ISRM

International Society for Rock Mechanics and Rock Engineering

ISRM AI Café Talks:
30 Minutes of Knowledge Exchange

Next talk:

Active learning with physics-informed neural networks for optimal sensor placement in tunneling through transversely isotropic rocks.

Alec Tristani, Postdoctoral fellow

Cornell University, USA.

28 January
16h00 (CET)

Program Ahead:

Unlocking the Computational Bottleneck in Coupled Process Simulations of Geomaterials: The Promise of Integrated Finite Element Neural Networks (I-FENN)

Mostafa Mobasher, Assistant Professor of Civil and Urban Engineering. NYU Abu Dhabi.

11 February
14h00 (CET)

Machine learning for rock mass classification in practical engineering applications.

Tom Frode Hansen. Senior Specialist Rock Engineering, NGI - Norwegian Geotechnical Institute.

11 March
16h00 (CET)

AI in Rock Mechanics & Rock Engineering (AI-RMRE) Commission
Contact: lina.guayacan@enpc.fr (AI café chair); hyoon@sandia.gov (commission chair)

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Active learning with physics-informed neural networks for optimal sensor placement in tunneling through transversely isotropic rocks.

Abstract

A deep learning strategy is presented to simultaneously solve Partial Differential Equations (PDEs) and back-calculate their parameters in the context of deep tunnel excavation. A Physics-Informed Neural Network (PINN) model is trained with synthetic data that emulates extensometer and convergence measurements. As acquiring field observations can be costly, a sequential active learning approach is implemented to determine the most informative locations for new sensors. The PINN is tested to reconstruct the displacement field around a deep circular tunnel excavated in transversely isotropic elastic rock and to determine constitutive and stress-field parameters. Results demonstrate excellent performance on small, scattered, and noisy datasets. The framework aims ultimately to support optimal subsurface monitoring and adaptive tunnel design.

Speaker

Alec Tristani is currently a postdoctoral researcher at Cornell University working with Prof. Chloé Arson on smart subsurface exploration. He obtained his PhD degree in October 2024 at École Nationale des Ponts et Chaussées supervised by Prof. Jean Sulem and Prof. Lina-María Guayacán-Carrillo. He is deeply interested in machine learning, analytical, and numerical methods for the design of tunnels and underground constructions, with a particular focus on inverse problems. Alec was recently awarded the Pierre Londe prize by the French Society of Rock Mechanics for his PhD work.

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