Ronaldo I. BORJA, Stanford University

Title: Phase field for compaction band formation: Capture of grain crushing and permeability evolution in heterogeneous media

Abstract:

Compaction bands form when the pore spaces between the solid grains of a rock mass collapse into a narrow zone. This deformation style has attracted much attention in the theoretical and numerical modeling community since the porosity reduction associated with pore collapse reduces the overall permeability of the rock, thus enhancing its potential to serve as a fluid flow barrier. Recent publications demonstrate the capability of the phase-field modeling approach for capturing the formation and propagation of compaction bands in porous rocks. In this talk, we will utilize the phase-field approach to show how grain crushing and fluid flow impact the formation and propagation of compaction bands. We employ a three-field finite element formulation in terms of solid displacement, fluid pressure, and the phase-field variable for this purpose. Using material parameters calibrated from real rocks, we show how the volume constraint imposed by fluid flow could impact the stress-strain responses of the rock as well as the ensuing geometric style of the compaction band.

Biography:

Ronaldo Borja works in theoretical and computational geomechanics, geotechnical engineering, and geosciences. His research includes the development of mathematical and computational frameworks for multiscale and multi-physical processes in geomechanics and other related fields. He is the author of a textbook entitled Plasticity Modeling and Computation published by Springer and serves as executive editor of two journals in his field: the International Journal for Numerical and Analytical Methods in Geomechanics and Acta Geotechnica. Ronaldo Borja is the recipient of the 2016 ASCE Maurice A. Biot Medal for his work in computational poromechanics.

Xiangsheng CHEN, Shenzhen University

Title: The Present Situation and Future Trends of Infrastructure Construction in Mainland China

Abstract:

Under the guidance of the "dual carbon" strategy, mainland China is transforming its infrastructure sector, transitioning from large-scale construction to a more green, resilient, and quality-focused approach. This shift is setting global benchmarks in energy utilization. By the end of 2022, the country demonstrated significant infrastructure development. It had created 2.7 billion square meters of urban underground space and operated urban rail transit lines that span over 10,566 kilometers across 57 cities, reflecting the shift towards more sustainable public transit. The national highways, part of a total road network of 5.35 million kilometers, are the longest in the world, demonstrating China's extensive connectivity. China's commitment to an ecological civilization is clear in its actions towards achieving carbon neutrality. The country has built the world's largest clean power generation system with non-fossil energy power generation capacity exceeding 1.1 billion kilowatts—equivalent to 50 Three Gorges Power Stations. It has also made significant strides in carbon emission reduction. In 2020, China's carbon emission intensity was reduced by 48.4% compared to 2005 levels, resulting in a cumulative reduction of approximately 5.8 billion tons of carbon dioxide. In support of the "Belt and Road" initiative, Chinese companies have made substantial investments in infrastructure projects across the globe. A notable example is the Addis Ababa light rail in Ethiopia. This project, designed and constructed by Chinese state-owned enterprises and operated by Shenzhen Metro, has had seven years of operation without casualties, underscoring the safety and quality of Chinese infrastructure projects. Mainland China is paving the way for the global transition to green, low-carbon, and resilient infrastructure. Future urban rail transit in the country is set to leverage new materials, processes, and advanced technologies such as digital twins and the Internet of Things (IoT). Such innovations will enhance infrastructure resilience, supporting the goal of achieving carbon neutrality in urban rail transit.

Biography:

Professor at Shenzhen University, Dean of the College of Civil & Transportation Engineering, Director of the Underground Polis Academy of Shenzhen University

After graduating from Huainan College of Mining in 1982, he worked continuously in research on shaft construction and tunneling in soft ground. Prof. Chen undertook research for the Shanghai Metro Co., Ltd. on the cross-river passage construction in soft ground for his study for PhD at Tsinghua University. He graduated from Tsinghua University with a PhD degree and his thesis was awarded the “Distinguished PhD theses” by the Ministry of Education of China. He shifted to Shenzhen Metro Co., Ltd. in Feb. 2001 and was appointed Chief Engineer in Jan. 2003.

He had taken charge the construction of more than 8 metro lines with use of many large underground spaces in the most difficult complex strata in Shenzhen, China since 2001. He joined Shenzhen University and was appointed the current position in March 2019. His main interests are underground engineering, tunneling, geotechnical engineering and shaft construction, especially ground freezing technique, ground move control technology and security environment synergism technology for engineering adjacent to subway structure. He is the author of 10 monographs and more than 210 academic papers and has been awarded by the State with 3 Prizes of National Scientific and Technological Progress and etc.

Yunmin CHEN, Zhejiang University

Title: Gravity driven mass transportation and transition: Hypergravity experiments

Abstract:

All matter on the Earth's surface and in the upper crust is subjected to the gravitational force caused by the mass of the Earth and the centrifugal force generated by the rotation of the Earth. The average gravity value at the Earth's surface is known as the standard gravity. Hypergravity is the condition where the force of gravity exceeds the standard gravity. This study aims to explore the driving effect of gravity on mass transportation and transition of multiphase media and the relationship between standard gravity and Hypergravity.

The gravity drives the transition and transportation of phase constituents. Gravity, as a kind of physical force, causes self-weight stress to gradually increase along the direction of gravity. The different mass densities in the multiphase system result in the driving force of the relative movement between different phase constituents. In the hypergravity environment, the self-weight body force is enhanced. Thus, a small-scaled object can generate the prototype self-weight stress field. The relative motion of multi-phase media is also enhanced, and the evolution process is shortened.

In this study, the influence of gravity in mass transportation and transition are studied, such as the failure of cavity rock, distribution of contact force between particles in the granular medium, convection and diffusion of different density fluid, waves liquefying the seabed, geological storage of CO_2, nuclides transportation in rock, and hydrate phase transition. Through experiments and numerical simulation, it is found that: (1) under hypergravity the failure area of cavity rock transfers to the bottom; (2) compared with the same stress generated by surface force, the contact stress between small particles is enhanced by hypergravity, which increases the critical hydraulic gradient of sand erosion; (3) the gravity increases the floating motion of the fluid, and the diffusion morphology satisfies the similarity relation of N^3; (4) hypergravity enhances the wave pressure and foundation stress, accelerates the accumulation of pore pressure and the transformation of soil (solid) into mud (fluid); (5) there is a critical hypergravity in the process of CO_2 floating displacement of pore water, the gravity is less than the critical value, and the displacement mode is the finger flow, otherwise it is the discontinuous bubble; CO_2 dissolution and transportation can be accelerated under hypergravity, and the scaling law satisfies the conventional similarity relationship; (6) when the Reynolds and Peclet number of seepage and solute migration in rock are less than critical values, the nuclide migration in hypergravity experiment is similar to that in prototype; (7) the hypergravity enhanced the liquid-gas mass transport and increased the decomposition rate of hydrate solid phase. Based on the above research results, the similarity of hypergravity physical modeling is established, which lays a foundation for the experiments of long-duration and large-scale problems.

The hypergravity experiment provides a revolutionary method to explore the law of matter motion and observe natural phenomena. Through interdisciplinary integration, hypergravity experiments can provide theoretical and technical support in engineering disaster prevention and mitigation, deep-sea and deep-underground resources exploitation, underground waste disposal, and other urgently needed fields in China.

Biography:

Prof. Yunmin Chen, born in 1962, is a Chair Professor of Civil Engineering at Zhejiang University. He was educated at Zhejiang University (1979-1989) with a BSc (Building Structural Engineering, 1983), MSc (Structural Engineering, 1986) and PhD (Geotechnical Engineering, 1989). From 1993-1995, he was a visiting scholar at IFCO Foundation Expertise in Netherlands. In 2015, he was elected as the Academician of the Chinese Academy of Sciences in recognition of his contribution in the field of geotechnical engineering. Currently, he serves as the Chief Scientist of a National Large Research Infrastructure project–Centrifugal Hypergravity and Interdisciplinary Experiment Facility (CHIEF). He is Co-Editor-in-Chief of the highly regarded International Journal Transportation GEOTECHNICS, and presently serves on the Editorial Board of 6 other international esteemed journals. He has published more than 300 refereed journal papers and been recognized by a number of awards, including three Second Prizes of The State Scientific and Technological Progress Award, the Outstanding Journal Paper Award by ASCE in 2015, and the Mao Yisheng Science and Technology Award in 2017. One of his experimental facilities named Innovative High-Speed Rail Tester (ZJU-iHSRT) was awarded as one of Ten Major Scientific and Technological Progress of China's Colleges and Universities in 2017.

Johnny CHEUK, AECOM

Title: Innovative approaches to sustainable coastal development

Abstract:

Coastal development and reclamation have been essential for human societies since ancient times, creating new land for agriculture, settlements, and industry. However, these activities have often come at a significant cost to the environment, causing habitat destruction, erosion, and pollution. With climate change and rising sea levels, the need for sustainable coastal development practices has become more urgent than ever.

This lecture focuses on innovative approaches to sustainable coastal development, with an emphasis on environmentally friendly materials and processes that enhance biodiversity and reduce carbon emissions. The lecture explores different key strategies for sustainable coastal development, covering the use of eco-shoreline, non-dredged reclamation with inert construction waste as fill material, as well as the adoption of industrial by-product, such as GGBS, in replacement of carbon-intensive ordinary Portland cement in ground treatment works.

By adopting these strategies, we can create resilient coastal environments that support biodiversity and reduce carbon emissions, while also promoting economic growth. These innovative approaches demonstrate that sustainability and economic growth can go hand-in-hand, and the lecture concludes by highlighting the importance of continuing this conversation and exploring new ways to build a more sustainable future.

Biography:

Dr. Johnny Cheuk is currently Vice President heading up the geotechnical team in the AECOM Hong Kong office. He is also the Asia Technical Excellence and Quality Lead in AECOM. Dr Cheuk has over 20 years of experience including research and practice in a wide spectrum of areas covering underground spaces, tunnels, caverns, deep excavations, foundations, reclamations and offshore geotechnical structures. With his strong technical background, he has been the project director or project manager for many infrastructure projects delivering engineering solutions to government and private clients.

Johnny is a thought leader in civil and geotechnical engineering and is committed to driving quality in the engineering profession through his roles on professional bodies. He is currently Vice-President of the Institution of Civil Engineers Hong Kong Association (ICE HKA). He is a past chairman of the Hong Kong Institution of Engineers (HKIE) Geotechnical Division, and a past president of the Hong Kong Geotechnical Society (HKGES). Johnny is an Adjunct Professor of The University of Hong Kong (HKU) and the Hong Kong University of Science and Technology (HKUST).

Wai Man, Raymond, CHEUNG, Geotechnical Engineering Office

Title: Sustainable Development through Smart Geotechnical Solutions-Hong Kong's experience

Abstract:

This keynote lecture presents the recent development and application of innovation and technology (I&T) in the geotechnical practice of Hong Kong. Smart geotechnical solutions have been offered to combat future challenges, in particular those arising from the climate change, as well as to enhance the productivity, efficiency and safety in engineering practice. Various key smart technologies have been identified for development and application, which include automation, robotics, digital technology, Internet-of-things (IoT) and artificial intelligence (AI), etc. In this lecture, the novel features of the Po Shan Drainage Tunnel (digital twin), the Smart Barrier System, the Common Operational Picture (COP), Smart Public Works Laboratories and various types of robots are highlighted. The speaker also introduces the latest I&T development in the Geotechnical Engineering Office (GEO), including the use of AI in landslip warning system and migration of the current 2-dimensional Geotechnical Information Infrastructure (GInfo) to 3-dimensional geotechnical information metaverse. These I&T initiatives strengthen the GEO's emergency preparedness and response to landslide risk, and thus enhance the climate resilience of Hong Kong.

Biography:

Ir Dr Raymond Cheung has more than thirty years' experience in civil and geotechnical engineering. He has been involved in a number of mega infrastructure projects in Hong Kong under the Airport Core Programme, including the Airport Railway, Chek Lap Kok International Airport reclamation and Western Harbour Crossing, before joining the Hong Kong SAR Government in the late 1990s. He has published numerous technical papers and a book on various fields of civil and geotechnical engineering. He is a member of various international technical committees such as Technical Committee 205 (Safety and Serviceability) of the International Society for Soil Mechanics and Geotechnical Engineering (ISSMGE), the School Scientific Committee of Landslide Risk Assessment and Mitigation (LARAM), and the International Network on Landslide Early Warning Systems (LandAware). He is currently Head of the Geotechnical Engineering Office (GEO) of the Civil Engineering and Development Department overseeing control of geotechnical works, setting geotechnical standards, testing and development of construction materials, mining operation and quarrying, tunneling, cavern and underground space development, the Landslip Prevention and Mitigation Programme, and the landslide emergency services.

Jian CHU, Nanyang Technological University

Title: New soil improvement methods for land reclamation using dredged clay or waste

Abstract:

The fill materials used for land reclamation in Southeast Asia in the past have been mainly marine sand dredged from the sea. However, sand obtained in this way is not sustainable partially because of the detrimental effect of dredging on the coastline erosion and the surrounding coastal and waterway environment and ecosystems. The use of seabed mud, such as mud from maintenance dredging or waste materials becomes an alternative.

It is challenging to use mud or slurry for land reclamation as the fill is too soft for workers or machine to go on top. A working platform has to be formed. Methods for the formation of the working platform will be presented. With a working platform, conventional soil improvement methods such as PVDs or vacuum preloading can be applied.

However, the above methods are too time consuming as the working platform can only be formed after all the fill materials have been placed. It is also time consuming to form a working platform. The normal soil improvement that can only be carried out after the formation of working platform is also time consuming unless more expensive methods are adopted. One method that could reduce the time taken for land reclamation using mud or slurry has been developed. In this method, a patented product, the Horizontal Drainage enhanced Geotextile (HDeG) sheet, is used to form horizontal drains for consolidation of mud. The fill materials can be treated layer by layer during the placement of the fill. When the fill materials have been placed to the required elevation, the muddy soft clay layers below have been much improved. This method will not only save substantial amount of time, but also allow the fill materials at the bottom layers to be consolidated under a consolidation stress much higher than 80 kPa. The design parameters can also be derived during the construction and thus the accuracy of the design and settlement prediction can be much improved. This HDeG method and the related advantages and disadvantages will be discussed. Some lab modelling testing results using the HDeG for the consolidation of mud will also be presented to evaluate the effectiveness and issues associated with this method. Finally, a method to use incinerated ash from a municipal solid waste landfill site for land reclamation will also be proposed. It is hoped with the proposed methods, future land reclamation could be carried out in a more efficient, cost-effective way and eco-friendly way.

Biography:

Prof Chu is a professor at the School of Civil and Environmental Engineering, Nanyang Technological University (NTU). He is also the Director of the Centre for Urban Solutions (CUS). He joined NTU in 1991 after receiving his PhD from The University of New South Wales, Australia. Prof Chu also worked for Iowa State University, USA, from 2011 to 2014 as professor and James M. Hoover Chair in Geotechnical Engineering. Prof Chu has more than 25 years' research and consulting experiences in geotechnical engineering, in particular in the areas of laboratory and in-situ testing, engineering properties of soils, soil improvement and land reclamation.

Currently, Prof Chu is the President of Geotechnical Society of Singapore and the Chair for ISSMGE Technical Committee TC217 on Land Reclamation and a committee member for ISSMGE Technical Committee TC211 on Ground Improvement. He was the Chair for ISSMGE Technical Committee TC39 on Geotechnical Engineering for Disaster Mitigation and Rehabilitation from 2005 to 2009.

Prof Chu has published over 300 technical papers in international journals and conferences and holds several patents. He has delivered over 60 keynote or invited lectures at international conferences including the State-of-the-Art Lecture on Construction Processes at the 17th International Conferences on Soil Mechanics and Geotechnical Engineering in 2009. He is Editor for Acta Geotechnica, Associate Editor for ASCE Journal of Materials in Civil Engineering, and editorial board member for other 7 international journals. He received the R. M. Quigley Award from the Canadian Geotechnical Society in 2004 for publishing the best paper in the Canadian Geotechnical Journal in 2003 and the Outstanding Geotechnical Engineer Award from the Geotechnical Society of Singapore in 2018. He has been a consultant for many projects and organisations in Singapore and overseas.

Matthew Richard COOP, University College London

Title: The Mechanics of Tailings in Static and Cyclic Loading

Abstract:

The failure of tailings dams has been the cause of numerous fatal disasters. In part these could be attributed to a poor understanding of their mechanics, with inappropriate adoption of modes of behaviour that we would adopt for geologically deposited clays and sands. The literature on their mechanics therefore tends to be muddled, with even an inconsistent vocabulary around liquefaction leading to attention not being focussed on the key issues. The lecture will summarise about fifteen years' research on the behaviour of mine tailings, examining tailings from various different geological settings, geographical locations and mineralogies, investigating their basic mechanics, their sensitivity to static liquefaction and their behaviour when loaded cyclically. A particular feature that may complicate their behaviour in some cases is that they can have a transitional mode of behaviour whereby the density of deposition influences strongly the location of the normal compression and critical state lines.

Biography:

Matthew has about 40 years research experience, concentrating on the behaviour of soils and weak rocks as revealed through high quality laboratory testing. Following industrial experience in offshore foundations and his Doctorate on the behaviour of offshore piles at Oxford University under the supervision of Peter Wroth he was a lecturer/senior lecturer at City University, London before moving to Imperial College in 2000, where he became professor in 2007. In 2010 Matthew moved to the City University of Hong Kong where he established a laboratory specialising in the micro-mechanics of soils returning to London in 2016 to University College. In 2003 he delivered the Géotechnique Lecture. He is the current chair of TC101 of the ISSMGE, for the laboratory testing of soils. He was the founding editor of Géotechnique Letters, the current editor in chief of Géotechnique and is the author of over 110 journal papers which have been awarded ten major research prizes.

Manchao HE, China University of Mining and Technology

Title: Accurate Prediction of Geohazards

Abstract:

Earthquakes and landslides are two major geological disasters causing huge casualties and economic losses each year across the world. Both landslides and earthquakes can be shown in a model of double blocks separated by a sliding plane. The key for geo-disaster prediction is the Newton force variation along the sliding plane. However, the measurement of the Newton force on the sliding plane is extremely difficult. Therefore, most of the current researches on earthquakes and landslides rely on the displacement monitoring between the two blocks. The relative displacement between the two blocks is considered as the necessary condition but not the sufficient condition for the occurrence of the earthquake or landslide, which may be the reason for the general recognition of the limitation on geo-disaster prediction. The presentation introduced a study on the theory of Double-Block Mechanics (DBM) including the measurement of the Newton force, which is the necessary and sufficient conditions for initiating a geological disaster due to the blocks motion, using the so-called Negative Poisson's Ratio cable with constant resistance and large-deformation characteristic. Applications for geo-disaster prediction were also described in this presentation.

Biography:

Dr. Manchao He is currently an Academician of Chinese Academy of Sciences (CAS), foreign Academician of Argentine National Academy of Engineering (ANI), the Director of State Key Laboratory for Geomechanics and Deep Underground Engineering (SKLGDUE) in Beijing, and Professor of China University of Mining and Technology-Beijing (CUMTB), China. He is the President of the Chinese Society for Rock Mechanics and Engineering (CSRME). He is also the Vice President of International Consortium on Geo-disaster Reduction (ICGdR).

Dr. Manchao He mainly engaged in the research of Rock Mechanics and Engineering, including the prediction of landslides, mining technologies, rockburst mechanism and control, etc. He successfully self-developed a new monitoring system which measures the Newton Force Variation along the slip surface of landslide. It has been applied successfully in many practical projects, which makes a significant contribution to landslide disasters prediction and control. He has been awarded 4 National Awards, 2 Chinese Outstanding Patented Invention and an International Society for Rock Mechanics and Rock Engineering (ISRM) Technological Innovation Award.

Alvin K M LAM, ARUP

Title: A New Digital-based Approach for Geotechnical Design

Abstract:

Geotechnical engineers often deal with complex terrains and geologies, which are usually interpreted from the topographical survey, LiDAR data, geophysical survey and ground investigation boreholes. In the past, these data were mapped or modelled but were often presented in 2D manner, making it difficult to visualize them in a 3D space. However, with the advancement of computing power and the development of 3D modeling and digital tools, engineers can now work and visualize their designs in a 3D environment.

In this presentation, Alvin will showcase the practical application of Rhinoceros 3D (Rhino) in geotechnical designs. He will demonstrate how engineers can utilize Grasshopper, a visual programming language running within Rhino, to automate design processes using the generative algorithms without requiring extensive scripting knowledge. In addition, Alvin will illustrate the capability of Grasshopper in generating optimized and sustainable designs that minimize material usage.

Biography:

Ir. Alvin K M Lam is the Director of Geotechnics based in the Hong Kong office. He is also a Registered Geotechnical Engineer (RGE) in Hong Kong and the East Asia Skills Leader of Ground Engineering in Arup. He has extensive experience in ground investigation, engineering study, pile study, foundation design, site formation design, slope assessment, deep basement excavation and site supervision for a variety of large-scale infrastructure and building projects in Hong Kong, South Korea and other East Asia regions. He was awarded the grand prize of the HKIE Innovation Awards for Young Members in 2009 for his outstanding application of a special foundation system. In recent years, he has been advocating the use of digital tools for geotechnical design within Arup.

Jianfu SHAO, University of Lille

Title: Damage and cracking modeling in saturated and partially saturated media with material heterogeneity

Abstract:

Cracking is the main mechanism of failure of brittle materials. Its description is crucial for the durability analysis of structures. In cohesive materials, the failure is generally due to the transition from diffuse damage to localized cracks. In the firs part, we present a micromechanics inspired damage model. It takes into account properly the unilateral effect due to crack open-closure and friction-damage coupling. Particular attentions are paid on effects of pore fluid pressures on damage evolution kinetics. Based on such damage model, in the second part, we present a numerical method based on the variational principle of fracture mechanics. However, the specific emphasis is put on modeling of shear and mixed cracks in rock materials under compression-dominating stresses. Again, the effect of pore pressures is taken into account. Finally, some application examples are presented. In particular, the thermo-hydromechanical responses and the evolution of damaged zones due to excavation, heating around underground galleries are investigated, in the context of geological disposable of nuclear waste.

Biography:

Jianfu Shao is currently an exceptional-class professor at university of Lille. He has brought original contributions to theoretical development, experimental investigation and numerical modeling in the field of geomechanics, in particular on multi-scale approaches. He is an associated editor of two major international journals (IJRMMS, EJECE) and a member of editorial board for five other top international journals (IJP, COGE, NAG, RMRE, AGEO). He is the recipient of the Maurice A. Biot Medal (2022) for his seminal contributions to understanding the role of microstructure to macroscopic behaviour of porous materials.

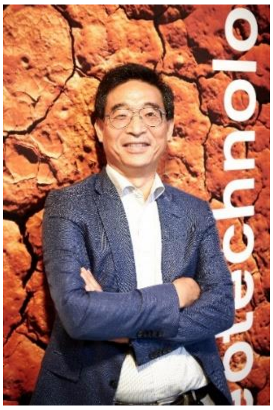
Daichao SHENG, University of Technology Sydney

Title: Particle migration under dynamic loads and associated problems

Abstract:

Dynamic loads cause pore fluid and particle migration in porous materials, resulting in a number of related problems like mud pumping under rail tracks, internal erosion of earth dams, dynamic separation of iron ore and coal during ocean transportation. Each of these problems can lead to catastrophic consequences. This talk focuses on experimental study of effects of load frequency, load magnitude, particle size and excess pore pressure on particle migration under cyclic loads. It busts myths like mud pumping is caused by soil liquefaction, and mud pumping only occurs in fine grained soils. It helps to understand why bulk carriers sink in ocean when there is no evidence of liquefaction of materials they carry. The talk also outlines computational challenges in modelling such problems.

Biography:



Professor Daichao Sheng is a Distinguished Professor of Civil Engineering and the Head of School of Civil and Environmental Engineering at University of Technology Sydney (UTS) since 2019. Before his current role, he was a Professor of Geomechanics at the University of Newcastle during 1997-2019. He also holds a conjoint position at Central South University in China since 2013. His research interest spans computational geomechanics, unsaturated soils, transport geotechnics and environmental geotechnics. Prof Sheng is an elected Fellow of the Australian Academy of Technology and Engineering (FTSE), and a Fellow of Institute of Engineers in Australia (FIEAust).

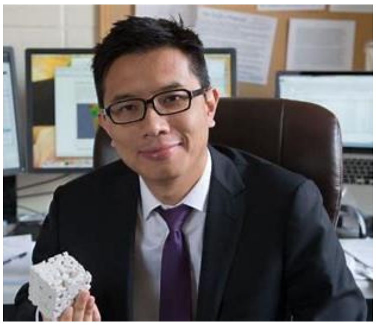
Steve WaiChing SUN, Columbia University

Title: From Mathematical Models for Soil Plasticity to Neural Networks and Back: Interpretable Machine Learning for Geomechanics

Abstract:

This paper introduces a new approach that combines the strengths of the expressivity of deep neural networks and the interpretability and portability of the mathematical expression determined by symbolic regressions to formulate plasticity models that can precisely capture the plastic behaviors of solids. By introducing neural network architectures that generate feature space and aggregate those data in a polynomial form, we enable the yield function to be determined analytically. By comparing with the benchmark state-of-the-art algorithms, the proposed method is capable of delivering more robust and accurate predictions, while the divide-and-conquer approach significantly improves the computational efficiency, especially for high-dimensional models aimed to capture material behaviors that lack material symmetry, exhibit size-dependent effect or complex hardening/softening mechanisms. By leveraging the portability of symbolic regression, the resultant models can be easily deployed to third-party software such as UMAT in ABAQUS. Extensions of the proposed approach for inverse problems and materials design in feature space will also be discussed.

Biography:



Professor Sun is an associate professor of civil engineering and engineering mechanics at Columbia University. He obtained his B.S. from UC Davis (2005); M.S. in civil engineering (geomechanics) from Stanford (2007); M.A. degree from Princeton (2008); and Ph.D. in theoretical and applied mechanics from Northwestern (2011). From 2011-2014, he worked in the mechanics of materials department at Sandia National Laboratories (Livermore, CA), first as postdoc, then promoted to the rank of senior member of technical staff in 2013. Sun's recent research interest is on high-precision machine learning and data-driven modeling of nature and man-made materials. Sun has published over 80 journal articles (see Publications). His research has been recognized by several awards across the globe, including the John Argyris Award from IACM, Leonard de Vinci Award from ASCE EMI, Zienkiewicz Numerical Methods in Engineering Prize, among others.

Professor Sun is the recipient of the John Argyris Award (2020), NSF CAREER Faculty Development Award in 2019, ASCE EMI Leonardo da Vinci Award in 2018, the Zienkiewicz Numerical Methods in Engineering Prize in 2017, US Air Force Young Investigator Program Award in 2017, the Dresden Fellowship in 2016, US Army Young Investigator Program Award in 2015, and the Caterpillar Best Paper Prize in 2013, among others.

Wei WU, University of Natural Resources and Life Sciences

Title: On bleeding of fresh concrete in deep foundations

Abstract:

The concrete of bored piles and diaphragm walls is often placed via tremie pipe to minimize segregation and mixing with bentonite suspension. The design and performance of tremie concrete often needs to meet the competing requirements for workability and stability, i.e. resistance against segregation and bleeding. Excessive bleeding in fresh concrete may give rise to channels and cavities impairing the quality of deep foundations. This paper summarizes our works on the bleeding of fresh concrete in the past decade. These works include the filtration test for bleeding propensity, the early strength of fresh concrete in a large shear box, the in-situ stress state in bored piles during and after placement and the centrifuge tests on model piles of fresh concrete. Finally, a mathematical model for the bleeding in deep foundation is established, which allows a solution in form of solitary waves. The solution offers a convincing explanation for bleeding mechanism.

Biography:

Prof. Wu is director of the Institute of Geotechnical Engineering at the Universität für Bodenkultur (BOKU), Vienna, Austria. He received his BEng from Wuhan University, China in 1982, MSc from Xian University of Technology, China in 1985, PhD from Karlsruhe University, Germany in 1992. Afterwards, Dr. Wu entered the cut-and-thrust world of engineering consulting. He joined Lahmeyer International Ltd in Frankfurt, Germany in 1992. In 2002, Dr. Wu moved to Electrowatt Infra Ltd in Zurich, Switzerland. During his time in Frankfurt and Zurich, Dr. Wu had worked on some major tunnel projects of the world, e.g., Metro Athens, Greece and Gotthard Base Tunnel, Switzerland. In 2003, he was offered the chair professor at BOKU. Prof. Wu is the editor-in-chief of Acta Geotechnica, and has coordinated some large research projects funded by the European Commission.

Ali ZAOUI, University of Lille

Title: Nanoscale modeling of advanced sustainable graphene nano-coated geopolymer materials

Abstract:

The durability of building materials is an important challenge in construction sector to improve their service life-time by increasing the resistance to water infiltration and other aggressive environment. The most common acceptable effective strategy for delaying the deterioration of buildings is to conduct an effective surface treatment. It is a promising way for enhancing the durability of advanced building materials to conduct a hydrophobic surface by avoiding the infiltration either of water or hazards substances.

Nowadays, alkali-activated materials, named geopolymers, are advanced alternatives to cementitious materials, where their excellent chemical and fire resistance are some of its most appealing properties. Their production is accompanied by a much lower CO2 emission when compared to Portland cement. In building industry, seeking for high strength and durable materials is crucial to reach lower carbon footprints and also for curtailed consumption energy either for heating or for cooling.

In this talk, I will discuss about the development of superhydrophobic metakaolin aluminosilicate (geopolymer) surfaces by protecting them with a graphene layer from moisture intake through the porous geopolymer matrix. This study aims to investigate the dynamical adsorption of a nanodroplet of water on the graphene-coated geopolymer surface. It will deeply focus on the analysis of the interfacial adhesion between a graphene layer and metakaolin geopolymer surface as well as the hydrophobicity and the strength of the modified geopolymer surface. Molecular dynamics (MD) and DFT calculations are carried out to evaluate the surface and the adsorption energies for low and high silicon content. The surface wettability characteristics is examined from the contact angle between a nanodroplet of water on the graphene-coated surface. As improving the surface strength properties is deemed necessary, interfacial bonding effect on adhesion energy and mechanical properties of the coated nanostructure is also discussed.

Biography:

Professor Ali ZAOUI is a distinguished professor of Civil Engineering at the University of Lille, France. He holds the prestigious title of French Grand Professor, which is the highest level of recognition in the country. In addition to his role as a professor, he is a member of the French National University Council and the Administrative Committee of the Ecole Polytechnique of Lille, France. Professor Ali ZAOUI is also the key figure responsible for the establishment of the Civil and Environmental Engineering laboratory in France and currently serves as its Director since 2020. Furthermore, he is the Head of the International Master Program in Nanotechnology in Civil Engineering at the University of Lille, France.

Throughout his career, Professor Ali ZAOUI has achieved remarkable accomplishments in the field of first-principles and molecular dynamics simulation of various materials. His expertise extends to semiconductors, metals, ceramics, clay, minerals, concrete, and nanocomposites. He has contributed significantly to the scientific community with over 180 publications in highly regarded international journals. Moreover, Professor Ali ZAOUI is a member of the European Organization for Cooperation in Science and Technology (ECOST) and leads the Preventive Self-healing

Concrete Structures project. His dedication and contributions have earned him the prestigious first Prize of the 2010 Scientific Excellence Award (PES).

Hehua ZHU, Tongji University

Title: Rapid identification of tunnel surrounding rockmass and real-time safety analysis

Abstract:

Aiming at the "one-hour support design of rock tunnel", which is a worldwide unsolved engineering technical problem, a series of intelligent mobile terminal as the hub of data collection, transmission and feedback, cloud computing platform as the data processing center, and the integration of rock mechanics and three-dimensional geometric information intelligent recognition algorithm to automatically calculate the classification index of the surrounding rock and intelligently match the support design drawings have been developed based on the international first infrastructure intelligent service system (iS3). The tunnel intelligent design system is based on the intelligent mobile terminal as the hub of data collection and transmission and feedback, the cloud computing platform as the data processing centre, and the integration of rock mechanics and 3D geometric information intelligent recognition algorithm to automatically calculate the classification index of the surrounding rock and intelligently match the support design drawings. The whole process takes only 5-10 minutes, from the photo collection by the intelligent mobile terminal at the excavation surface to the visualisation of the grading information and construction plan by the intelligent mobile terminal of the field personnel. Meanwhile, the in-house developed 3D continuous/discontinuous numerical analysis module can be used to predict the location of potential collapse bodies and numerically verify the safety of the support scheme.

Biography:

Hehua Zhu is now Distinguished Professor in Geotechnical Engineering at Tongji University and the Academician of the Chinese Academy of Engineering, and Director of State Key Laboratory of Disaster Reduction in Civil Engineering.

He received his Bachelor's and Master's Degrees in Mining Engineering from Chongqing University in 1983 and 1986, respectively, and his PhD was awarded in Structural Engineering (Civil Engineering) at Tongji University in 1989. He did his post-doctoral research at the Geo-Research Institute of Osaka and Kyoto University, Japan, from 1993 to 1995. He proposed a generalized 3D Hoek-Brown rock strength criterion together with Prof. Lianyang Zhang, which was also called generalized Zhang-Zhu rock strength criterion (GZZ) recommended as ISRM standard. He was awarded with the Humboldt Research Prize in 2015 and the T.H.H. medal at ICCES'13 in 2013. He created an International journal of Underground Space.

Renpeng CHEN, Hunan University

Title: Rapid identification of tunnel surrounding rockmass and real-time safety analysis

Abstract:

Soil mass excavation above existed shield tunnels is a common recurring problem. Excessive settlement and severe diseases might occur for the underlain tunnel if no appropriate countermeasure is adopted. Development of the downward soil arching below excavation base is a key factor influencing the responses of the shield tunnel. This presentation introduces a theoretical model to describe the developing downward soil arching. Furthermore, the method for depicting the interaction between the downward soil arching and shield tunnel is proposed to predict the excavation-induced tunnel heave. Finally, zoned excavation and shaft excavation with anti-heave frame are developed to reduce the underlying shield tunnel deformation by mitigating the expansion of the loosened zone.

Biography:

Dr. Renpeng Chen is a professor specializing in Geotechnical Engineering in the College of Civil Engineering at Hunan University. Dr. Chen is also Director of Research Center for Advanced Underground Space Technologies of Hunan University and Vice-chancellor of Hunan University. Dr. Chen has research interests and expertise in soil arching, technologies for urban underground construction, and transportation geotechnics. Dr. Chen has served as an investigator on over 50 research projects with grants received from national government agencies including Natural Science Foundation of China, Ministry of Science and Technology, numerous design institutes and construction companies. Dr. Chen has authored/co-authored over 300 peer reviewed publications. He is a member of Committee of Geotechnical Infrastructure for Megacities and New Capitals (TC305), and Asian Regional Technical Committee of Urban Geotechnics, of ISSMGE. Dr. Chen received Best Paper Awards of 2013 ISEV, 2016 Outstanding Journal Paper Awards of Journal of Performance of Constructed Facilities-ASCE, and China Youth Science and Technology Award.

Qiushi CHEN, Clemson University

Title: A set of hysteretic nonlinear contact models for DEM: Theory, formulation, and application for deformable granular particle flow

Abstract:

In the discrete element method (DEM), contact models describe how particles interact with each other and with boundaries, and are a key element to capture the bulk behavior of a granular system. In this work, we propose a set of hysteretic nonlinear contact models for approximating the bulk strain-hardening phenomena of relatively soft granular materials. These contact models comprise of simple polynomial and/or exponential functions to allow for easy calibration. To ensure numerical stability, we have derived unconditionally stabilized viscous damping force models. The resultant DEM model is implemented in LIGGGHTS-INL and applied to simulate an axial compressibility test and hopper flow for milled pine chips. Results show that the DEM model can reproduce the bulk stress–strain profiles of the physical samples and that the predicted responses agree reasonably with the experimental data.

Biography:

Dr. Qiushi Chen is an Associate Professor in the Glenn Department of Civil Engineering at Clemson University. Dr. Chen received his M.S. and Ph.D. degrees from Northwestern University and his B.S. degree from Shanghai Jiaotong University. He is the vice chair of the ASCE Geo-Institute's Computational Geotechnics Committee and served on review panels of various federal funding agencies. Dr. Chen's research interests are in the mechanics and computational modeling of granular materials, discrete element method, and liquefaction hazard assessment and mapping. Before joining Clemson, Dr. Chen was a postdoc at the Department of Energy's Sandia National Laboratories.

Samson Abate DEGAGO, Norwegian University of Science and Technology

Title: Clarifying Key Misconceptions About Creep and Consolidation of Clays

Abstract:

Soft clay deposits are characterized by their strong tendency to undergo significant creep deformation. Ample laboratory experiments as well as field observations show existence of rate effects/creep during the primary compression phase (consolidation) of clayey soils. However, understanding the underlying mechanisms has been a subject of active debate among researchers. As a result, two distinct schools of thoughts, referred to as creep hypotheses A and B, have been used as a basis to explain the effect of creep during the primary compression phase. Despite being extreme and opposite to each other, advocates of both creep hypotheses independently presented ample experimental and numerical data substantiating their respective claims. This led to confusion and misconception about the role of creep during primary compression phase. In addition to this, the simplification adopted in standard education of consolidation and creep contributed to a deep-rooted misunderstanding and confusion that is still reflected in the current geotechnical practice.

This talk gives highlight of a work conducted with an aim to explain the evidence presented to advocate the creep hypotheses within a common and consistent framework. Key laboratory and field data as well as numerical substantiations were systematically and thoroughly investigated. The apparent misconceptions involved in the experimental substantiation of creep hypothesis A are thoroughly explained. This provided convincing arguments as to why creep hypothesis A is not actually experimentally substantiated. Numerical simulations of field cases using creep hypothesis A have mainly been affected by sample disturbances and the implication of this is illustrated with experimental data and numerical analyses. It is shown that cohesive soils behave in conformity with creep hypothesis B, that is in accordance with isotache concept. It is also illustrated that a constitutive model based on hypothesis B can give excellent prediction of long-term field measurements of both settlements and excess pore pressure responses. Recognition and implementation of these aspects in various regulatory documents and codes is highlighted.

Biography:

Samson A. Degago is Senior Principal Engineer at Geotechnics and Climate Adaptation section, Legislation and Regulatory Authority, Norwegian Public Roads Administration (NPRA) and Associate Professor II at the Geotechnical Division, Dept. of Civil and Environmental Engineering, Norwegian University of Science and Technology (NTNU). He has 16 years of industrial and research experience. His main research engagements areas include settlement of clays and peat materials, stability of natural slopes in clays, experimental and numerical study of debris flow and submarine slides.

Hongwei HUANG, Tongji University

Title: Anisotropic rock mechanics and engineering application

Abstract:

High-density development will inevitably lead to adjacent various disturbances, such as surcharge, excavation, new tunnel crossing, squeezing pile, et. al. These disturbances are essentially loading and unloading effects. The influence of loading and unloading on the tunnel is amplified, not a linear superposition. On the other hand, soil parameters have a significant spatial variability, which will further aggravate the adverse effect on tunnel. In this presentation, the experimental study of the coupling effect on segmental shield tunnel lining under surcharge loading and excavation unloading was first introduced. Meanwhile, a coupling effect index (ρ) was proposed to evaluate the coupling degree of different disturbances. The classification was also presented, divided into favourable, zero, and unfavorable coupling effects. Then, combined with the coupling effect index model in deterministic conditions and the amplification factor method under uncertain conditions, the coupling effect index considering soil spatial variability is given. Results show that there will be a significant amplification effect in multiple coupling considering the loading, unloading and soil spatial variability.

Biography:

Prof. Huang Hongwei is a full professor in Department of Geotechnical Engineering at Tongji University. His research interests are focused on risk management, assessment and control of tunnel and underground engineering; health monitoring and detection of underground infrastructure structure; and big data and artificial intelligence in underground engineering. Prof. Huang is the recipient of numerous awards, notably National Candidates for Millions of Talent Engineering in the New Century (2009), Chang Jiang Scholars Program Distinguished Professor (2013), Head of innovation team in key areas of innovation talent promotion plan (2017), Ten Thousand Talent Program for leading academics in technology innovation (2017), GEOSNet Award (2019). He is presently serving as the director of the International Joint Research Center for Resilient Infrastructure.

Erdin IBRAIM, University of Bristol

Title: From rigid-soft particles to particle crushing: a leap into the void

Abstract:

This talk will briefly focus on the principles of some analytical and experimental tools designed to detect void ratio changes, understand their role, and assess their impact on the behaviour of granular soils, especially when influenced by factors such as the presence of soft particles, interaction with linear flexible inclusions, or the phenomenon of particle crushing.

Biography:

Erdin Ibraim is Professor of Experimental Geomechanics at the University of Bristol. He has developed a strong research focus on the fundamentals of soil behaviour and their application to geotechnical systems. His research investigations span across the length scales, from micro to macro, from soils to structures. Recent activities include developments of advanced laboratory geotechnical testing and understanding of complex deformation properties of geomaterials under multiaxial loading (stiffness, anisotropy, time effects). He has held a two-year Visiting Professorships Chair at IFSTTAR Nantes, France and is serving as Vice-Chair of the ISSMGE Technical Committee of experts in Laboratory Stress Strain Strength Testing of Geomaterials, TC101. He Co-Chaired the organisation of the 7th International Symposium on Deformation Characteristics of Geomaterials, IS-Glasgow 2019.

Shuilong SHEN, Shantou University

Title: Anisotropic rock mechanics and engineering application

Abstract:

This research summarized six innovative thinking modes in the research of engineering problem: 1) transplantation innovation, 2) combination innovation, 3) refinement innovation, 4) extension innovation, 5) local change innovation, and 6) original innovation (see Fig. 1). Gradually increasing innovation level from 1 to 6; 1-5 is generally a 1-N innovation, while 6 is a 0-1 innovation; However, it is not absolute. If 1-N changes greatly, it can also be an innovation of 0-1. For example, Terzaghi's consolidation theory starts with the assumption of effective stress, and then the combination of seepage mechanics and solid mechanics achieves the original innovation, which solves the problem of stress and deformation of soft soil that has not been solved by predecessors. Although this approach, i.e., effective stress, has been proven to be trustworthy, the development of direct measurement method has remained at an embryonic stage for 10 decades due to innovation difficulties. With the development of optical fiber technology, this centennial unsolved case has been effectively resolved in recent years by Hong Kong based researchers (Yin et al, 2020; Tan and Yin, 2022), as shown in Fig. 2. Their work provides an experimental confirmation to the Terzaghi's hypothesis, a contribution which is an unprecedented achievement in the field of soil mechanics after the seminal work of Terzaghi. Therefore, Yin group's contribution can be thought of as an innovation of 0-1. Then, we summarize the innovative research work of my team in geotechnical engineering, especially in the intelligent construction of tunnel engineering in recent years: from the application of artificial intelligence algorithm to analyze geotechnical engineering data to the innovative research thinking method of modifying neural network activation function to improve calculation efficiency, and artificial intelligence to identify stratum characteristics and parameters.

Biography:

Prof. Dr. Shen is the Dean of the College of Engineering, Shantou University. Dr. Shen is now a distinguished leading talent of Guangdong Province, China. Prof. Dr. Shui-Long Shen received his BSc. in Underground Space Technology from Tongji University in 1986 and his MPhil in Structural Engineering from the same university in 1989. He obtained his Ph.D. in Geotechnical Engineering from Saga University, Japan, in 1998.

After Dr. Shen received his PhD, he worked in the Institute of Lowland Technology (ILT) as a lecturer from 1998 to 2001. During this period Dr. Shen served as an Associate Editor of Lowland Technology International-an International Journal. From 2001 to 2003, Dr. Shen worked in National Institute for Environmental Studies in Tsukuba-the Science City of Japan. In 2003, he joined the Department of Civil Engineering (DCE) of Shanghai Jiao Tong University (SJTU) as a faculty member and Department Head of DCE-SJTU from 2010 to 2018. Dr. Shen joined the College of Engineering, Shantou University. Since 2004, Dr. Shen has been keeping collaboration with other international organization, e.g., Saga University, Virginia Tech, The University of Kansas, The University of Hong Kong, Suranaree University of Technology Thailand, Ecole Centrale de Nantes France, Swinburne University of Technology, RMIT University, Australia as a guest/visiting/adjunct professor.

Dr. Shen's research interests focus on the urban underground infrastructural system, smart maintenance of urban underground facilities, and flooding hazards prevention and mitigation by use of intelligent approaches. He published/edited six books, of which three conference proceedings published by ASCE. Dr. Shen published more than 430 technical papers in Journals and International conferences, in which over 308 papers were published in International Journals with total citation over 20500 times (google), over 17800 in Scopus, and over 15800 times in WOS. Dr. Shen's H-Index in Google Scholar is 82, in SCOPUS is 77, in Web of Science is 74. World's Top 2% Scientist-Stanford University List. His stature is reinforced by the inclusion in Research.com listing of Best Scientists in two fields: Engineering and Technology (D-Index: 72, world ranking: 441, China ranking: 53) and Earth Science (D-Index: 69, world ranking: 641 and China ranking: 29). He has been selected as one of the 'highly cited scholars in China' by Elsevier. The nominee has also been ranked among the top 10 highly cited scholars in the field of geological resources and engineering on the academic influence ranking of Tongzhouyun Global High Cited Scholar Database (http://www.globalauthorid.com/).

Chaosheng TANG, Nanjing University

Title: Bio-mediated geotechnology and its application in geoengineering

Abstract:

Bio-mediated geotechnology refers to the technology that utilizes various types of microbial processes to improve the hydro-mechanical behavior of soil and rock, aiming for the prevention and mitigation of geoengineering problems. Bio-mediated geotechnology has been identified as a hotspot research area in geoengineering in recent years, with the benefits of environmental friendliness, low energy consumption, and process controllability. Based on research progress on this topic, this talk systematically summarized the mechanisms of representative bio-mediated geotechnologies that can be well controlled and efficiently used, including biomineralization, biofilm and biogas. Among these geotechnologies, the most investigated and promising microbially induced carbonate precipitation (MICP) based on biomineralization was the focus of this talk. Key influencing factors including bacteria species, bacteria concentration, temperature, pH, cementation solution, soil properties and treatment strategies that affect the improvement effect of biomineralization were discussed. The engineering features (i.e., mechanical behavior, permeability, and erosion resistance) of the rock and soil improved by MICP were presented, as well as the corresponding involved mechanisms. The application status of biomineralization in foundation treatment, liquefaction mitigation, islands and reefs construction, dust suppression, soil and water conservation, cracking remediation and seepage control, heavy metal remediation, cultural relics protection, geological disaster prevention and other fields were reviewed and summarized. Finally, current biomineralization challenges were discussed, with potential solutions proposed.

Biography:

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 titles. His research focuses on extreme climate engineering geology and environmental geotechnical engineering. He has published more than 250 peer-reviewed journal papers. Prof. Tang serves as the Secretary-General of the International Society for Environmental Geotechnology (ISEG) and is an 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 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, the Huang Jiqing Youth Science and Technology Award by Geological Society of China.

Changfu WEI, Chinese Academy of Sciences

Title: Drying-induced soil shrinkage: Mechanism and modeling

Abstract:

When drying from a fully saturated state, soil transits from saturation to unsaturation, activating the effects of capillarity, adsorption, and osmosis. Traditionally, these effects have been elusive in modelling the shrinkage behavior of soil. This talk addresses this gap of knowledge by re-examining the underlying mechanisms for the drying-induced shrinkage of soil. To this end, the concept of intergranular stress is introduced to lump all the effects of osmosis, capillarity, and adsorption into a unique effective stress tensor, and a simple constitutive model is developed within the framework of the modified Cam Clay (MCC) model. The proposed model inherits the simplicity of the MCC model while ensuring a smooth transition from saturation to unsaturation. It is shown that the drying-induced intergranular stress includes two components, accounting for capillary and adsorptive effects, respectively, intertwined with the osmotic effect. Comparison of simulations with experimental data shows that the proposed model captures very well the main features of the drying-induced shrinkage behavior of soil, implying that the intergranular stress tensor can be effectively used to address the hydro-chemo-mechanical behavior of soil under complex loading conditions.

Biography:

Changfu Wei received his PhD from the University of Oklahoma in 2001. He is a professor at the Institute of Rock and Soil Mechanics, Chinese Academy of Sciences, and the vice director of the State Key Laboratory of Geomechanics and Geotechnical Engineering. His area of expertise includes the chemo-mechanics of geomaterials, unsaturated soil mechanics, mechanics of hydrate-bearing soils, and geohazard mitigation. He is the author or coauthor of more than 200 journal papers and more than 30 authorized patents. He is the scholar of the "100-talents program" of the Chinese Academy of Sciences. He has been serving as a member of the Technical Committee of Unsaturated Soils (TC 106) of ISSMGE since 2010, and an Editorial Board Member of several prestigious international journals.

Changjie XU, East China Jiaotong University

Title: Research Progress and Application of Green Retaining Technology for Excavation Engineering

Abstract:

In recent years, with the fast development of urban underground space construction, excavation engineering has been faced with the problems of land scarcity, high materials and energy consumption, economic waste, complex environmental conditions, frequent accidents, etc. This emphasizes the urgency of proposing green retaining technology. The speech will introduce the research progress and application of green retaining technology for excavation engineering from the following seven aspects, including green retaining structures, green anchor retaining technology, green stiffening support and water-stopping integrated system, green ground treatment technology, green integrated groundwater pumping-recharge method, green micro deformation control of excavation and green informationalized construction.

Biography:

Professor Changjie Xu is Deputy Party Secretary and President of East China Jiaotong University, as well as Professor and Doctoral Supervisor of Zhejiang University and East China Jiaotong University. Professor Xu has been a Distinguished Professor of "Changjiang Scholar" by the Ministry of Education, a recipient of The National Science Fund for Distinguished Young Scholars, an awardee of the National Talent Project, and a recipient of the Special Government Allowance from the State Council. He is an Executive Council Member of the Engineering Safety and Protection Branch of the Chinese Society for Rock Mechanics and Engineering (CSRME), as well as an Executive Council Member of the Geotechnical Engineering Information Technology and Application Branch of the CSRME. He has obtained an award of National Science and Technology Progress (second-class), an award from Zhejiang Province Natural Science (first-class), two first-class awards, and four second-class awards from Zhejiang Province Science and Technology Progress, a first-class award and a second-class award of Jiangxi Province Science and Technology Progress, an award of China Communications and Transportation Association Science and Technology Progress (first-class), as well as two first-class awards and one second-class award of Science and Technology Progress Award from The Ministry of Education.

Weiya XU, Hohai University

Title: Anisotropic rock mechanics and engineering application

Abstract:

Anisotropy is the fundamental property of engineering rock mass. Fundemental research and practical engineering application in hydropower projects are conducted systematical. These studies and investigations cover various aspects such as deformation characteristics, strength properties, constitutive models, THMC coupled mechanical models for anisotropic behavior, and multi-scale numerical simulation and their engineering applications. In terms of deformation characteristics, it was derived anisotropic Boussinesq solutions and established a back-analysis based on bearing plate tests. It was proposed an analytical solution for determining anisotropic deformation parameters. Case studies from Baihetan Hydropower Project indicate that the primary factors controlling anisotropic deformation are column tilt, the EDZ region, intralayer dislocation zone and size effects. For strength characteristic of anisotropic rock mass, the relationship between anisotropic rock strength and acoustic wave velocity has been established, along with numerical simulation methods for both continuous and discontinuous media. In anisotropic rock mechanics constitutive models, classical isotropic criteria have been extended to anisotropic mechanics through the spatial distribution of strength parameters. A microstructure tensor based anisotropic yield criterion and an anisotropic nonlinear model considering the tensile strength of tensor bands was established based on the microstructure tensor theory. A mechanical model for anisotropic damage was developed by combining tensor yield function with anisotropic damage. In coupled mechanical models, orthogonal joint rock mass hydro-stress physical configurations have been explored. Furthermore, the permeability of anisotropic rocks and derived permeability tensors from joint spatial distributions are characterized. Multi-scale numerical simulation methods for large-scale hydropower projects have been illustrated, overcoming challenges in constitutive models and parameter values for continuous media. These studies have been applied in Baihetan Hydropower Project with case studies demonstrating the scientific and effective application related to anisotropic rock mechanics.

Biography:

Professor Weiya Xu obtained his PhD degree in Engineering Geomechanics from Chinese Academy of Science in 1991. He has received degree Doctor of Engineering honoris causa from University of Waterloo Canada in 2022. He has been a Chair Professor of Geotechnical Engineering in Hohai University China since 1999 and Honorary Professor of Lille University France from 2023-2027. He has supervised 85 PhD graduates in Civil and Geo-Environmental Engineering. He is the author or co-author of 12 monographs and more than 510 journal papers. He has been an Invited Professor in several research-intensive universities in France, U.S.A. and Canada. He is on the board of several national and provincial organizations. In recognizing his many academic achievements and contributions, Professor Xu has received a number of awards, including being appointed Distinguished Expert in Science and Technology by the State Council of Chinese Central Government in 1994. Professor Xu served as the Vice President for Research and Innovation between

2009 and 2013 and Vice President for Global Affair and Education between 2017-2022. at Hohai university.

Prof. Xu is the Leading Scientist of Chinese National Engineering Research Centre of Excellence in Water Resource and Engineering Safety. Prof. Xu served as Director of Sino-France International Research Laboratory of Geomechanics and Environment Science Jiangsu Province since 2021. He is the Chairman of International Discipline Union of Hydraulic and Environment (2022-2027). Professor Xu has been appointed as Council member of International Association of Hydraulic and Environment and Chairman of IAHR-Hohai Co-Committee on Higher Education and E-learning since 2021.

Yangping YAO, Beihang University

Title: Unified Hardening Model for Clays and Sands

Abstract:

Drucker, the founder of plastic mechanics, for the first time constructed a plastic constitutive framework that could consider the deformation and strength of soil in a unified way. On this basis, Roscoe combined the basic mechanical properties of soil and established the Cambridge model to achieve a unified quantitative description of the deformation and strength characteristics of normally consolidated clay. In view of the defect that the Cambridge model cannot reasonably describe the stress-strain characteristics of overconsolidated clay and sand, the following contributions are made: (1) The Unified Hardening (UH) equation was constructed and the UH model was established, which could reasonably describe the stress-strain characteristics of normal consolidated clay, overconsolidated clay and sand. And it is further extended to UH constitutive theory which considers the influence of various complex factors. (2) The generalized nonlinear strength criterion and the transformed stress method for 3D stress condition are proposed, which reasonably combine the constitutive model and the 3D strength criterion; (3) UH model, with clear physical concept, few parameters and strong practicability, has been applied to a number of practical projects, especially in airports. For example, the UH model has addressed the disasters induced by “Pot-cover Effect”, the forecast of runway deformation, the monitoring of compacting quality of foundation.

Biography:

Yangping YAO, Professor of Beihang University in geotechnical engineering, chief scientist of the Chinese national "973 Program", vice chairman of Chinese Institution of Soil Mechanics and Geotechnical Engineering, deputy director of Geotechnical Mechanics Special Committee of the Chinese Society of Theoretical and Applied Mechanics, deputy editor of Chinese Journal of Rock Mechanics and Engineering. Engaged in geotechnical constitutive theory and airport engineering, established the Unified Hardening (UH) constitutive theory of soil, proposed a new concept of the "Pot-cover Effect" of airports. Selected for the world's Top 2% top scientists list and the Elsevier China Highly Cited Scholars list for three consecutive years (2020-2022). Won the Thomas Fitch Rowland Award of ASCE, the first prize of the Natural Science of Chinese Ministry of Education Award (twice), the grand prize of Science and Technology Advancement Award of Chinese Communications and Transportation of Association, the MAO Yisheng Prize in soil mechanics and geotechnical engineering.

Hong ZHENG, Beijing University of Technology

Title: Associative approximation of Galerkin and FVM for HMC fully coupled model under NMM framework

Abstract:

The numerical solution of the hydro-mechanical-chemical (HMC) fully coupled equations in porous media faces significant challenges due to spurious oscillation in pore pressure and concentration caused by locking and convection dominance. This study proposes a combination of two different discretization schemes: (1) the Galerkin discretization for the soil skeleton deformation, and (2) the finite volume method (FVM) for solute transport and fluid flow on the dual mesh, named G-FVM, where the approximations of skeleton displacement, pore pressure, and concentration are established by NMM, are able to reflect the compressible and incompressible deformation. In this way, the proposed method guarantees mass conservation of solute at the level of cells, which is essential to eliminating unphysical oscillations, as well as the stability of skeleton deformation. Typical examples of chemo-osmotic consolidation and chemo-mechanical consolidation are simulated to verify the accuracy of the proposed method. By comparing the numerical solutions of 1D and 2D chemo-mechanical consolidation problems with the full Galerkin method, it is suggested that the G-FVM is a reliable and effective computational approach for HMC coupling problems in porous media, even with a large Péclet number.

Biography:

Zheng Hong is a professor at Beijing University of Technology, a Beijing scholar, and a recipient of the National Science Fund for Distinguished Young Scholars. The main research direction is computational geotechnical mechanics. Some of the achievements have been fully incorporated into the undergraduate and master's textbooks as well as multiple industry standards, and have been adopted by international large-scale commercial software. Published nearly 100 SCI papers as the first/corresponding author, with over 7200 SCI citations. Continuously selected on the Elsevier High Cited Authors List, he is one of the top 2% scientists in the fields of engineering and applied mathematics released by Stanford University, and also a member of the Global Top Scientists List (in the field of engineering technology). Editorial board member of mainstream domestic and international academic journals such as Journal of Geotechnical Engineering and Computers and Geotechnics.

Weilie ZOU, Wuhan University

Title: Reducing Lateral Earth Pressure on Retaining Walls in Expansive Soils Using Eps Geofoam: Analysis and Application

Abstract:

Expansive soil typically exerts significant lateral earth pressure on retaining walls upon wetting, which may lead to serious distress of retaining walls. Placing a layer of EPS geofoam between the retaining wall and expansive soil can effectively reduce the lateral earth pressure. This is due to the high compressibility of the EPS, which accommodates the lateral swelling strain of the expansive soils upon wetting. This presentation reports small-scale and model test studies on the retaining wall-EPS-expansive soil system. The experimental results demonstrate that (i) the cyclic swelling and shrinkage of the expansive soil during wetting-drying cycles do not affect the performance of the EPS in terms of reducing the lateral earth pressure; (ii) the 12 kg/m^3 EPS can reduce the lateral earth pressure by 50% when the expansive soil is fully saturated; (iii) without EPS, the lateral earth pressure increases with depth while the lateral earth pressure does not change significantly with depth when EPS is installed; (iv) the reduction in the lateral earth pressure increases with the increase in the thickness of EPS and the reduction in the density of the EPS. Based on the experimental observations, analytical approaches for determining lateral earth pressure are developed. The approaches are validated by in-situ monitoring data collected from a retaining wall project in expansive soil regions in Guangxi province, China.

Biography:

Professor Zou received the PhD degree from Wuhan University, China in 2004. He has been the academic leader in the field of ground treatment and slope strengthening at Wuhan University since 2014. Professor Zou’s research interests focus on unsaturated soil mechanics and geosynthetics. He has played a leading role in the development of innovative electrically conductive wick drains (ECWD) and glass fiber reinforced plastics (GFRP) screw anchors. He has also organized several national and international conferences. Professor Zou serves as Vice-President of Reinforced Soil Professional Committee and Deputy director of Unsaturated Soils and Special Soils Professional Committee, Chinese Society of Soil Mechanics and Geotechnical Engineering (CSSMGE), also editorial board member of Chinese Journal of Geotechnical Engineering (CJGE) and Chinese Journal of Rock and Soil Mechanics (CJRSM). He was awarded the First Prize of Science and Technology Progress of Ministry of Education of China in 2013 and the First Prize of Science and Technology Progress of Hubei Provincial Government in 2018.