Harnessing artificial intelligence in hard rock room-and-pillar mining design: A mini-review and future perspectives

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# ABSTRACT

The room-and-pillar mining method is a widely used technique for efficiently extracting shallow-seated tabular orebodies. In this method, pillars are left intact to support the weight of the rock mass above. Despite its effectiveness, many operations have experienced large-scale pillar failures. Several parameters — geometric and geotechnical — influence the behaviour of these pillars. Current design techniques primarily employ empirical, analytical, and numerical methods. However, due to the complex interplay of various parameters, artificial intelligence (AI) is emerging as a promising alternative for designing and predicting the stability of hard rock mine pillars. Although machine learning, a subset of AI, is currently the most utilised approach, many other categories of AI remain underexplored in the context of pillar design and mining in general. This paper presents a review of AI applications in hard rock room-and-pillar design. The review is enhanced by using CiteSpace software to systematically analyse and visualise global trends in hard rock pillar design. The main objective of this study is to provide insights into the limitations of current AI applications in hard rock pillar design and to suggest potential avenues for future applications across the broader categories of AI.