MBCMG2024

2nd International Conference on Microbial Biotechnology in Construction Materials and Geotechnical Engineering

13 - 16 August 2024 | Singapore

PROGRAMME BOOK

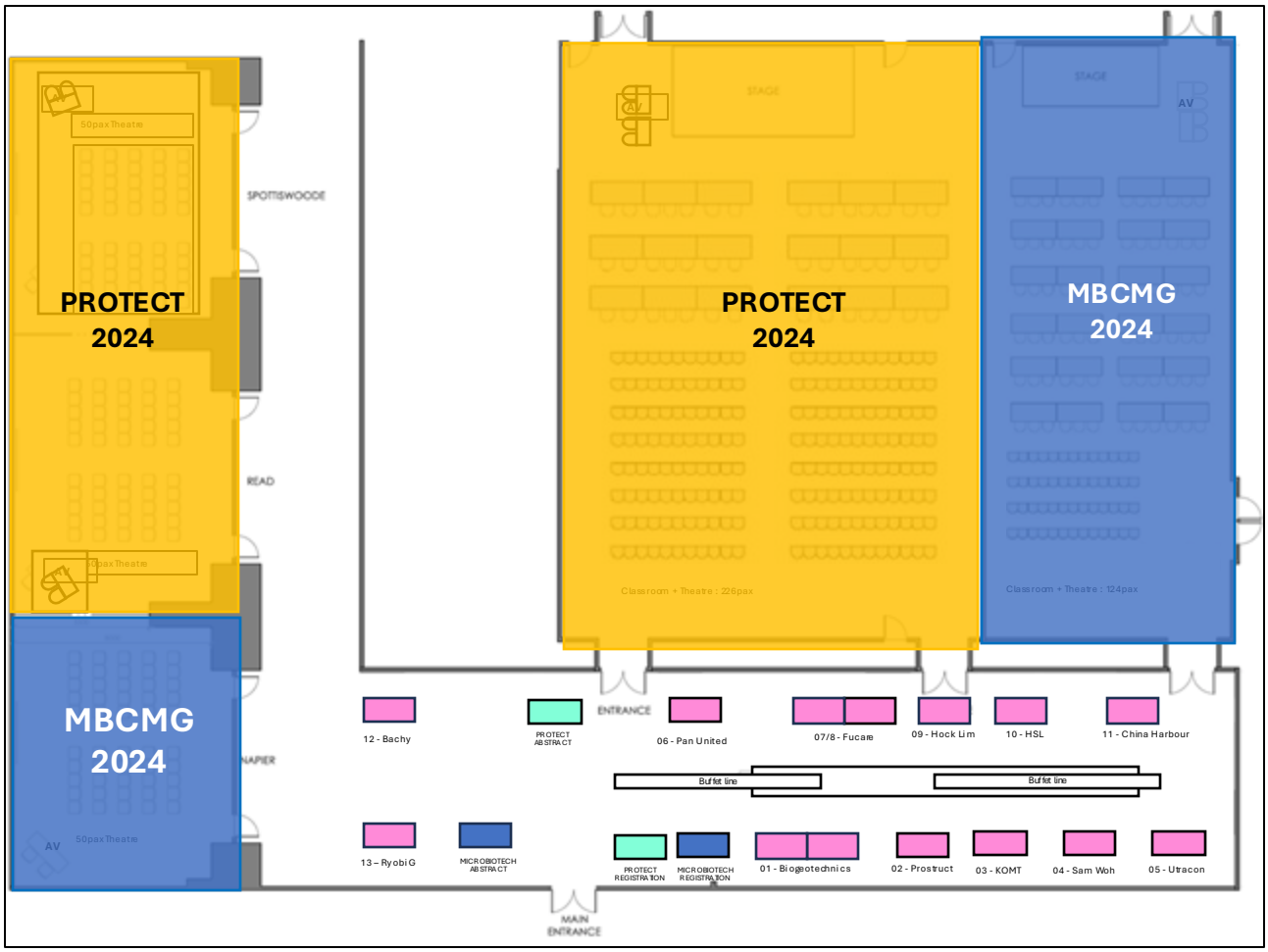
Organised by

NANYANG TECHNOLOGICAL UNIVERSITY SINGAPORE

NTU CEE Alumni Association

Index

FLOOR PLAN



Legend

SPONSOR BOOTH

MICROBIOTECH'S REGISTRATION & ABSTRACT

PROTECT'S REGISTRATION & ABSTRACT

PROGRAMME

14 August 2024	
0800 – 0830	Registration
Ballroom 2	
0830 – 0850	Opening Ceremony
0850 – 0925	**Keynote Session 1** Field Scale Applications of Enzyme Induced Carbonate Precipitation (EICP) Edward KAVAZANJIAN
0925 – 1000	**Keynote Session 2** Biogenic construction: System and perspectives Hanlong LIU
1000 – 1035	**Keynote Session 3** Self-healing of Concrete Based on Microbial Mineralization Chunxiang QIAN
1035 – 1100	Tea Break
1100 – 1125	**Invited Speaker 1** Enhancing soil resilience to climate change through a bio-approach Chaosheng TANG
1125 – 1150	**Invited Speaker 2** Stabilizing Byproducts with Microbially Induced Carbonate Precipitation: Challenges and Opportunities Brina MONTOYA
1150 – 1215	**Invited Speaker 3** Bio-Geotechnics for Geoenvironmental Engineering Applications Ningjun JIANG
1215 – 1315	Lunch

	Ballroom 2	Napier
	Oral Presentation Session 1 **Host: Liang CHENG**	**Oral Presentation Session 2** **Host: Hailei KOU**
1315 – 1500	**Invited Speaker** Inorganic Flocculant-Based Soybean Urease Extraction and its Effect on Biomineralization of Soil Hanjiang LAI	**Invited Speaker** Experimental study on corrosion resistance of granite residual soil strengthened by biostimulation-induced calcium carbonate precipitation Shiyu LIU
	Invited Speaker Development and application of microbial-induced restoration and conservation techniques for cultural relics Yang YANG	**Invited Speaker** Saturated permeability and water retention capacity in biochar-methanotrophs-clay for new landfill cover system Wenjing SUN
	Multiple heavy metals immobilization in contaminated water by Enzyme-induced carbonate precipitation method Yi BIAN	**Invited Speaker** Biochar-vegetation interactions on slope stabilization Jun Jun NI
	Investigation on the bioremediation of heavy metal-contaminated solution utilizing the two-step MICP method based on the urea-medium Xiaosong HUANG	Bio-cementation technique for lateral injection in a test pit: evaluation of treatment uniformity Cong-Yu WANG
	Synergistic solidification of heavy metal tailings by polyethylene glycol (PEG) and microorganisms Bo KANG Shaogeng CHEN	4D printing construction of living materials based on microbially-induced carbonate precipitation Peng JIN
	Large-scale application of microbial induced carbonate technology in the field of tailings solidification Chunli ZHENG	Experimental study on the dynamic fracture properties of granite exposed to cyclic freeze-thaw treatment and different mixed modes dynamic loading Zhihui CUI
	Experimental study on the seepage proof and leak plugging of vertical cracks in concrete by microbial grouting Qiang JIA	Research on Energy Evolution and Strain Localization of Freeze-thawed Sandstone under Uniaxial Loading-unloading Hao TAN
	Impact of different water-reducing agents on the properties of Limonite Self-compacting conductive concrete Zhenhua REN	Study on the mechanism of biomass ash in carbonation of magnesium slag and its main mineral phases Siyuan BIAN
	Assessment of surface treatment systems for protecting concrete structure Jin Ping LU	Effects of a new synthetic Fe-PAM flocculants on filtration and consolidation of bentonite slurry Junqiang SHI

1500 – 1520	Tea Break	
1520 – 1700	**Ballroom 2**	**Napier**
	Abstract Session 3 **Host: Jianyun WANG**	**Abstract Session 4** **Host: Xiaohua PAN**
	Invited Speaker Synergistic solidification of Calcareous sand by Magnesium oxide and microorganisms Hailei KOU	**Invited Speaker** Optimization of bio-cementation for soil stabilization and erosion control Jia HE
	Invited Speaker Effective heavy metal bioremediation through enhanced biomineralization from microbiological and crystallographic perspectives Liang CHENG	**Invited Speaker** Enhanced Effect of Ice Nucleation Active Bacteria on the Strength of Warm Permafrost Liyun TANG
	Influence of particle and root bark morphology on the root pull-out behaviour and direct shear behaviour of the root-soil matrix Bei-Bing DAI	Improving erosion resistance of mine tailing dams with EPS-aided biocementation Anant Aishwarya DUBEY
	Cyanobacteria as a Novel Nutrient Source for Biomineralization Thora ARNARDOTTIR Jamie HAYSTEAD	Experimental Study on Microbial-cemented Tailings under Different Calcium Salts Yajie WENG
	Study on the large-scale preparation of auxiliary cementitious materials for CO2 fixation of cement kiln tail by microorganism and steel slag Yijin FAN	Mechanical Characterization of Stabilized Dredged Marine Deposits with High Water Content Using Industrial Wastes and Vacuum Preloading Rundong ZHAO
	Mechanical properties and stability of zinc-contaminatedred clay cured by MICP synergistically activated MgO Yu SONG	Effect of urease activity on the cohesion of deposited calcium carbonate Rui ZHANG
	Differences in carbon sequestration rates of granular γ-C2S, β-C2S and C3S minerals and their microscopic mechanisms Yangfan XU	The metabolic mechanisms and a novel doble-operons gene structure of Sporosarcina pasteurii Junyi SONG
	Alternative Scaffoldmaterials for photosynthetic and ureolytic MICP Robin NEW	Study on the properties and mechanism of sand reinforced by ARTP mutagenized calcified microorganism Xuanshuo ZHANG
1700	End	
1900 – 1930	Dinner Registration	
1930 – 2130	Conference Dinner	

Schedule is based on Singapore Time (GMT +8). Programme is correct at the time of publish and subject to adjustments

15 August 2024	
0800 – 0830	Registration
Ballroom 2	
0830 – 0905	**Keynote Session 4** MICP Ground Improvement Design to Support Structures Founded on Liquefiable Soils Jason DEJONG
0905 – 0940	**Keynote Session 5** Multi-Scale Testing and Modelling in MICP Yang XIAO
0940 – 1015	**Keynote Session 6** Single bacteria spore encapsulation for self-healing concrete En-Hua YANG
1015 – 1040	Tea Break
1040 – 1105	**Invited Speaker 4** Large-scale field test of desert sand reinforcement by sand plants combined with EICP technology Chi LI
1105 – 1130	**Invited Speaker 5** Using biology to improve sustainability in geotechnical engineering Leon Van PAASSEN
1130 – 1200	**Invited Speaker 6** Mechanism and Application of Biomineralization for Solidifying Sand Linchang MIAO
1200 – 1300	Lunch

	Ballroom 2	Napier
	Abstract Session 5 **Host: Wengang ZHANG**	**Abstract Session 6** **Host: Chuangzhou WU**
1300 – 1500	**Invited Speaker** Application of Aspergillus Oryzae Fungi for increasing shear strength of loose sand Aswin LIM	**Invited Speaker** Research on the Suppression of Surface Powdering and Cracking at Zhouqiao Earthen Site using EICP Technology Jianwei ZHANG
	Invited Speaker Cracks repair by use of microbially induced carbonate precipitation: progress and challenges Jianyun WANG	**Invited Speaker** Microbially influenced concrete corrosion inhibition in marine environments based on the bio-mineralization technique for sustainable coastal cities Xiaohao SUN
	Development of a pH-responsive hydrogel with high moisture absorption for bacteria-based self-healing concrete Fuxing HOU	Preparation of high-strength microbial mortar Lu WANG
	Study on the impact of real crack environments on biogenic CaCO3 precipitation process in microbial self-healing concrete Di SHEN	Experimental study on the reinforcement mechanism and wave thumping resistance of EICP reinforced sand slopes Shixia ZHANG
	Utilization of pH Responsive Hydrogel as Bacterial Protector in Manufacturing Self- Healing Mortar Puput RISDANARENI	Investigating the effects of microbial-induced calcite precipitation on clay's hydro-mechanical properties Jessica TSE
	A hydrogel-assisted EPS@(Ca-P&C) hybrid coating on biomedical magnesium alloy via microbial-induced mineralization Dong Fang CHEN	Exploration of airborne bacteria for high-efficiency microbial induced carbonate precipitation Meiqi CHEN
	Experimental study on the effect of microbial consortia-enhanced recycled concrete aggregates on the self-healing performance of concrete cracks Jiaguang ZHANG	Stress sensitivity of permeability in high-permeability sandstone sealed with microbially-induced calcium carbonate precipitation Chenpeng SONG

	Ballroom 2	Napier
	Abstract Session 5 **Host: Wengang ZHANG**	**Abstract Session 6** **Host: Chuangzhou WU**
	Investigation into the type of nutrients on the unconfined compressive behaviour of fungal composites Alireza FATHOLLAHI	Effect of (in)organic additives on microbially induced calcium carbonate precipitation Jamie HAYSTEAD
	Investigation of fungal induced carbonate precipitation (FICP) using basidiomycota fungi Jason ERIKSEN	A study on sand behaviour of injection method on multiple cycle MICP treatment Amalia Ula HAZHIYAH
	Frozen enzyme EICP method for more effective soil improvement Samuel NG	Microbial mineralization technology applied in self-healing of marine concrete Jing XU
1500 – 1520	Tea Break	
	Abstract Session 7 **Host: Jia HE**	**Abstract Session 8** **Host: Chao SHI**
	Invited Speaker Micromechanical properties and bonding fracture of EICP-reinforced sand analyzed using microindentation test Ming HUANG	**Invited Speaker** Exploring Root-inspired DEM Simulation for Evaluating Root-soil Complex Shear Strength Wengang ZHANG
1520 – 1740	**Invited Speaker** An efficient microbial sealing of rock weathering cracks using bio-carbonation of reactive magnesia cement Xiaohua PAN	**Invited Speaker** Seawater-based Soybean Urease Extraction and its Biomineralization of Calcareous Sand Mingjuan CUI
	Soil improvement via polymer-assisted soybean crude urease carbonate precipitation technique Zalfa Maulida IHSANI	Effects of combined red mud and phosphogypsum on strength and microscopic characteristics of cement-admixed clay Jianwen DING
	Evaluating the effect of soil grading on UCS of MICP treated sandy soils Reena N. HORA	Efficient stabilization of dredged sludge through the bio-carbonation of reactive magnesia cement method Rui WANG
	Micro-mechanism of bio-cementation based on micro-CT image analysis Ji-Peng WANG	Experimental study on solidification of graphite tailings sand by MICP under the regulation of glutinous rice slurry Zhimin LI

	Ballroom 2	Napier
	Abstract Session 7 **Host: Jia HE**	**Abstract Session 8** **Host: Chao SHI**
	Miniaturized device to measure urease activity in the soil interstitial fluid using wenner method Rafaela CARDOSO	Engineering carbonic anhydrase as a route to biostability and CO2 capture Katie GILMOUR
	Evaluating the performance and durability of concrete paving blocks enhanced by bio-cement posttreatment Sivakumar GOWTHAMAN	Regulating the microbially induced calcium carbonate precipitation (MICP) process through the application of electric fields Chao LV
	Fast Biomineralization to Inhibit Corrosion on Steel via Urease-Producing Bacteria Xuanhua FENG	Metre-scale sand improvement using microbially induced carbonate precipitation Gujie SANG
	Electrical resistivity method for monitoring the microbially induced calcium carbonate precipitation (MICP) soil stabilization processes Jun-Zheng ZHANG	The investigation of microbial induced calcium carbonate precipitation for soil improvement Jamie HAYSTEAD
	Long-term performance on drought mitigation through a bio-approach: evidence and insight from both field and laboratory tests Xin-Lun JI	Physical property of MICP-treated calcareous sand under seawater conditions by CPTU Kemeng YU
1745 – 1800	**Special presentation** **Briefing on recent research work on Bio-geotechnics in Nanyang Technological University** **Kangda WANG**	
1800 – 1820	Closing and Award Giving Ceremony	
1820	End	

KEYNOTE SPEAKERS

Keynote Speaker

Prof Edward KAVAZANJIAN

Arizona State University

United States of America

Prof Edward Kavazanjian, Jr. is a Regents' Professor and the Ira A. Fulton Professor of Geotechnical Engineering at Arizona State University (ASU). He joined ASU in 2004 after 20 years in engineering practice. He is Director of the Center for Bio-mediated and Bio-inspired Geotechnics (CBBG), a National Science Foundation-funded Gen-3 Engineering Research Center dedicated to the emerging sub-discipline of biogeotechnical engineering. His expertise includes geotechnical engineering for civil infrastructure systems, geotechnical earthquake engineering, design and construction of waste containment systems, and the mechanical properties of solid waste. He has been recognized by election as a member of the United States National Academy of Engineering and as a Distinguished Member of American Society of Civil Engineers

14 August 2024, Wednesday | 0850hrs – 0925hrs

Field Scale Applications of Enzyme Induced Carbonate Precipitation (EICP)

Talk sypnosis

Enzyme induced carbonate precipitation (EICP) is attracting increasing interest as an alternative to microbially induced carbonate precipitation (MICP) as a mean of soil improvement via ureolysis (hydrolysis of urea). EICP typically uses urease enzyme extracted from vegetative matter or fungus rather than microbial urease to catalyze the precipitation reaction. Work on ECIP at the Center for Biomediated and Bioinspired Geotechnics (CBBG) has now progressed from laboratory testing to field- scale trials. Field-scale applications in progress or completed to date will be described, including fugitive dust suppression, stabilization of mine tailings, surface water erosion control, and biocemented columns for foundation support.

Keynote Speaker

Prof LIU Hanlong

Chongqing University

China

Professor LIU Hanglong serves as the chairman of TC303 of the International Society of Soil Mechanics and Geotechnical Engineering (ISSMGE), and the editor-in-chief of Biogeotechnics and "Journal of Civil and Environmental Engineering (Chinese and English)". He has long been committed to scientific research and teaching in the fields of soft foundation reinforcement and pile foundation engineering, environmental geotechnical mechanics, and disaster prevention and mitigation engineering. He has published 326 SCI and other high-level papers, 12 ESI highly cited papers, and his H-index is 62. He has been selected into the Elsevier China Highly Cited Scholars list for five consecutive years since 2019 and selected into the Clarivate Global Highly Cited Scholars list in 2023. He obtained 132 national invention patents and 7 software copyrights. Published 5 monographs in Chinese and English and edited 7 national and industry standards. He has won 2 second prizes for National Technological Invention Awards, 1 second prize for National Science and Technology Progress Awards, and 2 second prizes for National Teaching Achievements.

14 August 2024, Wednesday | 0925hrs – 1000hrs

Biogenic construction: System and perspectives

Talk sypnosis

With the increasing demand for buildings and infrastructures and the mounting challenges associated with the current construction technologies such as high emission, high pollution, and high energy consumption, the civil engineering profession is at the crossroad for a transformation or upgrading before it can be put into tasks for these challenges. Inspired by the concept of harmonious coexistence between humans and nature, a new concept, biogenic construction, for civil engineering is proposed. The definition of biogenic construction is given. The framework and four components of biogenic construction are established. These include microbial construction, plant construction, animal construction, and bioinspired construction. Examples of each component are given. A new construction system for creating a more eco-friendly, healthier, and more sustainable environment for future civil engineering developments is also proposed.

Keynote Speaker

Prof Jason DEJONG

University of California, Davis

United States of America

Prof Jason DeJong is a Professor at the University of California, Davis. Jason is the Director of the NSF NHERI Center for Geotechnical Modeling and chair of the TC102 Technical Committee on Site Characterization. He is also a Co-PI of the NSF Engineering Research Center on Bio-mediated and Bio-inspired Geotechnics. Prof. DeJong's major technical contributions have been in the areas of soil and site characterization, earthquake engineering, biogeotechnics, and geotechnical sustainability. Results from his research program have been disseminated through more than 250 publications, recognized through numerous national and international awards, and adopted in industry practice. Jason regularly consults on large geotechnical infrastructure projects.

15 August 2024, Thursday | 0830hrs – 0905hrs

MICP Ground Improvement Design to Support Structures Founded on Liquefiable Soils

Talk sypnosis

The field of biogeotechnics is founded in the belief that studying, understanding, harnessing, translating, and applying biologically derived processes and ideas can invigorate innovation and generate new geotechnical technologies that will produce a step change in geotechnical practice with respect to sustainability, performance, and ultimately, societal safety. Microbially induced calcite precipitation (MICP), of the various technologies explored to date, has matured most rapidly, with comprehensive advances spanning from bio-geo-chemo-mechanical insights of the enabling scientific processes, to robust laboratory testing of how geotechnical engineering properties are improved, to upscaling of the technology for field implementation. After providing a broader overview, this presentation will focus on system-level MICP treatment strategies to stabilize structures susceptible to earthquake-induced damage due to liquefaction triggering. An optimal design solution, wherein structure settlement and permanent tilt can be minimized while limiting the induced acceleration and rocking to acceptable levels, is hypothesized to exist. A robust 1m radius centrifuge test program was performed at the University of California, Davis (UCD) Center for Geotechnical Modeling (CGM) to investigate how the treatment conditions (depth, cementation magnitude) of a MICP treated zone, both with and without a structure, affect the soil-structure interaction (SSI) of a simple structure founded on loose Ottawa F65 sand. A dense array of embedded sensors, a high-speed camera motion tracking system, and cone penetration test soundings were used to measure system performance during and between shaking events. Results show that a finite MICP treatment zone that is sufficiently deep to eliminate liquefaction effects within the soil-structure interaction zone, but allows localized liquefaction at depth beneath the MICP treated zone, can provide acceptable performance. More specifically, treatment down to about two-thirds the liquefiable depth was shown to be effective in reducing permanent building settlement and tilt significantly while limiting the magnitude of accelerations and rocking induced on the structure during shaking.

Keynote Speaker

Prof QIAN Chunxiang

Southeast University

China

Qian Chunxiang is a chief professor at Southeast University, an expert with special allowance from the State Council of China, the director of the Key Laboratory of Microbial Mineralization Technology in the China Building Materials Industry, and the chief scientist of the "14th Five-Year Plan" National Key R&D Plan Project. Her research focuses on concrete crack reduction and repair, self-healing, self-protecting, and self-insulating cement-based materials, as well as low-carbon carbon fixation theory and technology for cementitious materials. She has pioneered research in microbial mineralization within the field of civil engineering in China. Professor Qian has authored four monographs, published over 300 papers, developed three software works, and holds 51 authorized invention patents. She has led and participated in projects that have received two second-class national science and technology progress awards and four first-class provincial and ministerial awards. In both 2022 and 2023, she was recognized among the top 2% of scientists globally.

14 August 2024, Wednesday | 1000hrs – 1035hrs

Self-healing of Concrete Based on Microbial Mineralization

Talk sypnosis

A certain width cracks are allowed in design of concrete structures from view point of loading. But in harsh environment, cracks result in great reduction of durability of concrete structures. So, it is necessary to repair cracks properly. Self-healing is an upgraded and bionic technology which can repair cracks timely and doesn't need construction space and manpower. Bacteria induced self-healing was firstly reported in 2007. The first patent in China was issued in 2013. The research progress of past ten years in China will be presented, including design methods for core- shell structure of healing agents and its dosage in concrete, characterization methods for self-healing effectiveness, mechanism of microbial mineralization in crack mouth, applications in real structures, etc.

Keynote Speaker

Prof XIAO Yang

Chongqing University

China

Prof. XIAO Yang is a Professor at the Chongqing University of China. Prof. Xiao's major technical contributions have been in the areas of the mechanical characteristics and constitutive theories for coarse granular soils, energy soils, and biocemented soils. He has been recognized as a "Highly Cited Chinese Researchers" from 2018 to 2023 due to his outstanding research works. Prof. Xiao has been supported by multiple projects of the National Natural Science Foundation of China and National Key Research and Development Program of China. Results from his research program have been disseminated through more than 130 publications, recognized through numerous regional, national and international awards, and adopted in geotechnical engineering. Additionally, Prof. Xiao serves on the editorial boards of several prestigious international journals, including the Executive Deputy Editor-in-Chief of Biogeotechnics, an Associate Editor of International Journal of Geomechanics-ASCE, and Editor of the Canadian Geotechnical Journal and Acta Geotechnica.

15 August 2024, Thursday | 0905hrs – 0940hrs

Multi-Scale Testing and Modelling in MICP

Talk sypnosis

The integration of biogeotechnics into geotechnical engineering represents a transformative approach that uses biological processes to enhance the sustainability and performance of ground improvement techniques. Among the various biogeotechnical methods, Microbially or Enzymatically Induced Calcite Precipitation (MICP or EICP) stands out for its rapid advancement and practical applicability. This presentation delves into the multi-scale research approaches for MICP, exploring the biomineralization mechanisms, experiments, and theoretical models across various scales. At the microscopic level, microfluidic experiments in droplet, porous and fractured media reveal the “bacterial attachment” biomineralization mechanisms, showing how biological crystal evolution is influenced by bacterial behavior, concentrations, flow rates, and the injection process. Advanced in situ tensile tests are utilized to investigate the micro-mechanical properties of the biocemented soils, indicating that the breakage of calcium carbonate crystals tends to occur in biocement with higher strength. A developed bio-chemo-hydro model provides a theoretical foundation for understanding the MICP process at the microscopic scale. Moving to the element scale, we investigate the mechanical characteristics and proposed constitutive models for biocemented sands under monotonic and dynamic loadings, respectively. These studies provide essential data for developing predictive models and understanding the broader implications of MICP on soil mechanics. At the macro scale, studies including precast concrete piles through biogrouting improvement and field trials demonstrate the significant effectiveness of MICP in real-world scenarios, demonstrating its potential to improve soil stability and strength. These multi-scale researches underscore MICP’s potential as a sustainable and effective ground improvement technique, contributing to low-carbon and environmentally friendly infrastructure constructions.

Keynote Speaker

Assoc Prof YANG En-Hua

Nanyang Technological University

Singapore

Dr Yang, En-Hua is an Associate Professor and Associate Chair (Academic) of the School of Civil and Environmental Engineering at the Nanyang Technological University, Singapore. Prior to joining NTU, Dr. Yang was a forensic engineer in Exponent's Buildings and Structures practice, USA. He received his PhD degree in Civil Engineering (Materials) from the University of Michigan at Ann Arbor. His principal area of research is cement-based construction materials. He is experienced in the Leadership in Energy and Environmental Design (LEED) green building rating system and is a LEED Accredited Professional certified by the U.S. Green Building Council. He currently serves as Associate Editor of Journal of Sustainable Cement-based Materials and Section Editor of Handbook of Cementitious Composites. Dr. Yang has published more than 170 SCI journal articles with more than 12000 citation and a H-index of 60 (Google Scholar, July 2024). He is among the World's Top 2% Scientists ranked by Standford University for both career and single year since 2020. He was the recipient of the CEE Innovation Award (2023), the IA-FraMCoS Young Researcher Best Paper Award (2019), the Nanyang Education Award (2016), and the Awards of Highly Cited Original Papers of Applied Energy (2016). He is the inventor of 45 intellectual properties (IP) in construction and building materials. His research on innovative construction and building materials have been implemented in full-scale field trails by industries and agencies.

15 August 2024, Thursday | 0940hrs – 1015hrs

Multi-Scale Testing and Modelling in MICP

Talk sypnosis

Concrete is naturally brittle and the formation of cracks in concrete is almost inevitable from shrinkage and environmental and mechanical loads. The presence of cracks allows the ingression of moisture, carbon dioxide, and other aggressive ions, which leads to the deterioration of concrete and acceleration of the corrosion of steel reinforcing bars, and ultimately shortens the service life of reinforced concrete structures. In some extreme cases, catastrophic failures and tragedies may occur. To cope with this critical issue, enormous resources have been allocated worldwide for structural health monitoring and crack repair. However, the current crack repair practice is time consuming and labour intensive. It is also costly and not effective in many cases. Self-healing of cracks can potentially improve durability and reduces maintenance of concrete. Microbial induced calcite precipitation is a novel approach to engage self-healing in concrete, and bacteria spores are protected from direct contact with the surrounding cement matrix to maintain their viability. This study proposes a novel single bacteria spore capsule via layer-by-layer (LbL) self-assembly of poly(dimethyldiallyl ammonium chloride) and silica nanoparticles to enhance the consistency of healing as well as to minimize the negative impact on the mechanical properties of the resulting concrete. The resulting single bacteria spore capsule has a size of 1 μm and the inclusion of the capsules dose not compromise the compressive strength of the matrix. Cement paste incorporating the capsules shows complete closure of large crack of few hundred microns and complete recovery of transport property. Healing products are observed along the entire crack from the surface to the interior

INVITED SPEAKERS

Invited Speaker

Prof TANG Chaosheng

Nanjing University

China

Prof Chao-Sheng Tang is the vice dean of the School of Earth Sciences and Engineering, Nanjing University, China. He holds the National Science Fund for Distinguished Young Scholars and Excellent Young Scholar. His research focuses on extreme climate engineering geology and environmental geotechnical engineering. He has published more than 280 peer-reviewed journal papers. Prof. Tang serves as the Secretary-General of the International Society for Environmental Geotechnology (ISEG), and associate editor or editorial board member for several journals, including Engineering Geology, Canadian Geotechnical Journal, and Bulletin of Engineering Geology and the Environment. Prof. Tang has received several prestigious awards, including the Tan Kah Kee Young Scientist Award for Earth Science, the First Prize of State Science and Technology Progress Award by the State Council of China, the First Prize of Natural Science Award by the Ministry of Education of China, and the Huang Jiqing Youth Science and Technology Award by Geological Society of China.

14 August 2024, Wednesday | 1100hrs – 1125hrs

Enhancing soil resilience to climate change through a bio-approach

Talk sypnosis

Extreme climate events exacerbated by climate change can trigger several weakening mechanisms in surface soils, potentially leading to a series of geological disasters and environmental problems, including land subsidence, soil cracking, soil degradation, soil erosion, and landslides. This study proposes a bio-mediated approach based on microbially induced calcite precipitation (MICP) to create a buffer barrier on soil surface to increase soil resilience to climate change. To explore its viability and the underlying mechanisms, we conducted a series of laboratory tests and filed trails on clayey soil that underwent extreme drought and heavy rainfall climate. The effect of cementation solution (CS) concentration, MICP treatment cycles and methods on the enhancement of soil resilience were investigated. Results indicate that MICP technology can significantly improve the water retention capacity, water stability and structural strength of soil, mitigate the evaporation and desiccation cracking of soil in arid climate, and enhance the erosion resistance of soil slopes under rainfall, thereby effectively improving the soil resilience to climate change. As increasing treatment cycles and CS concentration, the soil water retention capacity increases, the evaporation rate and desiccation cracks decrease gradually. 1.0 M is the optimal CS concentration for MICP to improve the soil water stability, mechanical strength, and erosion resistance. The two-phase MICP method demonstrated better effectiveness in enhancing surface soil resilience, the one-phase MICP method presents more uniform treatment effect on soil improvement. Microstructure analysis reveals that MICP-produced CaCO 3 crystals fill the pores and cracks in the soil, enhance soil water retention capacity, and suppress the evaporation of soil water. Meanwhile, the CaCO 3 crystals bond the soil particles, improving the water stability and mechanical strength of the soil, thereby effectively enhancing the soil erosion resistance. The findings of this study provide insights into the fundamental mechanisms of the interaction between climate change and MICP-treated soil, which contribute to developing environmentally friendly solutions to mitigate the impacts of climate change to soil stability.

Invited Speaker

Prof Brina MONTOYA

North Carolina State University

United States of America

Prof Brina Montoya is a Professor in the Department of Civil, Construction, and Environmental Engineering at North Carolina State University. Her primary research interests involve developing bio-mediated stabilization approaches to improve the sustainability and resiliency of infrastructure. Applications of microbial induced carbonate precipitation she has focused on include infrastructure subjected to natural hazards, such as earthquake-induced liquefaction and coastal/offshore erosion, and addressing anthropogenic hazards, such as stabilizing tailings impoundments and carbon sequestration. Her work related to biogeotechnics has been recognized by the National Science Foundation through the CAREER and BRITE Awards, and by the American Society of Civil Engineers through the Casagrande Award and Collingwood Prize.

14 August 2024, Wednesday | 1125hrs – 1150hrs

Stabilizing Byproducts with Microbially Induced Carbonate Precipitation: Challenges and Opportunities

Talk sypnosis

The management and storage of byproduct materials, such as coal combustion residuals, oil sand tailings, and ore mine tailings, face challenges including impoundment reclamation, dewatering, and strength loss. Microbially induced carbonate precipitation (MICP) can be used within byproduct materials to enhance their mechanical stability. MICP treatment processes in example byproduct materials and their limitations will be highlighted. Changes in self-weight consolidation, compressibility, and shear strength of select byproduct materials will also be discussed. Biostimulation and immobilizing trace elements within byproduct materials will also be discussed as opportunities with MICP.

Invited Speaker

Prof JIANG Ningjun

Southeast University

China

Prof Ningjun Jiang is currently a full professor of geotechnical engineering and interim vice director of graduate school at Southeast University (SEU), China. He received his PhD degree from University of Cambridge, UK. Prior to joining SEU, he was an assistant professor at University of Hawaii at Manoa, USA. His research areas include bio-mediated geotechnics, soil remediation, and ground improvement. Prof. Jiang has published more than 80 international journal and conference papers, which have been cited by more than 3000 times. He has received multiple research funding from National Natural Science Foundation of China, China Ministry of Science and Technology, Hawaii Department of Transportation, etc. He is the recipient of several academic awards, including Fredlund Award in 2019, Acta Geotechnica Best Paper Award in 2020, Soils and Foundations Editorial Board Member Award in 2021, and 75th Geotechnique Anniversary Early Career Award in 2023. Prof. Jiang is an Executive Deputy Editor-in-Chief for the newly lunched journal Biogeotechnics. Previously, he was also an editorial member of Soils and Foundations and Environmental Geotechnics.

14 August 2024, Wednesday | 1150hrs – 1215hrs

Bio-Geotechnics for Geoenvironmental Engineering Applications

Talk sypnosis

This presentation will introduce the innovative field of bio-geotechnics and its significant contributions to geoenvironmental engineering. Its applications in soil and water remediation, carbon capture/utilization/storage, and the use of recycled waste materials will be explored, highlighting how biological processes offer sustainable and efficient solutions for environmental challenges. Then, we will introduce our research team's advancements in microbial mineralization, which is employed to stabilize and solidify contaminated soils, create effective waste barriers, enhance in-situ bioremediation, and remediate contaminants in groundwater. Our research showcases the potential of bio-geotechnics to transform geoenvironmental engineering with robust, eco-friendly solutions for soil stabilization and contamination control.

Invited Speaker

Prof LI Chi

Inner Mongolia University of Technology

China

Prof Li Chi is a Professor at the Inner Mongolia University of Technology, specializing in environmental geotechnical engineering, the improvement and reinforcement of special soils, and geotechnical disaster prevention and early warning. Li Chi has devoted many years to researching geology and ecological environment management in arid and sandy regions. Her work includes the application of biological geotechnical technology for desertification control and the development of desert border control technology, which has earned her significant recognition among her peers. As a project leader, she has completed over 30 science and technology projects at the national, provincial, and ministerial levels. She has also published more than 200 papers in prominent academic journals. Prof Li is a certified geotechnical engineer and a demonstration expert. She is also a recipient of the Young and Middle-aged Science and Technology Innovation Award.

15 August 2024, Thursday | 1040hrs – 1105hrs

Large-scale field test of desert sand reinforcement by sand plants combined with EICP technology

Talk sypnosis

Mobile sand dunes have been recognized as severe natural disasters worldwide and it is of great significance to propose an effective and environmentally friendly method to combat mobile sand dunes. In this study, the enzyme-induced calcium carbonate precipitation (EICP) technology was used for desert sand solidification. Both laboratory experiments and large-scale in-site tests were conducted to demonstrate the feasibility of EICP treatment to improve wind-erosion resistance. The prospect of EICP technology combined with sand-plants to consolidate moving sand dunes was evaluated.

Invited Speaker

Dr Leon Van PAASSEN

Boskalis

Netherlands

Leon van Paassen is an expert on Biogeotechnics with more than 20 years of experience in academia and industry. He obtained an MSc degree in Engineering Geology at Delft University of Technology in 2002. After his graduation, he worked for several years as a geotechnical engineer at IFCO Foundations and Deltares. In 2009, he obtained a PhD degree in Environmental Biotechnology at Delft University of Technology. For his dissertation on "Biogrout, Ground Improvement by Microbially Induced Carbonate Precipitation" and affiliated papers he received the Young Member Award from the International Society for Soil Mechanics and Geotechnical Engineering (ISSMGE). Afterwards he worked as Assistant Professor at Delft University of Technology (2009-2016) and as Associate Professor at Arizona State University (2017-2022), where he mentored more than 120, BSc, MSc and PhD students and continued his research on bio-mediated ground improvement methods through laboratory experiments, numerical simulations and field scale implementations, which resulted in over 80 peer-reviewed papers in journals and conference proceedings. In 2022, he started working for Boskalis, a large dredging contractor and marine service provider based in The Netherlands, where he is involved in research and engineering for large dredging and land reclamation projects all over the world. He is also still affiliated to Arizona State University as an Adjunct Research Professor and Senior Investigator for the Center for Bio-Mediated and Bio-Inspired Geotechnics.

15 August 2024, Thursday | 1105hrs – 1125hrs

Using biology to improve sustainability in geotechnical engineering

Talk sypnosis

In recent decades, significant research efforts have been dedicated to develop bio-based technologies for civil and geotechnical engineering applications. One of the frequently used arguments for pursuing bio-based ground improvement methods is their potential to be eco-friendlier and more sustainable than existing technologies, such as those using cement or other chemicals, which can have a significant impact to the environment. However, these arguments often overlook several important factors. First, sustainability encompasses not only environmental but also economic and social aspects. Secondly, bio-based methods, like any other technology, require resources and energy and may produce waste or unwanted by-products. Several methods, such as Life Cycle Sustainability Analysis (LCSA), have been developed and used to compare the sustainability of different technologies. However, when using these methods, defining a functional unit, appropriate system boundaries, or metrics for a fair comparison can be challenging, often leading to bias and uncertainty. Despite these challenges, LCSA can help to identify the most significant impact factors that need to be addressed. By examining the results, it becomes evident that there are still bio-based methods and natural processes that remain underexplored and may prove to be more sustainable.

Invited Speaker

Prof MIAO Linchang

Southeast University

China

Linchang Miao, Ph. D, is Professor of Institute of Geotechnical Engineering, Southeast University, P. R. China. Professor Miao's research interesting includes metamaterial of vibration reduction, soft soil behavior & improvement, geo- environmental engineering, and unsaturated Soils. In recent ten years, Professor Miao focuses on the microbial geotechnology study, including MICP, EICP, the biomineralization for solidifying sand, and he has achieved good results. The relative research papers issued are over 50.

15 August 2024, Wednesday | 1130hrs – 1200hrs

Mechanism and Application of Biomineralization for Solidifying Sand

Talk sypnosis

Sand-dust storms have been globally recognized as severe natural disasters, and effective measures to control sandstorms and restore the ecosystem are urgently needed. This study proposed a biomineralization method for sand-dust storm control. The relevant mechanism was initially investigated, followed by a series of laboratory tests to determine optimum field treatment conditions. Subsequently, a large-scale field application experiment was conducted to examine the feasibility of biomineralization to control sand-dust storms. Results show that the biomineralization method is an environmentally friendly technology, with three advantages: (1) increasing the ability to resist wind erosion due to the formed crust layer; (2) increasing water retention capacity resulting from decreased permeability and porosity, and (3) beneficial to the growth of desert plants after solidifying sand of biomineralization. The biomineralization method overcomes the deficiency of sand- fixing engineering and can realize the goal of long-term sand-dust storm control. The biomineralization method not only can control sand-dust storms but also is a new technical route of carbon sequestration. These findings provided a solid foundation for utilizing the biomineralization method as an alternative approach to combat long-term desertification.

MBCMG2024
2nd International Conference on Microbial Biotechnology in Construction Materials and Geotechnical Engineering
13 - 16 August 2024 | Singapore

ABSTRACT BOOK

MBCMG2024

2nd International Conference on Microbial Biotechnology in Construction Materials and Geotechnical Engineering

13 - 16 August 2024 | Singapore

Click here to view Abstract book

ABSTRACT BOOK

Organised by

NANYANG TECHNOLOGICAL UNIVERSITY SINGAPORE

NTU CEE Alumni Association

SPONSORS

Thanks to

Platinum

Biogeotechnics

Gold

BACHY SOLETANCHE

CHEC 中国港湾 CHINA HARBOUR

HOCKLIM福林 ENGINEERING PTE LTD

HSL

Ryobi G

SAMWOH
Innovate Sustainable

Silver

KOMT

MBCMG2024