Probabilistic boundary modelling through fusion of exploration, blast hole and structural data via Gaussian Processes

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ABSTRACT

Probabilistic boundary modelling in stratified deposits, such as the banded iron formation (BIF) hosted deposits in the Pilbara Region of Western Australia, can capture the boundary location uncertainties and help better represent the model risks. Modelling the boundaries using widely spaced exploration holes creates a high level of uncertainty in areas between the holes, with different interpretations of the boundary equally probable. The number of possibilities can be reduced by including directional information. The model can be further guided by including data collected during mining. This research demonstrates a probabilistic Gaussian Processes based method of fusing these disparate data sources to better inform the boundaries. A 2D synthetic data set was created to mimic a typical cross section in a stratified iron ore mine. Four types of data were used: exploration holes, directional data from exploration holes, blast holes and directional data from production. Each additional data source further restricted the model and added detail to the boundary. When only exploration points are used, the model creates a smooth boundary with minimal variation between the holes. When directional information was added the behaviour of the model changed significantly, revealing additional folding that was not present in the initial model of the boundary. The bench data sources added further localised detail that improved the predictions for the next bench. This study demonstrates that such multi-source boundary updates can have a relatively large impact on the composition of individual benches, providing more accurate information for planning and production decisions.