Real-Time Mining

A framework for continuous process control and optimization

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Introduction

The flow of information, and consequently the decision-making along the chain of mining from exploration to beneficiation, typically occurs in a discontinuous fashion over long timespans. In addition, due to the uncertain nature of the knowledge about deposits and the inherent spatial distribution of material characteristics, actual production performance often deviates from expectations. Reconciliation exercises to adjust mineral resource and reserve models and planning assumptions are performed with timely lags of weeks, months or even years.

The key concept of Real-Time Mining promotes the change in paradigm from discontinuous intermittent process monitoring to a continuous process and quality management system in the resource extraction process. The framework includes a real-time feedback control loop that rapidly links online data acquired during extraction at the mining face, during material handling and processing with a sequentially up-datable resource model. This will allow near real-time optimization of decisions related to long-term planning, short-term sequencing and production control.

Method

In April 2015 the multi-partner and multi-national European Commission funded R&D project Real-Time Mining was launched (Benndorf et al, 2015). The key concept of Real-Time Mining research promotes the change in paradigm from discontinuous intermittent process monitoring and control to a continuous closed-loop process management system (Figure 1).
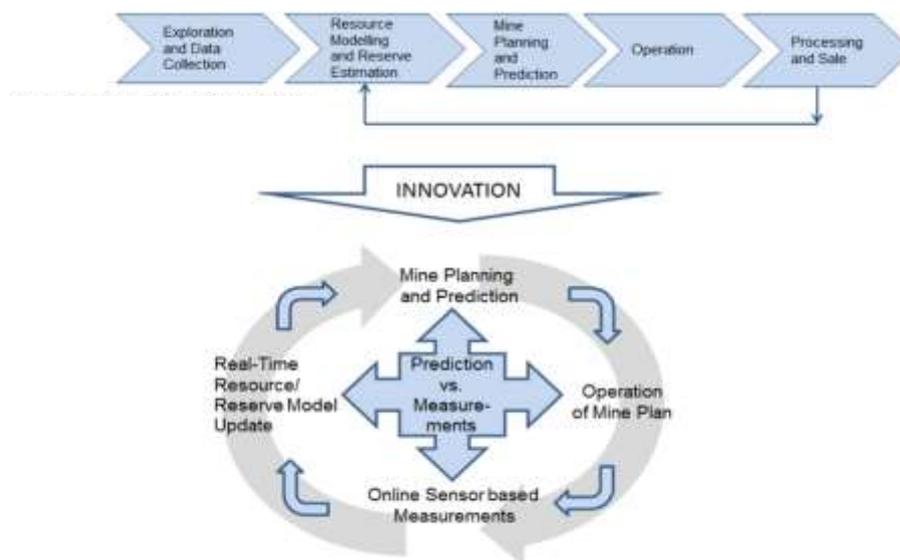

Fig. 1: Moving from discontinuous process to a real-time continuous closed-loop process

The development of such an integrated framework in the context of mineral resource management is novel and involves significant scientific challenges as it has to integrate multiple distinct scientific disciplines into one coherent process monitoring and optimisation framework. Main building blocks of Real-Time Mining are

- underground equipment positioning,
- sensor-based material characterization,
- sensor-based machine control monitoring,
- methods of spatial grade prediction using geostatistical approaches and rapid updating and
- optimization of short-term planning.

A key enabler to turn data into mining intelligence is the central part, the BigData management and visualisation (Buttgereit et al, 2016).

The main objective is to develop an innovative technical solution for resource-efficient and optimal high precision/selective mining in geologically complex settings. This will integrate the different components of autonomous positioning of mining equipment, spatially-referenced real-time sensor-based monitoring, extraction planning model updating together with decision and machine control optimization. The near autonomous system will enable access for exploration and exploitation in small deposits and difficult locations by selecting suitable equipment feasible in ruggedized and extreme conditions.

The presentation will introduce a closed loop framework for Real-Time Mining. First, the concept and necessary building blocks are outlined followed by a discussion of the state-of-the-art. To reach the status of an industrial proven concept (technology readiness level TRL 7 according to NASA scale), Real-Time Mining conducts active research and technical development to in two large demonstration cases, the Neves Corvo Mine in Portugal and the Reiche Zeche Mine in Freiberg. The presentation will highlight most recent developments, present first selected results and discuss the potential value added.

Acknowledgements

References

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