Machine-learning enabled model optimization of an emplacement drift in the context of deep geological disposal

Umer Fiaz[1], Lennart Paul[1], Jorge Urrea-Quintero[2], Joachim Stahlmann[1]

[1] Institute of Geomechanics und Geotechnical Engineering, TU Braunschweig
[2] Division Data-Driven Modeling of Mechanical Systems, Institute of Applied Mechanics, TU Braunschweig

Research Project: SEMOTI
Grant Number: 02E12102
Duration: 01.05.2023 – 30.04.2026

IGG Institut für Geomechanik und Geotechnik
Univ.-Prof. Dr.-Ing. Joachim Stahlmann

IAM Institut für Angewandte Mechanik
Prof. Dr.-Ing. Henning Wessels

Institut für Akustik und Dynamik
Prof. Dr.-Ing. Ulrich Römer

Objectives

- Optimize emplacement drift geometry to minimize integral permeability
- Parameters:
  delta_wall,
  delta_roof,
  delta_bottom

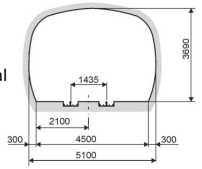
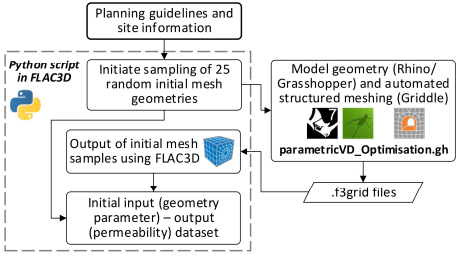


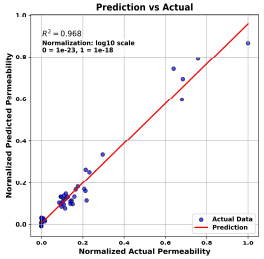
Figure: Cross-section profile of the emplacement drift for the highly radioactive waste (in mm)

Optimizations workflow

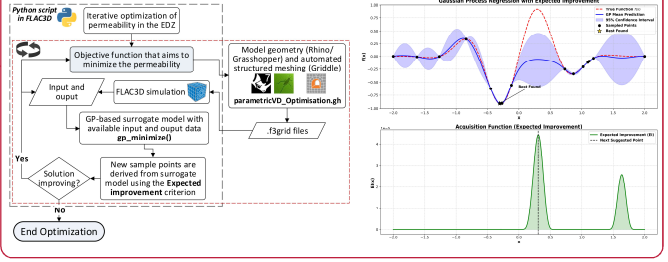


Accuracy evaluation

- Number of initial training samples considered = 25
- Total number of iterations = 50
- R^2 = 0.968

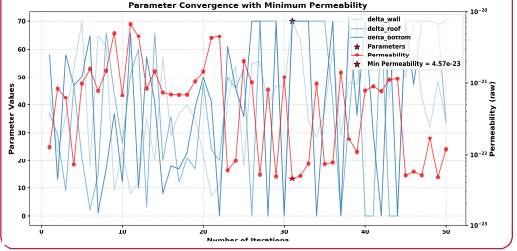


Iterative optimization



Optimization results:

- Parameters: delta_wall: 70.0, delta_roof: 70.0, delta_bottom: 70.0
- Minimum permeability (predicted): 4.566e-23



Further developments:

- Implementation of an information based criteria: Kullback-Leibler (KL) divergence
- Develop a Multi-Fidelity Surrogate Model
- Algorithmic and Workflow Enhancements

Abstract no. 157