pipe Keh-Jian Shou (Vice President Asia in ISSMGE / Professor, National Chung Hsing University, Taiwan)
10:30–11:00	Characterization of Geotextile Tube Stability Yong-Hoon Byun (Professor, Kyungpook National University, South Korea)
11:00–11:30	Learning from Rehabilitation of Geotechnical Engineering Works Suttisak Soralump (President in South East Asia Geotechnical Society & Thai Geotechnical Society / Professor, Kasetsart University, Thailand)
11:30–12:00	Debris-flow Hazard Assessment and Optimal Barrier Design Model for Mitigation Seung-Rae Lee (Professor, Korea Advanced Institute of Science & Technology, South Korea)
12:00–13:00	Lunch
Session 2	**Advanced Characterization Techniques for Geo-Infrastructures** Chair : Prof. Tae Sup Yun
13:00–13:30	Towards Community-Scale Landslide Resiliency: From 3D Mapping & Modeling of Past Natural Disasters to Preparing for Future Disasters Dimitrios Zekkos (Professor, UC Berkeley, USA)
13:30–14:00	Smart Sensing for Evaluation of Drilled Shaft Integrity Jong-Sub Lee (Professor, Korea University, South Korea), Jung-Doung Yu(Professor, Joongbu University, South Korea) and DongSoo Lee(Korea University, South Korea)
14:00–14:30	Current State of the Practice in the Philippines for Quality Assurance of Driven and Bored Piles Mark Albert Zarco (President in Philippine Society for Soil Mechanics and Geotechnical Engineering / Professor, University of the Philippines Diliman, Philippines)
14:30–15:00	Break
Session 3	**Forensic Failure Assessment** Chair : Prof. Yong-Hoon Byun
15:00–15:30	Geotechnical Marriage between Theory & Practice Marc Ballouz (President in ISSMGE, Int'l Institute for Geotechnics & Materials, Lebanon)
15:30–16:00	The Experience of Geotechnical Construction and Testing of Piling Foundations of Megastructures on Problematical Soil Ground of Kazakhstan Askar Zhussupbekov (Former Vice President Asia in ISSMGE / Professor, Eurasian National University, Kazakhstan)
16:00–16:30	Singapore Case Studies on Forensic Geotechnics Chun Fai Leung (Professor, National University of Singapore, Singapore)
16:30–17:00	Deep Learning for Image-based Compressional Wave Velocity Prediction of Cement-Reinforced Soil Based on Core-Image Tae Sup Yun (Professor, Yonsei University, South Korea)
	Closing comments

On the Mechanical Behavior of Underground Pipeline Rehabilitated by Cured In Place Pipe

Keh-Jian Shou, National Chung-Hsing University, Taiwan

Aged underground pipelines are commonly located below busy roads, and the traditional open-cut repairing methods involves possible social and economic impacts on traffic and businesses. Therefore, trenchless methods provide superior alternatives that avoid these concerns. As one of the trenchless rehabilitation methods, cured-in-place pipe (CIPP) possesses the advantage that it can preserve the original pipe alignment even under conditions such as joint separation or pipe bending. In this study, numerical analysis was applied to investigate the mechanical behavior of damaged underground pipeline rehabilitated by CIPP. The numerical model was calibrated by the laboratory test results, then applied to simulate the rehabilitated pipelines with various geometries and loading conditions. The influence of control factors (e.g., backfill, and interface) on CIPP rehabilitation performance was also analyzed in detail. The results of this study suggest that the CIPP could improve the damaged underground pipeline to certain extent, and the findings could be applied in design optimization and guideline development.

Keh-Jian (Albert) Shou is elected VP Asia of ISSMGE (2022~2026), now Chairman of ISTT, Honorary Chairman of CTSTT, and Distinguished Professor of Department of Civil Engineering, National Chung-Hsing University, Taiwan. His research interests include rock mechanics/engineering, engineering geology, and trenchless technologies. He has published more than 200 papers on these topics and is now the editor of Tunnelling and Underground Space Technology(SCI), and the associate editor of the ASCE Journal of Pipeline Systems Engineering and Practice(SCI) and Underground Space (SCI). He obtained his Ph.D. degree (Civil Engineering) from University of Minnesota, U.S.A. in 1993. His experience includes: 1. Senior Principal Engineer, Shannon & Wilson, Seatlle, USA (2008/2~ 2008/9), 2. Visiting Professor, TTC, Louisiana Technical University, USA (2006/1~2006/2), 3. Visiting Professor, RCUSS, Kobe University, Japan (2003/10~2004/3), 4. Research Engineer, CSIR/Miningtek, South Africa (1998/2~1999/1), 5. Geotechnical Engineer, National Expressway Engineering Bureau, Taiwan (1993-1994).

Characterization of Geotextile Tube Stability

Yong-Hoon Byun, Kyungpook National University

Geotextile tubes are widely used in coastal protection, beach restoration, and embankment reinforcement. Soils dredged on-site with a high water content are typically used to hydraulically fill the geotextile tubes, because the geotextile tubes can drain the water and retain the soil particles of the slurry. Generally, individual geotextile tube seems stable due to its high ratio of base width to height. However, the internal strength profile of geotextile tubes has not been sufficiently characterized yet, and furthermore, the structural stability of the stacked geotextile tubes can be affected by the internal shear strength of each tube. Therefore, the presentation contains the characterization of geotextile tube stability, which is divided into three themes: (1) internal strength characterization; (2) interface reinforcement between geotextiles; (3) behavior of stacked geotextile tubes. The first theme is to evaluate the internal shear strength of geotextile tubes using a miniature cone in a small-scale model test. Secondly, the characteristics of the interface friction between two geotextiles with respect to reinforcement will be demonstrated. Using three types of geotextiles and a cementitious binder, a series of direct shear tests for both unreinforced and reinforced geotextiles are performed along the curing period. Lastly, this presentation includes the horizontal and vertical displacements of four stacked geotextile tubes monitored using a dual camera system and digital image correlation technology. The interface layers between upper and lower geotextile tubes are either unreinforced or reinforced with a cementitious binder. As a result, this presentation shows the efficiency of interface reinforcement between geotextile tubes and the promising characterization techniques to evaluate the internal strength profile and displacement distribution of geotextile tubes.

Yong-Hoon Byun is currently working as an Associate Professor at the School of Agricultural Civil & Bio-Industrial Engineering at Kyungpook National University (KNU). He received his bachelor's degree (2009) and his Ph.D. (2014) in Civil and Environmental Engineering from Korea University. After working at Korea University for one year (2014~2015), he joined the Transportation Geotechnics research group at the University of Illinois as a Postdoctoral Research Associate in 2015. In 2017, he was hired as an Assistant Professor in Kyungpook National University. He specializes in characterization of various geo-materials using advanced in-situ testing methods and wave-based nondestructive testing methods. He is the Associate Editor of the International Journal of Geo-Engineering and the Editorial Board Member of Journal of Korean Society of Agricultural Engineers. He was honored with Young Researcher Awards by Korean Geotechnical Society (2018) and Korean Society of Agricultural Engineers (2021). He was selected as Young Geotechnical Engineers Symposium Delegate at 16th Asian Regional Conference on Soil Mechanics and Geotechnical Engineering nominated by Korean Geotechnical Society (2019). He is also a Co-Investigator of Hyper-converged Forensic Research Center for Infrastructure. His research interests are environmental-friendly binders and geosynthetics for embankment stabilization and advanced monitoring systems for transportation substructure and earth dam.

Learning from Rehabilitation of Geotechnical Engineering Works

Suttisak Soralump, Kasetsart University

Most of infrastructure projects require good practice of Geotechnical engineering to achieve the desired goal. However, some basic Geotechnical knowledge might be overlooked and cause a serious outcome to the project. Learning from design and construction of the project is one thing but learning its performance during the operation is very essential. This lecture will give an example of projects that had serious Geotechnical issues that affected the operation and objective of the use of the structures. The detail research work of the project related to dams, slope and soft clay foundation will be discussed in this lecture to reveal what really happened along with their rehabilitation works. The use of probabilistic analysis to cope with uncertainty in input parameters will also be discussed. Therefore, it is essential for using engineering-wise design to prevent the unforeseen problems and not to repeat the same mistake again.

Dr. Suttisak Soralump is an Associate Professor in Civil Engineering Department , Kasetsart University. He is graduated with B.Eng. from Chulalaongorn University, M.Eng. (Soil Engineering) from Asian Institute of Technology, and PhD (Geotechnical Engineering) from Utah State University. He is the President of Thai Geotechnical Society and Southeast Asian Geotechnical Society and Chairman of Disaster Preparedness and Mitigation Working Group of AFEO.

Dr. Suttisak specialize in Dam engineering, soft ground improvement, Slope stabilization, Geohazard mitigation, Landslide, Geotechnical Earthquake Engineering, Ground subsidence. Dr. Suttisak is an experienced Geotechnical Engineer. He was a team leader for more than 20 large dam rehabilitations, design and construction in Thailand and abroad. He is also involved in various ground improvement projects and has influenced in preparing several Engineering codes and Law related to Geo-hazard. He received many awards including Geotechnical Engineer of the year and Best National teacher of the year.

Debris-flow Hazard Assessment and Optimal Barrier Design Model for Mitigation

Seung-Rae Lee, Korea Advanced Institute of Science and Technology (KAIST)

Debris-flow hazards-prone regions pose a significant risk to people and infrastructures, which may cause casualties and inflict significant financial losses. Therefore, a comprehensive and efficient debris-flow risk assessment framework for assessing hazard risk and designing optimal barriers as mitigation measures are essential. The developed framework utilizes the following components to identify debris-flow risk and design optimal barriers: (a) UAV-spectral technology for quick site investigation to collect digital elevation model (DEM) and in-situ soil conditions, (b) statistical and physical model for identifying regional to large-scale landslide susceptibility, (c) SPEC-debris model for simulating debris-flow, (d) optimal closed and open-type barrier location selection model, and (e) SPEC-debris model for evaluating barrier performance. The SPEC-debris model is a depth-averaged numerical analysis model to simulate runout through the following governing equations: (a) smoothing particle hydrodynamic (SPH), (b) pathway algorithm adopted from shallow-water equations (SWE), (c) energy conservation model incorporating entrainment principle and Voellmy rheology, and (d) collision mechanism. The optimal barrier location selection model utilizes the debris-flow network data structure to model debris-flow propagation and the heuristic optimization model to find the most sustainable and cost-effective barrier locations that satisfy multiple engineering requirements. The SPEC-debris-barrier platform, which contains the SPEC-debris model, is an analysis software for simulating debris-flow, selecting optimal barrier locations, and evaluating barrier performance. The capability and applicability of the developed framework are demonstrated through the debris-flow disaster in 2011 at Mt. Umyeon, Seoul, South Korea.

Seung-Rae Lee is a Professor of Civil and Environmental Engineering at the Korea Advanced Institute of Science and Technology (KAIST). Seung-Rae Lee received his bachelor's and master's degrees in civil engineering from Yonsei University in 1982 and 1984, respectively. Afterward, he received his master's degree and Ph.D. from Stanford University in 1985 and 1989, respectively. In 1989, he was hired as an Assistant Professor at the Korea Advanced Institute of Science and Technology (KAIST), where he is currently a Professor. He delivered many keynote lectures and seminars, including the 2021 Korean Geotechnical Society Fall Conference. His research interests include landslide hazard assessment and mitigation methods, in-situ data acquisition techniques, and thermo-hydro-mechanical properties of bentonite buffer in high-level radioactive waste storage.

Towards Community-Scale Landslide Resiliency: From 3D Mapping & Modeling of Past Natural Disasters to Preparing for Future Disasters

Dimitrios Zekkos, University of California at Berkeley

Landslides represent a distributed hazard that has significant consequences on infrastructure and communities. They occur due to a range of environmental "stressors" such as precipitation events, earthquakes, and human activities. Despite our capacity to reliably back-analyze landslides following their occurrence, our ability to predict the occurrence of landslides within a region remains limited, due to the lack of regional computational models with reliable, spatially-resolved input parameters. However, a predictive ability is key for our communities to become resilient against landslides. Advances in multi-scale monitoring approaches using satellites, Unmanned Aerial Vehicles and on-the-ground deployments can be leveraged to generate this input that can be used to calibrate predictive regional models. In this presentation, an application of such regional co-seismic landslide resiliency frameworks will be presented with a focus on the landslides that occurred during the November 17th 2015, M_w 6.5 earthquake in the island of Lefkada, Greece. The earthquake resulted in 700+ landslides. Using the satellite and UAV-based imagery, three-dimensional models of the co-seismic landslides at high resolution were created. The satellite and UAV imagery was also complemented with on-the-ground, in situ investigations. Regional slope stability analyses were conducted to match the mapped landslides following the earthquake and the insights were used for regional resiliency assessment against landslides as well as predictive modeling of subsequent events.

Dimitrios Zekkos, PhD, PE, is a Professor in the Civil and Environmental Engineering Department at the University of California at Berkeley and the CEO of ARGO-E an infrastructure analytics company. Dimitrios received his undergraduate degree from the University of Patras in Greece and his MSc and PhD from the University of California at Berkeley. Prior to joining Berkeley, Dimitrios worked at a consulting company in the Bay Area and was a faculty member at the University of Michigan. His research work is at the interface of natural hazards, geotechnical engineering, and informatics. He has deployed following disasters in many areas including the USA, Nepal, New Zealand, Japan, Dominica and Greece following natural disasters, such as earthquakes, hurricanes and monsoons. His research group devises and employs experimental and computational approaches to characterize the response of the geo-environment and infrastructure to natural hazards. His research has been recognized with several research Awards by organizations such as the American Society of Civil Engineers and the International Society for Soil Mechanics and Geotechnical Engineering. He can be reached at: https://dimitrioszekkos.org/

Smart Sensing for Evaluation of Drilled Shaft Integrity

Jong-Sub Lee, Korea University

This study proposed and demonstrated a smart monitoring system that uses transmission lines embedded in a reinforced concrete structure to detect the presence of defects through the changes in the electromagnetic waves generated and measured by a time-domain reflectometer. Laboratory experiments were first conducted to identify the presence of voids in steel–concrete composite columns. The results indicated that a void in the concrete caused a positive signal reflection, and the amplitude of this signal decreased as the water content of the soil in the void increased. Multiple voids resulted in a decrease in the amplitude of the signal reflected at each void, effectively identifying their presences despite the amplitude reduction. Furthermore, the electromagnetic wave velocity increased when voids were present, decreased as the water content of the soil in the voids increased, and increased with the water–cement ratio and curing time. Field experiments were then conducted using bored piles with on-center (sound) and off-center (defective) steel reinforcement cage alignments. The results indicated that the signal amplitude in the defective pile section —where the off-center cage was poorly covered with concrete—was greater than that in pile sections where the cage was completely covered with concrete. The crosshole sonic logging results for the same defective bored pile failed to identify the off-center cage alignment defect. This study therefore demonstrated that electromagnetic waves may provide a useful tool for the health and integrity monitoring of reinforced concrete structures.

Jong-Sub Lee is a Professor at the School of Civil, Environmental, and Architectural Engineering at Korea University, and had served as an Associate Dean at the Graduate School, KU (2017-2019). Jong-Sub Lee received his bachelor's degree in in civil and environmental engineering from Korea University in 1991 and his master's degree in civil and environmental engineering from KAIST (Korea Advanced Institute of Science and Technology), Korea in 1993. After working for the Hyundai Engineering and Construction Company for seven years (1993~1999) as a research engineer, he entered the civil and environmental engineering graduate program at the Georgia Institute of Technology (Georgia Tech) in 2000. In 2003, he received his Ph.D. from Georgia Tech. In 2005, he was hired as an Assistant Professor in Korea University, where he is currently a Professor. He is a Principal Investigator (PI) of Hyper-converged Forensic Research Center for Infrastructure (ERC sponsored by National Research Foundation of Korea). He delivered many keynote lectures in international conferences including the 19th International Conference on Soil Mechanics and Geotechnical Engineering (ICSMGE). He is member of the National Academy of Engineering of Korea. He published more than 255 journal papers (140 international and 115 national) and 290 conference papers until 2022. His research interests are non-destructive testing and evaluation with advanced sensing, in-situ subsurface characterization, and foundations.

Current State of the Practice in the Philippines for Quality Assurance of Driven and Bored Piles

Mark Albert Zarco, University of the Philippines Diliman

Given the often-challenging geotechnical conditions underlying most construction sites in the Philippines, pile foundations are a common scheme for founding structures. The majority of pile foundations in the Philippines consist of either pre-cast concrete piles or cast-in-place concrete bored piles. This paper presents an overview of the current state of practice regarding the quality assurance procedures used to identify installation and construction defects in driven and cast-in-place concrete piles. Quality assurance procedures generally involve tests aimed at determining the allowable capacity of the pile through either static or high-strain dynamic load tests, performed in combination with pile-integrity tests typically consisting of low-strain pile integrity tests (PIT) for driven piles or cross-hole sonic logging (CSL) for cast-in-place bored piles. The complementary nature of these tests in identifying installation or construction defects is highlighted in this paper and diagnosing the underlying causes in the construction protocol. The paper concludes by summarizing current challenges to implementing quality assurance protocols and provides recommended improvements to the current state of practice for addressing these challenges.

Mark Albert Zarco is a Professor and Head of the Geotechnical Engineering Group, Institute of Civil Engineering University of the Philippines Diliman. He is also the current chair of the Specialty Division for Geotechnical Engineering of the Philippine Institute of Civil Engineers (PICE), President of the Philippine Society for Soil Mechanics (PSSMGE) which is a member society to the ISSMGE, and serves as a Director in the International Press-in Pile Association (IPA). He is an honorary member of the Association of Structural Engineers of the Philippines (ASEP), and serves as the vice-chair of the ASEP Technical Committee on Soils and Foundations. His research interests lie in the area of computational geomechanics and its application to geotechnical engineering as well as the assessment and mitigation of risk association to geotechnical hazards. He holds a Doctor of Philosophy in Civil Engineering majoring in Geotechnical Engineering from the Virginia Polytechnic Institute and State University.

Geotechnical Marriage between Theory & Practice

Marc Ballouz, ISSMGE President

This lecture is an effort to summarize years of practice in geotechnical and forensic engineering, lessons learned from combining design, contracting, academia, and research. The lecture will introduce the concept of SOLGEH with the importance of collecting data prior to conducting any engineering analysis or giving any recommendations. The importance of a stable engineering solution lies in providing functionality with a cost effective solution without compromising safety. Every engineer should be very vigilant in checking the compatibility of units in every numerical data obtained or issued as most engineering problems in life come from the lack of matching units and incompetence of checking the logic of results. Skills are obtained from practice, and this is true in engineering. The best practice is in the every day life; thus engineering should be lived during the daily activities. Common example is in the observation of walking on sand that can tell us a lot about the theory we learn such as Terzaghi's equation. It is wrong to rely on intuition when solving engineering problems as it may lead to wrong conclusions. Theories were developed to be used. Key equations have changed humanity throughout history. Every engineering problem, simple or complicated, should be analyzed and theories applied before submitting results and taking decisions. The importance of marrying theory to practice is shown in many case histories. Lessons learned from some of those case histories are presented in this lecture in an effort to make an impact and leave the audience with some useful conclusions.

Dr. Marc Ballouz, is the president of ISSMGE, the international society of soil mechanics & Geotechnical Engineering. ISSMGE was founded in 1936 by Karl Terzaghi, the father of modern geotechnics, and currently represents 90 country members with more than 30,000 geoengineers. This is the highest position a geotechnical engineer can reach worldwide. Dr. Ballouz is known for being the man of all trades: A solid theoretician as well as a hands-on practitioner. His engineering journey started early on when he was 15 on construction sites with his father civil engineer. After obtaining his PhD degree from Texas A&M University, He established his own company IGM that quickly became international, known for its Design/Built innovative solutions. He was simultaneously teaching at 3 universities from 1996 to 2008, and currently is a visiting professor teaching foundation engineering at Texas State University. He has more than 10 key papers in renowned geotechnical engineering journals, and more than 100 design/built reports for large and challenging projecrts worldwide, and many other publications including the famous YouTube video "what is geotechnical engineering" that got him the prestigious ISSMGE Public Relations award. He was active for 8 years at the ISSMGE board from 2009 to 2017. He was serving on the board of the GEOINSTITUTE of America (2021-2022) when he was elected President of ISSMGE on May 1 st 2022.

The Experience of Geotechnical Construction and Testing of Piling Foundations of Megastructures on Problematical Soil Ground of Kazakhstan

Prof. Askar Zhussupbekov, L.N. Gumilyov Eurasian National University Saint Petersburg State University of Architecture and Civil Engineering (SPBGASU) Moscow State University of Civil Engineering (MGSU)

This lecture presents results of the geotechnical construction and testing of piling foundations of the Megastructures on problematical soil ground of (Abu-Dhabi Plaza, Expo-2017, LRT, BAKAD, International Hospitals in Petropavlovsk and Astana). A series of the static and dynamic piling tests, plate load tests, BDLT and PIT, Cross-hall investigations were carried out. The characteristics of difficulty soil mass associated with different layers were evaluated using numerical simulation as soil-structure interaction. The results show by graphically and also with analysis summarizing conclusions. This presentation will focus on the field applications of the megastructures on boring and drilling piles on problematical soil ground of Kazakhstan. This lecture provides programs and results of piling tests with static and different of the six construction sites under difficulty soil conditions. Forensic geotechnical engineering included comparison of test results which provided by different international standards (Kazakhstan codes, Eurocodes, American standards, etc.). These applications are important for understanding of interaction of piles with problematical soil ground of Megastructures of Kazakhstan.

Askar Zhussupbekov is a Professor of Department of Civil Engineering of Eurasian National University (ENU, Kazakhstan) and also adjunct professors of Saint Petersburg State University of Architecture and Civil Engineering (SPBGASU), and Moscow State University of Civil Engineering (MGSU), Russia, and Director of Geotechnical Institute of ENU (2012-2023), Kazakhstan. Askar Zhussupbekov received his bachelor's degree and master's degree in civil engineering from Saint Petersburg State University of Architecture and Civil Engineering (SPBGASU), Russia, in 1977. After working for the Karaganda State Industrial University (1977-1982), Kazakhstan, as an assistant professor, he entered the geotechnical engineering graduate program at the Saint Petersburg State University of Architecture and Civil Engineering (SPBGASU), Russia in 1982. In 1985, he received his Ph.D. from SPBGASU. In 1986, he was hired as an Associate Professor in Karaganda State Industrial University (Kazakhstan), where he became to Professor and First Vice-Rector of Karaganda State Industrial University. He is now President of Kazakhstan Geotechnical Society and as well as consulting work for civil and geotechnical projects at new capital Nur-Sultan (Kazakhstan), West Kazakhstan (Caspian Sea area), Almaty (old capital of Kazakhstan), Saint-Petersburg, Moscow, Yuzhno-Sakhalinsk (Russia). He delivered many keynote lectures in international conferences including the 16th Asian Regional Conference of Geotechnical Engineering (ISSMGE). He is a chair of TC 305 «Geotechnical Infrastructure for Megacities and New Capitals» of ISSMGE. His research interests are geotechnical engineering (piling and deep foundations), geomonitoring, undermining soil ground, disaster prevention and reduction, in situ testing, preservation of historical sites. He has published more than 380 scientific papers, including 6 books on Geotechnical Engineering. He has been supervised more than 45 Dr. Ph. dissertations and 10 Dr. Engineering dissertations (included foreign students from Japan, Turkey, South Korea, Cambodia,Tanzania, Tajikistan, China, Mongolia, Russia). He is member of ASCE, GGS, SEAGS, RSSMGE, IALT, IACR.

Singapore Case Studies on Forensic Geotechnics

Chun Fai Leung, National University of Singapore

Geotechnical failures occasionally take place in many parts of the world. Post-failure investigations would be initiated to establish the causes of failures such that lessons can be learned and mistakes not to be repeated as well as establish the guilty party involved for the purpose of court proceedings or compensation. However, such investigations are not straightforward as there are often missing or incomplete information and supporting documents resulting in missing links among the various stages of investigations. In this lecture, a number of cases studies are presented starting with the straightforward cases with the causes of failure readily identified after brief period of investigations. Less straightforward cases are then presented illustrating the necessary technique and expertise to dissect these cases. Finally, a couple of complex cases are then presented to highlight that for major geotechnical failure, it is often a combination of multiple factors that cause significant failures. The procedure to identify the order of importance of the factors is elaborated.

C.F. Leung is an Emeritus Professor at the Department of Civil and Environmental Engineering at the National University of Singapore (NUS), Prof Leung received his Bachelor and PhD degrees in civil engineering from the University of Liverpool, UK. His research interests include centrifuge modelling as well as offshore and marine geotechnics. He has published over one hundred papers in top tier international geotechnical and offshore engineering journals. Prof Leung delivered many keynote/invited lectures in international geotechnical and offshore engineering. He is a fellow of Academy of Engineers Singapore. Prof Leung received the Singapore Ministry of Transportation Innovation Awards in 2008 and 2021 and the Outstanding Geotechnical Engineer Award from the Geotechnical Society of Singapore in 2012. Prof Leung is also active in geotechnical practice as he has served as geotechnical consultant for over one hundred projects in Singapore and beyond. He has also served as expert witness for a number of geotechnical failures and issues.

Deep Learning for Image-based Compressional Wave Velocity Prediction of Cement-Reinforced Soil based on Core-Image

Tae Sup Yun, Yonsei University

This study proposed a novel approach to predicting the compressional wave velocity (Vp) from surficial core images taken from a cylindrical core specimen of cement-reinforced soil using a convolutional neural network (CNN) regression model. It is based on the hypothesis that the internal structure of the specimen is partially exposed on the circumferential surface of the specimen by coring, so that the surficial core image is related to the compression wave velocity. Experimental measurement of Vp was conducted at hundreds of points along the horizontal direction in cylindrical cores, and the corresponding core images were cropped to include the measurement points. A dataset was prepared by pairing the pre-processed surficial core images with the measured Vp values, and a CNN regression model with a pre-trained backbone network by transfer learning as a feature extractor was constructed. Data augmentation and several regularization strategies were applied for stable learning while avoiding overfitting problems, and retraining of the network model by fine-tuning was performed under supervised learning. The predictive results of the trained network model achieved a convincing R-squared value of 0.78. Compressional wave velocity inherently describes the internal structure of the specimen, while the proposed model only used the surficial core images, resulting in slightly scattered predictions. The internal structure of the over- and under-estimated specimens was observed using 3D x-ray computed tomographic imaging, and it revealed that surficial core images insufficiently reflected their internal structure. Nevertheless, this study showed that consecutive Vp profiles could be obtained by estimating Vp at unmeasured points based on core images, and the proposed approach demonstrates the feasibility of image-based prediction of geotechnical properties.

Tae Sup Yun is a Professor at the Department of Civil and Environmental Engineering at Yonsei University, and now serves as an Associate Dean in College of Engineering (2020-2022). Tae Sup Yun received his bachelor's degree in Geology from Yonsei University in 1997. In 2001, he entered the civil and environmental engineering graduate program at the Georgia Institute of Technology (Georgia Tech) where he received his M.S. and Ph.D. in 2003 and 2005. Then, he was hired as a P.C. Rossin Assistant Professor at Lehigh University. In 2009, he joined Yonsei University. His research interests include deep learning based analysis of geotechnical visions and images, optimization of tunnelling by artificial intelligence, multi-phase fluid flow, and geophysical characterization of geomaterial.