GEOAI FRONTIER FORUM #8 · THURSDAY 19 NOVEMBER 2026

Advancing and Broadening Decision-Making under Uncertainty

Toward Foundation Model-Based Reliability Assessment

10:00 – 12:00 CET | 17:00 – 19:00 China · Singapore | 18:00 – 20:00 Japan · Korea | **Online**, broadcast from Deltares, Delft, the Netherlands

Hosted by **Geodata and AI** (Elsevier). Co-hosted by the **Subcommittee on Implementation of Data-Driven Reliability-Based Design and Risk Assessment**, Applied Mechanics Committee, Japan Society of Civil Engineers. Chair: **Yu Otake**, Tohoku University.

> **Registration is now open.** Please register on the Teams webinar page: events.teams.microsoft.com. Colleagues in China are kindly asked to register through the WeChat portal of Geodata and AI.

PROGRAMME

10:00	Welcome and introduction
10:05	**Luke Griffiths & Thea Sveva Faleide** · Norwegian Geotechnical Institute
10:30	**Bruno Zuada Coelho** · Deltares
10:55	**Taiga Saito** · Tohoku University and Deltares
11:20	**Sohei Jimbo** · National Institute for Land and Infrastructure Management
11:45	Discussion
11:55	Closing

Each talk is 20 minutes, with 5 minutes for questions. All times are CET.

ABSTRACTS AND SPEAKERS

10:05 CET

Using Self-Supervised Models to Guide Offshore Wind Site Characterisation

Luke Griffiths & Thea Sveva Faleide

Luke Griffiths — Lead Geophysicist, Norwegian Geotechnical Institute, Norway
Thea Sveva Faleide — Senior Geoscientist, Norwegian Geotechnical Institute, Norway

Offshore wind farm (OWF) development relies on the efficient use of large seismic datasets, yet manual horizon interpretation is slow, varies between interpreters, and is hard to automate reliably. In the NGI project On Certain Ground, which combines geostatistics, machine learning, and physics to quantify uncertainty from data acquisition to foundation design, we explore how seismic foundation models can speed up this task. Because named horizons/labels and facies classes rarely transfer between sites, we treat horizon detection as a simple question of whether each point in the image is part of a horizon or not, so that the result describes a reusable geological boundary rather than a site-specific label. Models pre-trained on large volumes of unlabelled seismic data are adapted to this task using a much smaller set of interpreted horizons. The approach produces coherent horizon predictions despite the sparsity of horizons in seismic images, although incomplete labelled interpretations remain a key limitation. The results suggest that this formulation is a promising, transferable approach for early-stage OWF site screening, where rapid and consistent boundary mapping can inform early project decisions. Looking ahead, we see opportunities for uncertainty quantification and tighter data integration towards fit-for-purpose engineering models.

Luke Griffiths

Luke is a Lead Geophysicist and researcher at NGI with around 10 years of experience and a PhD in experimental geophysics. Drawing on expertise in geophysics, inverse methods, data science and laboratory testing, his work focuses on building integrated ground models fit for engineering design, with an emphasis on improving data usage, efficiency, and communication of uncertainty to decision-makers. He has acted as Geoscience Lead on several major offshore wind projects across a range of complex settings. His current research explores self-supervised models to guide site characterisation and target investigations where they matter most.

Thea Sveva Faleide

Thea is a Senior Geoscientist at NGI with a broad background in geology and geophysics. She holds a PhD in seismic imaging and modelling of geological structures and subsurface depositional systems, including the detection of fluids such as CO2 in seismic data. Thea combines this expertise with hands-on experience in geotechnical laboratory testing, including soil classification, rock mechanical and geophysical testing, X-ray/CT-scanning and Multi-Sensor Core Logging. She is part of NGI's team integrating geological, geophysical and geotechnical data for consultancy and research projects.

10:30 CET

AI-Driven Subsurface Characterization: Conditional GANs for Subsurface Schematisation and Deep Reinforcement Learning for Sequential Site Investigation

Bruno Zuada Coelho

Researcher, Deltares, the Netherlands

Geotechnical site characterisation relies on sparse in-situ data, such as Cone Penetration Tests (CPTs), leaving engineers to infer large portions of the subsurface from experience or conventional interpolation. This talk presents two complementary AI approaches to this problem. First, SchemaGAN, a conditional Generative Adversarial Network trained on 20,000 synthetic cross-sections, generates subsurface schematisations directly from CPT data in negligible time. It outperforms conventional interpolation methods, producing clear layer boundaries and realistic anisotropy, a result confirmed by a blind survey and two case studies in the Netherlands. Second, a Deep Reinforcement Learning framework determines where to place the next CPT, adapting to local soil conditions to balance investigation effort against characterisation accuracy. For the same number of tests, it achieves lower error than uniform spacing on synthetic data, with negligible inference time. Together, these methods point toward intelligent, data-driven site investigation, in which subsurface models and sampling strategies inform each other.

Bruno Zuada Coelho

Bruno Zuada Coelho is a researcher at Deltares, specialising in the geotechnical performance and resilience of critical infrastructure. His work increasingly centres on AI for geotechnical engineering, from generative subsurface schematisation to reinforcement learning for site investigation. He holds a PhD from Delft University of Technology and has held research positions at University of Cambridge, as a Marie Curie fellow, and Chalmers University of Technology. He believes the future of infrastructure analysis lies in hybrid models that learn from data while remaining grounded in physics.

10:55 CET

AI-Driven Subsurface Characterization: A Tabular Foundation Model (TabPFN) for Subsurface Schematisation from Sparse CPT Data

Taiga Saito

PhD Candidate, Tohoku University, Japan · Visiting Researcher, Deltares, the Netherlands

In this talk, we explore TabPFN, a foundation model pretrained on general synthetic tabular data, for subsurface schematisation from sparse cone penetration tests (CPTs). Using only spatial coordinates and observed soil behaviour type index values, we reconstruct two-dimensional sections without additional geotechnical training. We evaluate predictions on synthetic sections and at two field sites in the Netherlands. In the baseline comparison with six input CPTs, we obtain accuracy comparable to SchemaGAN on synthetic sections and lower mean errors at held-out field CPTs. On synthetic sections, we obtain lower mean errors with additional CPTs and pointwise prediction intervals with average coverage close to nominal levels. We can incorporate new observations as context without retraining. We also

fine-tune TabPFN on the synthetic sections used to train SchemaGAN, obtaining lower synthetic errors but higher errors at both field sites. We discuss TabPFN's potential for sequential site investigation and ways to incorporate geotechnical information through context or fine-tuning.

Taiga Saito

Taiga Saito is a PhD candidate at Tohoku University, supervised by Yu Otake, and a visiting PhD researcher at Deltares, the Netherlands. Saito also collaborates with Stephen Wu at the Institute of Statistical Mathematics, Japan. These collaborations center on statistical modeling and foundation models for geotechnical site characterization. Current work evaluates pretrained models such as TabPFN for spatial prediction and uncertainty quantification, and investigates how geotechnical data and knowledge can be incorporated into such models, including through the design of pretraining data, to support engineering decisions.

`11:20 CET`

Reliability Updating for Port Facilities: Application to Breakwater Stability Assessment

Sohei Jimbo

Research Officer, National Institute for Land and Infrastructure Management (NILIM), Japan

Port facilities are subject to severe environmental loads and uncertainties in ground conditions, and require efficient maintenance to ensure their long-term functionality. Since uniform and simultaneous maintenance of all structures is impractical, maintenance priorities should be determined based on a vulnerability assessment that identifies critical sections across the port. This talk presents a port-scale assessment of the sliding stability of breakwaters, which are among the most important structures in ports. To efficiently perform probabilistic calculations based on Monte Carlo simulation, surrogate models were employed to enable spatially continuous evaluation of wave conditions along the entire breakwater length. Furthermore, the probability distribution of the friction coefficient of the breakwaters was updated using their survival records during a past storm event. The results reveal spatial heterogeneity in the safety margin of the breakwaters, both among and within sections. This study provides valuable insights into the data-driven design and maintenance of civil engineering structures through reliability updating based on inspection, monitoring, and damage/no-damage records.

Sohei Jimbo

Sohei Jimbo is a research officer at the National Institute for Land and Infrastructure Management (NILIM), Japan, where he belongs to the Port Facilities Division, responsible for the national technical standards for port and harbor facilities. He received his M.Eng. degree in Civil Engineering from the University of Tokyo in 2022. His research focuses on coastal engineering, particularly the implementation of climate change adaptation measures for port and coastal structures. More recently, he has been working on optimal decision-making in the design of port facilities, leveraging AI and integrating engineering and economic perspectives.