Advanced Modeling of Mine Water Rebound and Inter-Mine Hydraulics

MoGruPlex Project

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Introduction

- **Mine Water Rebound Modeling**: After mining ceases, mine water levels in abandoned mines rise due to groundwater recharge, deep water inflow and inter-mine seepage.
- **Previous Models:** RUDAKOV & WESTERMANN (2021) focused on a single or hydraulically isolated mines.
- **Need for Extension:** Real-world mines are interconnected, requiring inter-mine dynamics and improving predictive accuracy.

Objectives

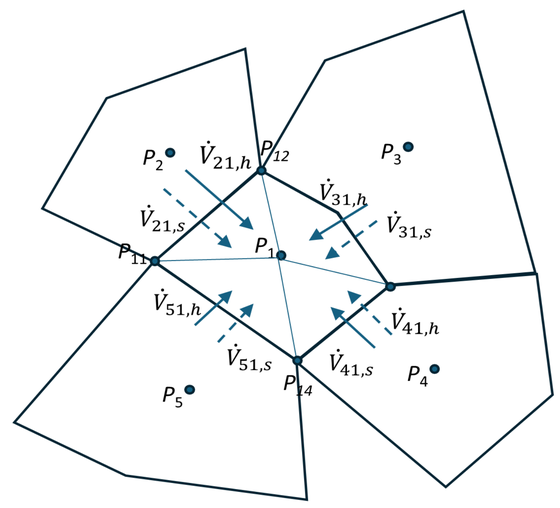
- **Predictive Accuracy:** Enhance forecasting for ground-water contamination and flooding risks.
- **Analytical Model:** Develop an enhanced model that accounts for inter-mine water dynamics.

Expected Benefits and Applications

- **More Accurate Predictions:** The model provides precise water level predictions by incorporating inter-mine interactions.
- **Better Risk Assessment:** Improved prediction of potential environmental hazards such as groundwater contamination and flooding.
- **Improved Decision-Making:** Supports in post-mining water resources management and planning reclamation efforts.

Proposed Model Concept

- **Polygonal Mine Representation:** Each mine is modeled as a center point, with water levels calculated individually while considering the influence of neighboring mines through hydraulic connectivity.



- **Inter-Mine Flow Consideration:** Water exchange between mines is included, improving accuracy in representing the complexities of interconnected mining systems.

Mathematical Formulation

Inter-Mine Flow Components:

- **Hydraulic Flow ($\dot{V}_{ij,h}$):** Water movement through mine galleries, modeled using the *Darcy-Weisbach* equation.
- **Seepage Flow ($\dot{V}_{ij,s}$):** Water flow through geological barriers, modeled using the *Dupuit-Thiem* equation.

Computational Approach

- **Stepwise Calculation of Water Levels:** Water levels for each mine are calculated iteratively in steps, adjusting based on the inter-mine flows.
- **Ensuring Stability:** The iterative process ensures stability and minimizes errors by gradually updating the water levels, accurately reflecting the influence of neighboring mines at each step.

Conclusion

- **Model Extension:** Extended model integrates inter-mine hydraulics into traditional water rebound models, enhancing predictive accuracy.
- **Computational Efficiency:** Despite the added complexity, the model remains computationally efficient.
- **Future Work:** The model will be validated with real-world data, with future research focused on optimizing parameters for improved accuracy and performance.

Quellenangaben
RUDAKOV, D. & WESTERMANN, S. (2021): Analytical modeling of mine water rebound: Three case studies in closed hard-coal mines in Germany. – Mining of Mineral Deposits, Volume 15 (2021), Issue 3, 22-30.

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