

Mine schedule optimisation with ventilation constraints: a case study

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Abstract

This paper describes a process for optimising mine schedules with ventilation constraints using the Schedule Optimization Tool (SOT), the Ventilation Constraint Module (VCM) and a ventilation network solver (Ventsim). The VCM was developed as a component of MIRARCO's SOT+ research project.

Proper ventilation is critical for underground mines to operate safely, yet it is often not adequately considered early in the mine planning cycle. The need to account for ventilation early in the long-term planning cycle motivated the development of the VCM. The VCM generates constraints on the schedule of mining activities for each zone and for each stage of the mine life, based on available airflows. These constraints are intended to ensure that a mine schedule will be feasible from a ventilation perspective. Adhering to these ventilation-based constraints, as well as other constraints related to the project, SOT maximises the net present value (NPV) of the long-term schedule. The VCM will also assist the user in identifying opportunities to redistribute the airflow in the mine in ways that support higher-NPV schedules.

A case study for a hypothetical underground mine will be presented, showing that the VCM supports the generation of optimised life-of-mine schedules that adhere to realistic ventilation constraints.

Keywords: *mine schedule optimisation, ventilation, Ventilation Constraint Module, Schedule Optimization Tool, mine planning*

1 Introduction

A mine ventilation system clears contaminants out of an underground mine, providing fresh air to workers and equipment. In general, ventilation accounts for 35 to 50% of the total energy cost for an underground mine (Allen & Tran 2011; Hardcastle et al. 2007). For metal and non-metal underground mines, the ventilation system is mainly used for diluting the concentration of harmful gases such as diesel particulate matter (DPM) and dust below regulatory limits, and for cooling the air.

Since adequate ventilation is necessary for safe underground mining, accounting for ventilation constraints early in the mine planning cycle can have significant benefits. In particular, a feasible schedule with maximised net present value (NPV) can be generated due to the simultaneous optimisation of the ventilation system and the long-term schedule. Currently, there is no commercial mine scheduling software package that explicitly accounts for ventilation constraints in the schedule optimisation process.

The VCM has been developed by MIRARCO as part of the SOT+ research project. Two other software modules have been developed within the project, namely the GeoSequencing Module and the Advanced Valuation Module (AVM). The GeoSequencing Module generates geotechnically motivated scheduling constraints, while the AVM implements processes for generating robust optimised schedules that account for product price and ore grade uncertainties.

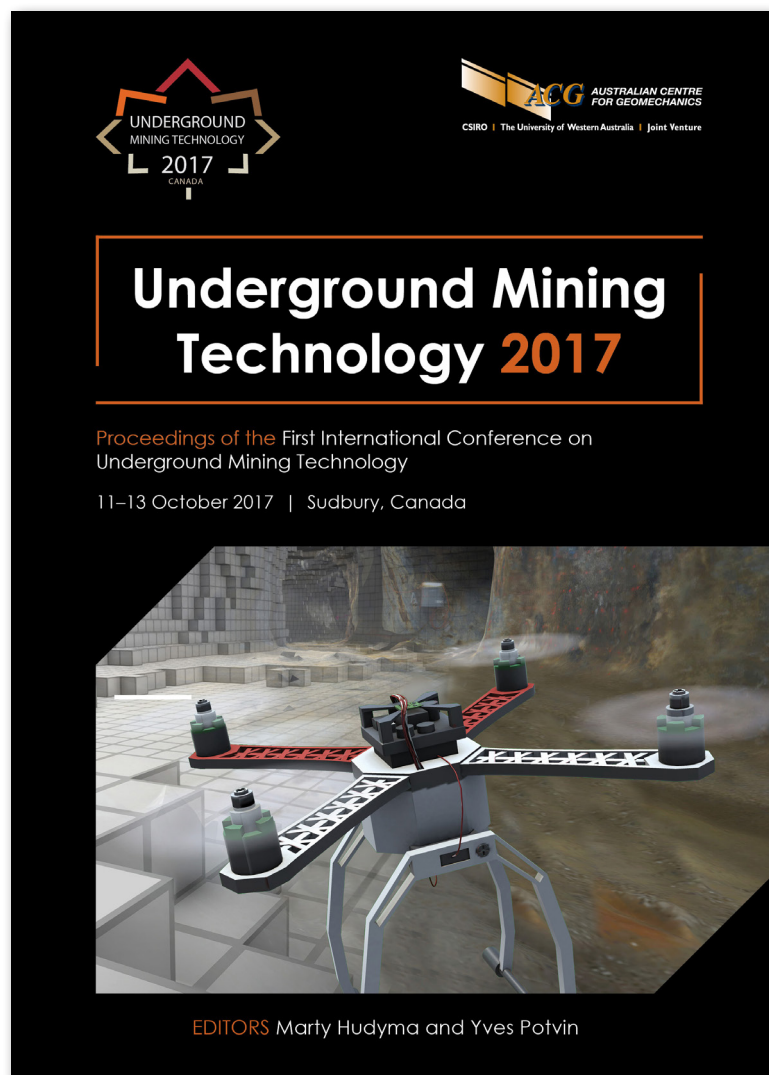
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