

1 PHD POSITION IN
"ARTIFICIAL INTELLIGENCE FOR SUSTAINABLE RENEWABLE ENERGY PRODUCTION
AND STORAGE IN SUBSURFACE RESERVOIRS"

AVAILABLE POSITION

This appointment is part of the Grant “Leveraging AI for Sustainable Renewable Energy Production and Storage,” funded by Hi! Paris (<https://www.hi-paris.fr/>). The research will be conducted at ENSTA Institut Polytechnique de Paris. The position provides the opportunity to work on a challenging and impactful research topic. The knowledge, innovation, and skills developed through this role will provide excellent prospects for career growth in both industry and academia.

RESEARCH CONTEXT AND PROJECT SUMMARY

Climate change demands innovative strategies to harness renewable energy. The Earth's subsurface offers significant potential through technologies such as Deep Geothermal Energy, Hydrogen Underground Storage, and Carbon Capture, Utilization, and Storage (CCUS). These methods could transform the energy landscape in France and Europe but are often hindered by induced seismicity from fluid injection into the Earth's crust.

Addressing this challenge requires advanced solutions. Mathematical control theory, as explored in the ERC INJECT project (<https://cordis.europa.eu/project/id/101087771>), offers strategies to minimize seismic risks while optimizing energy production. Alternatively, Artificial Intelligence (AI), particularly Reinforcement Learning (RL), presents a transformative approach with its model-agnostic and performance-oriented nature. RL can develop high-efficiency policies for managing subsurface systems and serves as a paradigm for tackling complex systems with similar uncertainties and constraints, unlocking broader applications across diverse fields.

For more details, contact: ioannis.stefanou@ensta.fr

DESCRIPTION OF THE POSITION

As a PhD researcher you will explore Artificial Intelligence methods to address real-world challenges for controlling systems governed by non-linear and non-smooth partial differential equations (PDEs). Key objectives include the development of robust, stable, and adaptable RL algorithms, which can enhance predictive models for induced seismicity, control and production optimization.

The position emphasizes interdisciplinary research, integrating AI with geomechanics and control theory to deepen scientific understanding of subsurface fluid injection and earthquake mechanics. Outcomes will contribute to cutting-edge scientific advancements with impact to both academic and industrial communities.

REQUIREMENTS

Successful candidates are expected to have strong scientific skills and high motivation. Fluency in spoken and written English is mandatory.

The candidates will carry out research, develop tools and write scientific articles in close collaboration with the project's PI, Pr. Ioannis Stefanou, and the members of the INJECT group.

The candidate is expected to have:

- Background in Applied Mathematics or completion of related coursework.
- Skills in programming (e.g. Matlab/Python/C++).
- Knowledge of Machine Learning.

It will be highly appreciated:

- Interest/background in Dynamics/Mechanics/Geomechanics/Geophysics .
- Knowledge of control of ODE's and/or non-smooth systems and/or PDEs.
- Experience in a lab and team skills.

CONDITIONS OF EMPLOYMENT

The appointment is for a duration of three years. The successful candidate will be appointed by ENSTA Institut Polytechnique de Paris (ENSTA IP Paris) and will join the INJECT research group within the IMSIA laboratory. They will be based at the Mechanical Hub building, a collaborative space housing leading research laboratories specializing in solid mechanics, fluid mechanics, and living mechanics from ENSTA and École Polytechnique.

The research team provides an engaging and collaborative research environment, access to state-of-the-art research facilities, and opportunities for professional development and collaboration.

In addition to conducting research, the position offers opportunities for engaging in academic activities such as supervising Master's and undergraduate students. The project also includes funding for travel to international conferences and research visits, fostering collaboration and the dissemination of findings within the global academic community.

APPLICATIONS

The position is open and will start upon agreement.

Suitable, highly-motivated candidates should send an application (including a CV, a cover letter describing interests and qualifications related to the offered position and contact details of two reference Professors, all compiled in a single PDF file) to ioannis.stefanou@ensta.fr. Candidate selection will be performed on the basis of the excellence of the CV and motivation.