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Application of the GeoSequencing Module to ensure optimised underground mine schedules with reduced geotechnical risk

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Abstract

Conventionally, engineers will impose stope sequencing rules in order to ensure the stability of excavations as mining progresses. Typical rules include fixed direction, primary-secondary and chevron. Using a mine planning software suite, a mine layout is designed, and a set of stope-to-stope precedence links are created, enforcing the applicable rule. The mine planner produces a schedule that meets these and other constraints, in an effort to achieve a high net present value (NPV) for the operation. This time-consuming process limits the planner's ability to assess alternative mining strategies. Further, the process tends to over-constrain the mine schedule, since it is often the case that an alternative set of precedence constraints can enforce the same rule. By over-constraining the schedule, and by not assessing alternative strategies, significant value may be lost.

The GeoSequencing Module is software that facilitates the assessment of stope sequencing strategies, through integration with the Schedule Optimization Tool (SOT). The GeoSequencing Module rapidly generates multiple alternative sets of stope-to-stope precedence links that enforce stope sequencing rules selected by the user. Each set of precedence links is referred to as a geosequencing scenario. For each geosequencing scenario, SOT optimises the life-of-mine schedule, allowing the planner to identify the scenario that supports the highest value for the mining operation. Furthermore, the software has been integrated with a boundary element solver, facilitating assessment of the geotechnical stability of the optimised schedules.

A case study for an underground mine has been conducted to validate this methodology. The study demonstrates that multiple mining strategies can be conveniently assessed to determine which scenario yields the most desirable outcome for the mining operation in terms of both geotechnical stability and financial assessment.

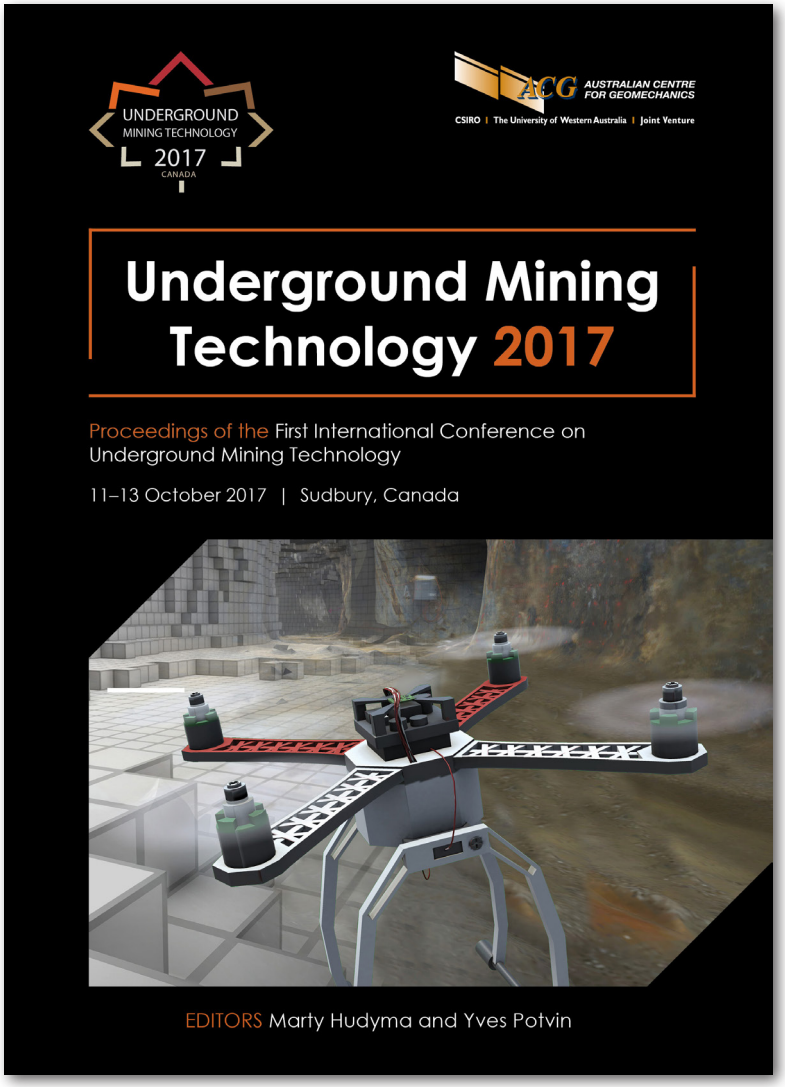
Keywords: *mine planning, mine schedule optimisation, geomechanics, stope sequencing, numerical modelling*

1 Introduction

Conventional long-term mine planning practices often restrict the planner's ability to assess multiple alternative mine planning strategies. Ideally, multiple constraints and parameters should be taken into account, such as ventilation requirements, product price and ore grade uncertainty, as well as geotechnical extraction constraints. Unoptimised plans are often produced during different stages of mine planning due to the time-consuming nature of developing and assessing alternative extraction strategies.

The Schedule Optimization Tool (SOT) can assist a planner in addressing these challenges. SOT optimises the net present value (NPV) of life-of-mine schedules. It uses heuristics and a custom genetic algorithm to rapidly generate, assess and optimise mine schedules which conform to all user-defined operational and precedence constraints (Maybee et al. 2010; Fava et al. 2011).

Three new software modules that integrate with SOT have been developed through MIRARCO's SOT+ research project, to enhance the planner's ability to constrain, optimise, and analyse mine schedules in order to extract the maximum value from a mining operation. A high-level description of these software modules follows.



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References

Fava, L, Millar, D & Maybee, B 2011, 'Scenario evaluation through mine schedule optimisation', in R Kuyvenhoven, E Rubio & M Smith (eds), *Proceedings of the 2nd International Seminar on Mine Planning*, Gecamin, Santiago, pp. 1–10.

May, W 2014, *An Investigation of Induced Rock Stress and Related Damage in Popular Stope Sequencing Options Using Numerical Modelling*, CSMM152 – dissertation project, Camborne School of Mines, Penryn.

Maybee, B, Fava, L, Dunn, P, Wilson, S & Fitzgerald, J 2010, 'Toward optimum value in underground mine scheduling', *CIM Journal*, vol. 1, no. 3, pp. 176–182.

MIRARCO Mining Innovation 2017, *SOT+*, MIRARCO Mining Innovation, Sudbury, viewed 5 July 2017, http://www.mirarco.org/sotplus/

Morrison, DM 1996, 'Deep hardrock mining: the future', *CIM Bulletin*, vol. 89, no. 1000, pp. 46–51.

Revolution Mining Software Inc. 2017, *Schedule Optimization Tool*, version 2.0, Revolution Mining Software Inc., viewed 5 July 2017, http://www.revolutionmining.com/sot-v2-0

Shnorhokian, S, Mitri, HS & Moreau-Verlan, L 2014, 'Assessment of stope sequence alternatives in a diminishing ore pillar', in M Hudyma & Y Potvin (eds), *Proceedings of the Seventh International Conference on Deep and High Stress Mining*, Australian Centre for Geomechanics, Perth, pp. 471–484.

Wiles, T 2017, *Map3D*, Map3D International Ltd, viewed 5 July 2017, https://www.map3d.com/.