SBRE: a simple, flexible and scalable framework to perform conditional simulations for uncertainty quantification

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ABSTRACT

Geostatistical simulations are the best practice for uncertainty quantification in non-linear systems. Simulations currently undertaken on an ad-hoc basis in the mining industry due to high requirements on powerful computing environments and advanced capabilities in geostatistics. In contrast to the estimation process, multivariate simulations can be performed using different methods, tools, and computational environments, similarly to data science methods. For large companies with multiple commodities it is important to have a standard framework to test, build, and run different workflows using different methods, application and computational environments. This work presents an auditable, modular and scalable framework to create geostatistical simulation workflows where the workflow is abstracted from the implementation. Key aspects: automation – workflows should be able to run automatically given updated data (if hands on modelling is not required); auditability – workflows should document key considerations and parameters; modularization – workflows should permit swapping out components, for example substituting domaining in Leapfrog software by automated domaining using machine learning scripts; scalability – easy, repeatable, portable deployments on a diverse infrastructure (for example, experimenting on a laptop, then moving to an on-premises cluster or to the cloud); reproducibility – parameters should be archived to permit re-running and reproduction of workflows in future years; and sensitivity analysis – any component of a workflow should be able to run with multiple scenarios of parameters and data to enable global uncertainty quantification and sensitivity analysis. The presented framework is used to create different workflows for geostatistical simulations in multiple assets to quantify uncertainty in the value chain: resource categorizations, reserves uncertainty, value of information, robust mine planning, etc.