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Research position (postdoc or research engineer)

Development of a statistical learning model to optimize uranium in situ recovery

Contacts

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Keywords

Machine learning, reactive transport, hytec, uranium.

Context

Orano Mining and the Geosciences department of Mines Paris PSL have collaborated to achieve a better understanding of the hydrogeochemical processes involved in the In Situ Recovery (ISR) of uranium. This mining technique, suited to confined and permeable aquifers, consists in the circulation of a leaching solution within the deposit through injection wells. The solution, which becomes progressively enriched due to the uranium dissolution, is then recovered through production wells. Uranium is then separated in a treatment facility. Nowadays, this technique represents 60% of uranium worldwide production.

HYTEC, a reactive transport simulator, allows to accurately simulate the processes involved in the uranium recovery. These simulations are currently used at the Katco mine (Kazakhstan) both for predicting uranium production (Lagneau et al. 2019, Collet et al. 2022) and the environmental footprint (Escario Perez et al. 2022). Hence, mining operators can benefit from the predictive capacities of HYTEC to guide their operations. In particular, they wish to use HYTEC to optimize the mining sequence for uranium recovery. However, the important computation times associated with HYTEC prevents them from performing a deep optimization. In this context, we wish to study the possibility of developing statistical learning tools to overcome these limitations.

Proposed study

This study will be conducted in three stages

1) Calibration of a neural network model

The first stage will consist in developing an efficient neural network architecture based on simplified case (pair of injection-production wells).

The model training will be based on the hydrogeochemical processes simulated with HYTEC. This model should be able to take into account the varying operating conditions (solution composition, injection-production rates).

2) Upscaling

The second stage will focus on the upscaling of the initial model to be used on a larger and more realistic geometry. We will start by investigating a production cell (one producer in the center of a hexagonal network of injection wells). Finally, the model will be operated on multiple cells (the production block) simultaneously.

3) Optimization of the mining sequence

The last stage will be to use the developed methodology on the production block scale to improve the mining sequence and to optimize uranium recovery.

Profile

Young PhD or engineer from a major school or university with experience in statistical learning and knowledge in reservoir engineering and hydrogeology. Past experience with machine learning (eg. PyTorch or Tensorflow) would be an important asset. An aptitude for teamwork in a multidisciplinary framework, at the boundary between research and industry will be appreciated.

Practical information

This project will be funded for one year as a collaboration between the Geosciences department of Mines Paris PSL and Orano Mining. This contract may start from May 2023. Work will be conducted partly in the Orano office (Chatillon 92) and Geosciences department (Fontainebleau 77). A trip to the Katco mine in Kazakhstan is likely.