Optimization of Horizontal Transport in Underground Mines Using Machine Learning and Data Integration from Safety and SCADA Systems

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# ABSTRACT

Horizontal transport is a critical component of the production process in underground mining operations. With the ever-expanding reach of underground mines, continuous adaptation of equipment and work organization to dynamically changing operational conditions is essential for optimal equipment usage. This includes selecting appropriate configurations for wheeled loading and haulage machinery responsible for transporting material from production faces to transfer points, as well as optimizing the entire conveyor transport network. Effective process optimization requires tools that not only facilitate an understanding of current operations but also enable the adjustment of workflows to ensure the targeted tonnage is transported within a specified time frame, while minimizing energy expenditure. Key challenges to efficiency, aside from random operational incidents, include equipment downtime caused by traffic bottlenecks on haul roads, machines idling while waiting for loading, and conveyor systems operating without load. Data from existing safety systems and SCADA systems provide essential information, from which equipment utilization metrics and numerical tracking of material flow within the transport network can be extracted. This article presents an example of integrating data from various sources and applying machine learning techniques to address these challenges. Additionally, the use of reporting tools in a GIS environment is demonstrated to further enhance process visualization and decision-making.