1 ERC PhD Position in "Control Theory and Optimal Sensor/Actuator Placement for Energy Production and Storage in Underground Reservoirs"

AVAILABLE POSITION

The appointment forms part of the ERC-CdG project "Preventing human-induced seismicity to fight climate change" (INJECT), funded by the European Research Council (ERC). The research will be conducted at ENSTA, member of 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 poses an imminent threat to our civilization. Prominent new technologies to fight climate change involve the earth's underground renewable and sustainable energy resources and underground storage. However, all these technologies depend on the injection of fluids into the earth's crust, which, in turn, can cause significant earthquakes. INJECT will solve this problem on the basis of a new, ground-breaking scientific method that will prevent human-induced seismicity and will maximize energy production and storage from renewable and sustainable natural resources.

INJECT's interdisciplinary methodology is based on an astute scientific programme that brings control theory and mathematics to the heart of this new challenging problem. Based on cutting-edge theoretical developments, robust controllers and observers will be designed to optimally adjust fluid injection rates, prevent induced seismic events over large regions and optimize energy production and storage. INJECT's innovative theoretical methods will be thoroughly tested through high-fidelity numerical models that will account for poro-elasto-dynamics, Coulomb friction, multiphysics and reduced-order modeling. The experimental plan will build on demonstrators and hybrid lab-computer testing.

For more details: https://cordis.europa.eu/project/id/101087771
https://erc-inject.eu
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DESCRIPTION OF THE POSITION

As a PhD researcher, you will work on two key objectives: (a) design controllers to prevent induced seismicity during fluid injections while optimizing on-demand fluid circulation in the Earth's crust, and (b) determine the optimal placement of sensors and actuators to enhance system performance and monitoring. The underlying mathematical model to be controlled consists of a system of Partial Differential Equations (PDEs) that describe the dynamic behavior of fluid-saturated porous rocks with embedded frictional discontinuities, known as faults. Earthquakes are dynamic instabilities arising from this non-linear system of equations. Fluid injections act as inputs to the system, whose temporal evolution is monitored using a variety of advanced techniques and sensors.

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++).

It will be highly appreciated:

- Background in control of ODE's and/or non-smooth systems and/or PDE's.
- Background in Dynamics/Mechanics/Geomechanics/Geophysics.
- 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 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, both members of IP Paris.

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 submit an application (including a CV, a cover letter describing interests and qualifications related to the offered position and contact details of two reference Professors) to:

https://enstaparis.recruitee.com/o/doctorant-control-theory-and-optimal-sensoractuator-placement-for-energy-production-and-storage-in-underground-reservoirs.

Candidate selection will be performed on the basis of the excellence of the CV and motivation.