NAWI Graz
GEOZENTRUM

GRAZ UNIVERSITY OF TECHNOLOGY
INSTITUTE OF ROCK MECHANICS AND TUNNELLING
HEAD: UNIV.-PROF. DIPL.-ING. DR.-ING. THOMAS MARCHER

TU Graz

Master Theses Topics

General information

- Almost all reports/theses have to be written in English
- Every 2-3 months presentation sessions are organized at which students present their current results in front of the institute's staff and other (master) students.
- Topics investigated by the institute's staff and by the students are not restricted to offered theses. If you have your own ideas we would be happy to discuss them with you. Just stop by!

FFG Project – Regenerate

Evaluating Geothermal Potential in Tunnels through Simulations.

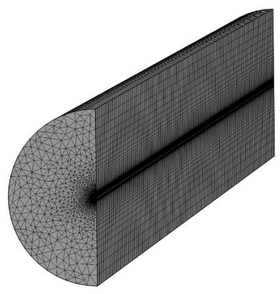
Objective: Transform existing underground spaces into thermal energy production and storage systems.

Utilization of:

- Low-enthalpy geothermal energy.
- Waste heat from wastewater and industrial processes.

Focus Areas:

- Monitoring, testing, and data analysis.
- Numerical modelling to understand tunnel behaviour.



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FFG Project - SPuRM

Storage Potential of Underground Rock Mass

Simulation: Comprehensive THM simulations to model storage behavior and evaluate efficiency.

Optimization: Calibration and validation of numerical models using experimental data and flow simulations.

Analysis: Investigation of the effects of fracture water flows in hard rock.

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HSSR classification schemes

Focus on HSSR (Hard Soil / Soft Rock)

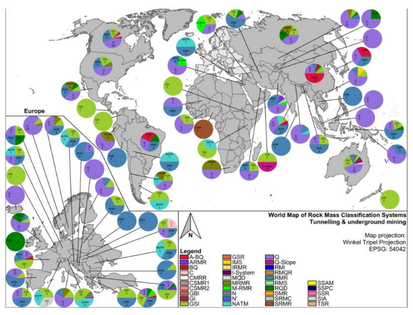
Identifying existing classification systems for:

- soft rock and hard soils

Identifying relevant factors for:

- soft rock and hard soils

Goal: multidisciplinary approach for more accurate and reliable classifications.



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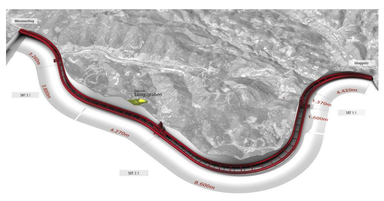
Semmering Base Tunnel (SBT) – lessons learnt

Data Analysis: interpret recorded data

Parameter Analysis: Review and assessment of geological, hydrological, and geotechnical factors

Back calculations: FEM analysis (2D and 3D) of relevant excavations areas



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Eurocode 7

Standardization need for design of tunnels and other underground structures?

Prospects for design work in the context of the Eurocodes?

Various Tasks / Studies:

- Running tunnels (shallow / deep seated)
- Cut and cover structures and stations as well as caverns and shafts
- Comparison of various design approaches and design philosophies.
- FEM and bedded beam spring models
- Input parameter – characteristic values versus design values

ÖSTERREICHISCHE GESELLSCHAFT FÜR GEOMECHANIK

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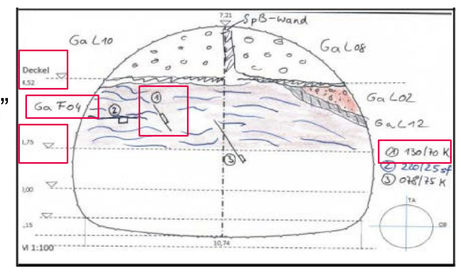
Structured Information Extraction from Geotechnical Documentation with GPT

Goal: to run custom GPT/RAG for feature extraction, extract data and validate the results from unstructured to structured data

Workflow:



- Make a ranked list of "expected features"
- Develop a Python code to extract and list all "features"
- Train custom GPT/RAG: experiment with prompts (CoT, knowledge base) to extract "features"
- Find metrics to assess GPT/RAG performance

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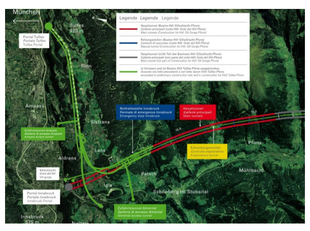
Fault zone detection based on exploratory data utilizing machine learning techniques

Goal: Classification and identification of fault zones based on exploratory data and drilling data for automation of fault zone detection in TBM excavation

Workflow:



- Literature research on ML methods
- Getting familiar with the BBT project and the available data
- Identification of a technique suited for the application
- Applying and evaluating different methods

Cooperation with BBT, possibility to do a research stay at the construction site

Possibly combinable with "TBM operational data-driven fault zone detection" thesis

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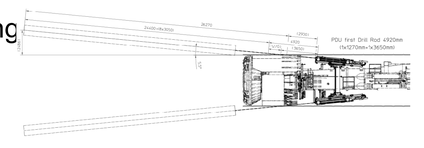
Optimizing TBM excavation by interpreting grout drillings utilizing machine learning techniques

Goal: Parameter determination useful for optimizing and optimization of TBM excavation

Workflow:



- Literature research
- Getting familiar with the AST project and the available data
- Identification of parameters most important to be optimized in TBM excavation
- Identification of a techniques suited for MVTS data interpretation
- Applying and evaluating different methods

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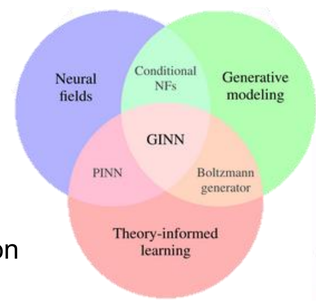
Generative design and geometry informed neural networks in geotechnics

Goal: Determine potential of generative design/GINNs in geotechnics to explore vast number of design possibilities that may not have been considered by human designers

Workflow:



- Literature research on application of generative design and GINNs
- Searching for possible applications in geotechnical engineering
- Applying it on most promising application

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Improving the quality of synthetic measurement while drilling (MWD) data generated from SMOTE technique

Goal: to improve the quality of the synthetic (fake) generated values for target variable i.e., 'ΔR(mm)' and the MWD parameters using data preprocessing techniques. As a result, the ML-algorithm performance should be improved.

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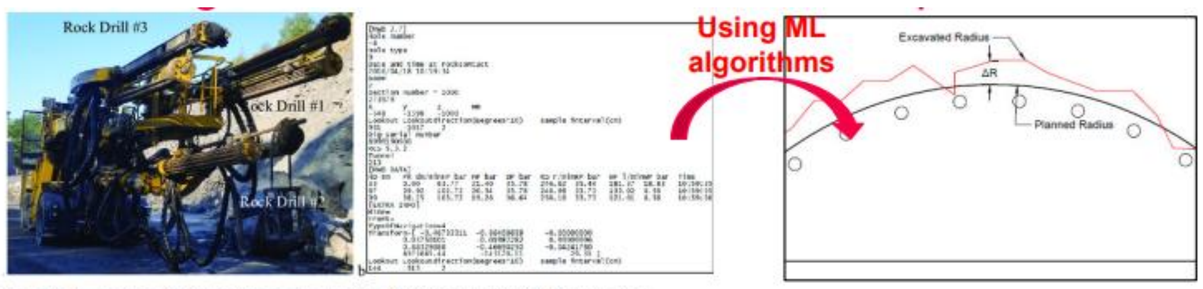

van Eldert, Jeroen & Schunnesson, Håkan & Saiang, David & Funehag, Johan. (2020).

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RMT