Reproduction of Inequality Constraint between Iron and Silica for Accurate Production Scheduling

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ABSTRACT

Conventional geostatistical algorithms cannot reproduce bivariate complexities such as inequality constraint, nonlinearity and heteroscedasticity. Poor reproduction of these features may decrease the accuracy and reliability of mine planning results. In this regard, inequality constraints between primary and disturbing elements are common in metalliferous deposits. Therefore, the resemblance between bivariate relations in borehole data and produced model is as crucial as variogram and histogram validation. Implementation of traditional methodologies for such complex datasets can lead to overestimation of disturbing elements, which will decrease the NPV of the deposit. In this paper, an Iron dataset containing Iron and Silica grades with inequality constraint between variables is introduced as a case study. This study proposes an algorithm based on a hierarchical sequential Gaussian cosimulation framework integrated with inverse transform sampling. The proposed methodology considers the linear inequation in the hierarchical cosimulation process to model variables with inequality constraints. As a comparison, conventional sequential Gaussian cosimulation is also applied on the same dataset to demonstrate the difference in bivariate relation. Multicollocated searching strategy is used in both methodologies to model Iron and Silica. While validation of marginal distribution and spatial variability is similar for both methods, the conventional algorithm cannot reproduce inequality constraint. The modeled realizations are then used to assess the uncertainty of a plan and generate a stochastic strategy that adapts the destination of the blocks depending on the scenario. Comparing production schedules resulting from proposed and conventional geostatistical methodologies shows the importance of inequality constraint reproduction and more accurate long-term mine planning.