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Peer-reviewed Conference Contribution

# Using control theory for preventing induced seismicity due to fluid injections in a reservoir

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Deep Geothermal Energy, Hydrogen Underground Storage and Carbon Capture Utilization and Storage are promising techniques to satisfy the large-scale needs of the energy sector. However, they all depend on the injection of fluids into the earth's crust, which, in turn, can cause earthquakes [1, 2]. Earthquakes nucleate when large amounts of elastic energy, stored in the earth's crust, are suddenly released due to abrupt sliding over faults. Fluid injections can create new, or reactivate existing, seismogenic faults and, therefore, cause earthquakes [2, 3].

More recently, new results for controlling the earthquake instability of a single, natural, mature seismic fault were obtained [4, 5, 6, 7, 8]. These works were based on the mathematical control theory to stabilize and control the underlying physical system, which is underactuated, strongly non-linear and uncertain. The above works could inspire new approaches for preventing induced seismicity too [4, 9].

In this work, a 3D diffusion equation is considered to model induced seismicity due to fluid injections in a geological reservoir. A robust tracking control is then designed to force the seismicity rate to follow a desired reference, minimize induced seismicity and assure fluid circulation. The designed regulator ensures the control task despite system uncertainties and external perturbations. Simulations of the process are presented to show the reliability and performance of the control approach.

## Data availability Statement

By the date of publication of this conference contribution, a preprint will be available in arXiv.

## Contributor statement

Diego Gutiérrez-Oribio: Conceptualization, Methodology, Software, Visualization, Writing - Original draft

Ioannis Stefanou: Conceptualization, Funding acquisition, Methodology, Software, Supervision, Writing – Review & Editing

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