Alec Tristani

Postdoctoral Researcher - Cornell University

E-mail ayt34@cornell.edu alectristani@gmail.com — Mobile +33 6 52 51 13 39 — Alec Tristani

EDUCATION

11/2021 — 10/2024 **École Nationale des Ponts et Chaussées**, Navier laboratory, Champs-sur-Marne, France. PhD. **Title** : Enriching tunnel behavior analysis with artificial intelligence tools. **Supervision** : Jean Sulem (thesis supervisor) and Lina-María Guayacán-Carrillo (co-supervisor). Defended on October 25, 2024.

09/2020 — 09/2021 **Ecole Centrale de Nantes**, Nantes, France. Master in civil and geotechnical engineering.

09/2018 — 09/2020 **Ecole Centrale de Marseille**, Marseille, France. Engineering degree. Mathematics, Mechanics, Informatics, Chemistry, Physics, Economics, Finance, Management. 3.96/4 GPA.

09/2015 — 07/2018 **Lycée Michelet**, Vanves, France. Classes préparatoires, specialized in Physics and Chemistry (PC*).

RESEARCH AND INDUSTRY EXPERIENCE

12/2024 — Present **Postdoctoral Researcher**, Cornell University, Ithaca, USA.

- Developing computational methods based on physics-informed machine learning algorithms for underground exploration;
- Implementing deterministic and probabilistic approaches to solve inverse problems in deep underground cavities;
- Training physics-informed neural networks based on active learning strategies to optimally place new sensors in the field.

11/2021 — 10/2024 **PhD Candidate**, Navier laboratory, École Nationale des Ponts et Chaussées, Champs-sur-Marne, France.

- Developed a framework for tunnel design based on a complementary approach involving analytical, numerical and machine learning formulations;
- Derived closed-form solutions for fractional viscoelastic plastic constitutive models for the back-analysis of field convergence measurements;
- Implemented physics-informed machine learning surrogate models to assess the short- and the long-term ground-lining interaction.

04/2021 — 09/2021 **Industry internship**, Bouygues Travaux Publics, Vitry-sur-Seine. T2A Project of the Grand Paris Express.

- Construction of a deep tunnel for the future metro line 15 South;
- Set up of a methodology in order to better manage water ingress applied to the excavation of underground galleries.

12/2020 — 04/2021 **Research Project**, Toovalu, Nantes. Developed a climate observatory and low-carbon trajectories for a group of 137 companies through data analysis.

02/2020 — 08/2020 **Research internship**, Geotechnical Center of Excellence, University of Arizona, USA. Department of Mining Engineering and Geotechnics.

- Analyzed rock slope stability of several open-pit mines in Arizona and Utah;
- Implemented new computational methods for breaking down slope movements by modelling each pixel of radar image data.

RESEARCH INTERESTS

- Scientific machine learning for surrogate and inverse modelling in underground constructions;
- Optimal experimental design computational methods in geotechnical engineering;
- Short- and long term assessment of ground-structure interactions in tunnel design;
- Analytical and numerical approaches based on constitutive laws;
- Fractional viscoelasticity and plasticity of rock materials.

AWARDS

- **Pierre Londe 2025 PhD Prize**, awarded by the French Society of Rock Mechanics for the best national PhD thesis in Rock Mechanics, recognising outstanding research contributions in the field;
- **EDSIE Scholarship**, awarded for travel to present at the European ISRM Rock Mechanics Symposium - Alicante, Spain;
- **Centrale Méditerranée Scholarship**, awarded to support research internships abroad (University of Arizona, USA).

TEACHING EXPERIENCE

08/2025 — Present **NYC Utilidors Research Project**, Earth and Atmospheric Sciences Department, Cornell University, Ithaca, USA.

- Leading a group of 17 graduate and undergraduate students to design utilidors (shallow tunnels) in New York City;
- Collaborating with Town+Gown based in NYC;
- Designing the course and providing tutorials for numerical software and machine-learning algorithms;
- Mentoring and interacting with students during weekly office hours;
- Writing the course syllabus and graduate assignments;
- Long-term objective: develop digital twins for predictive maintenance.

01/2025 — 06/2025 **Teaching Assistant**, Earth and Atmospheric Sciences Department, Cornell University, Ithaca, USA.

- Developed tutorials for the MOOSE numerical software in Prof. Chloé Arson's Finite Element course;
- Modelled hydro-mechanical coupling for the design of boreholes, and analysed deep cavity behaviour in fractured rocks;
- Mentored and met with more than 10 students during weekly office hours.

01/2023 — 05/2023 **Supervised Research Internship**, École Nationale des Ponts et Chaussées, Paris, France.
- Mentored M. Feuillas, a master's student intern in the MSROE program specialising in geotechnical engineering;
- Analysed reinforcement learning algorithms for tunnelling applications;
- Mentored and interacted during weekly meetings.

02/2022 — 08/2022 **Supervised Research Internship**, École Nationale des Ponts et Chaussées, Paris, France.
- Supervised S.A. Donzis, a master's student intern in the Civil Engineering program of ENPC;
- Implemented machine-learning surrogate models based on the bagging ensemble approach to assess the short-term ground-lining interaction in tunnels;
- Mentored and interacted daily.

12/2021 — 09/2024 **Geotechnical Experiments**, École Nationale des Ponts et Chaussées, Paris, France.
- Taught laboratory experiments to master students related to geotecnics: penetrometer test, Casagrande box, heat transfer theory.
- Taught practical sessions and tutorials related to traditional approaches in tunnel design.

02/2022 **Lecturer**, EELISA program, Universidad Politécnica de Madrid, Madrid, Spain.
- Taught a class of 40 students on rock mechanics and traditional tunnel design approaches;
- Presented the integration of new artificial intelligence tools into current geomechanics computational methods.

09/2018 — 02/2020 **Private Tutoring**, Marseille, France.
Taught over 100 hours of advanced mathematics, physics, and chemistry to university and high school students.

PUBLICATIONS

Peer-reviewed journals

- A. Tristani, J. Sulem, and L.-M. Guayacán-Carrillo (2024c). "Analytical solutions considering face advance and time-dependent behavior for back-analysis of convergence measurements in deep circular tunnels under isotropic initial stress state". In: *International Journal of Rock Mechanics and Mining Sciences* 182, p. 105866. ISSN: 1365-1609. DOI: https://doi.org/10.1016/j.ijrmms.2024.105866
- A. Tristani, L.-M. Guayacán-Carrillo, and J. Sulem (2024b). "Data-Driven Tools to Evaluate Support Pressure, Radial Displacements, and Face Extrusion for Tunnels Excavated in Elastoplastic Grounds". In: *International Journal for Numerical and Analytical Methods in Geomechanics*. DOI: https://doi.org/10.1002/nag.3889
- A. Tristani and C. Arson (2025). "Active learning with physics-informed neural networks for optimal sensor placement in deep tunneling through transversely isotropic elastic rocks". In: *arXiv preprint 2511.20574*. DOI: 10.48550/arXiv.2511.20574

International conferences (with proceedings)

- A. Tristani, L. Guayacán-Carrillo, and J. Sulem (2025). *A physics-informed machine learning surrogate model to assess the long-term ground-lining interaction in viscoelastic plastic grounds*. Vol. 59th U.S.

Rock Mechanics/Geomechanics Symposium. U.S. Rock Mechanics/Geomechanics Symposium. DOI: 10.56952/ARMA-2025-0533

- A. Tristani, J. Sulem, and L. Guayacán-Carrillo (2024a). "Optimization search to characterize the time-dependent behavior of rock mass based on convergence measurements in deep tunnels". In: *New Challenges in Rock Mechanics and Rock Engineering*. CRC Press, pp. 1037–1043. DOI: https://doi.org/10.1201/9781003429234
- A. Tristani, L.-M. Guayacán-Carrillo, J. Sulem, and S. A. Donzis (2023). "Applicability of Artificial Neural Networks (ANN) for Equilibrium State Prediction in Tunnel Excavation". In: *15th ISRM Congress*. Salzbourg, Austria. URL: https://hal.science/hal-04376928

Articles (without proceedings)

- A. Tristani, J. Sulem and L.-M. Guayacán-Carrillo. Using machine learning to assess ground-lining interaction from convergence data. Tunnels et Espaces Souterrains. AFTES N°292. April-May-June 2025;
- A. Tristani, L.-M. Guayacán-Carrillo and J. Sulem. Enriching tunnel behavior analysis with artificial intelligence tools. Tunnels and Underground Spaces. AFTES N°285. July-August-September 2023.

ABSTRACTS (peer-reviewed)

Oral Presentations

- A.Tristani, L.-M. Guayacán-Carrillo, and J. Sulem. A physics-informed machine learning surrogate model to assess the long-term ground-lining interaction in viscoelastic plastic grounds. 59^{th} US Rock Mechanics / Geomechanics Symposium - Sante Fe, New-Mexico, USA, 11 June 2025;
- A. Tristani, J. Sulem and L.-M. Guayacán-Carrillo. Enriching tunnel behavior analysis with artificial intelligence tools. ITA-CET conference - ETH Zurich, Switzerland, 4 June 2024;
- A. Tristani, J. Sulem, and L.-M. Guayac´an-Carrillo. "Optimization search to characterize the time-dependent behavior of rock mass based on convergence measurements in deep tunnels". European ISRM Rock Mechanics Symposium - Alicante, Spain, 17 July 2024;
- A. Tristani, L.-M. Guayac´an-Carrillo, J. Sulem, and S. A. Donzis. "Applicability of Artificial Neural Networks (ANN) for Equilibrium State Prediction in Tunnel Excavation". 15^{th} International ISRM Congress - Salzburg, Austria, 13 October 2023;

Posters

- A. Tristani, J. Sulem and L.-M. Guayacán-Carrillo. Optimization search to characterize the time-dependent behavior of rock mass based on convergence measurements in deep tunnels. CREAMS Workshop, Champs-sur-Marne, 10 November 2023;
- A. Tristani, J. Sulem and L.-M. Guayacán-Carrillo. Using machine learning to predict stress and displacement at the wall of a tunnel. Poster. 34th ALERT Workshop, Aussois, September 2023.

INVITED TALKS

- A. Tristani, C. Arson. Inverse analysis for tunneling in transversely isotropic media using physics-informed neural networks and active learning. *International Society of Rock Mechanics (ISRM)*. 14 January 2026.
- A. Tristani J. Sulem and L.-M. Guayacán-Carrillo. Enriching tunnel behavior analysis with artificial intelligence tools. *French Society of Rock Mechanics (CFMR)* - 4 December 2025;

- A. Tristani, C. Arson. Inverse analysis for tunnelling in transversely isotropic media using physics-informed neural networks and active learning. *Thornton Tomasetti*. New-York City - USA, 10 September, 2025;
- A. Tristani J. Sulem and L.-M. Guayacán-Carrillo. Enriching tunnel behavior analysis with artificial intelligence tools. *Swiss Federal Institute of Technology of Zurich (ETH)* - 4 March 2024;
- A. Tristani J. Sulem and L.-M. Guayacán-Carrillo. Enriching tunnel behavior analysis with artificial intelligence tools. *Swiss Federal Technology Institute of Lausanne (EPFL)* - 27 February 2024;
- A. Tristani, L.-M. Guayacán-Carrillo, J. Sulem and S.A. Donzis. Applicability of Artificial Neural Networks (ANN) for equilibrium state prediction in tunnel excavation. *French Society of Rock Mechanics (CFMR)* - Mines ParisTech, France, 19 October 2023;
- A. Tristani, J. Sulem and L.-M. Guayacán-Carrillo. Enriching tunnel behavior analysis with artificial intelligence tools. *Universidad Politécnica de Madrid* - Madrid, February 2022.

REVIEWING ACTIVITIES

I regularly review articles in the following international peer-reviewed journals:

- *Rock Mechanics and Rock Engineering*;
- *International Journal for Numerical and Analytical Methods in Geomechanics*;
- *Tunnelling and Underground Space Technology*;
- *Scientific Reports* (Part of Nature);
- *Geomechanics for Energy and the Environment*;
- *Journal of Engineering Mechanics*.

LANGUAGES

- **French**: native;
- **English**: C1 (TOEIC 990/990);
- **Spanish**: intermediate (B2);
- **Russian**: beginner (A2).

SKILLS

- **Data Science:** Machine learning, Optimization, Statistics;
- **Programming:** Python, C, C++, LaTeX;
- **Software:** Flac 3D/2D, Moose, Revit, Robot, AutoCAD.