# Resource Model Updating by Compositional Sequential Ensemble Filtering

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**Abstract**

In mining engineering, resource and grade control models aim to characterize the spatial distribution generating by geostatistics methods of ore tonnage and grade in an deposit. A continuously self-updating resource model concept has recently been developed by Wambeke and others (2016) and aims to improve the raw material quality control and process efficiency of any type of mining operation. The proposed concept integrates sensor data measured with different support along the production line into the resource or grade control model and provides continuously locally more accurate estimates. Applications in underground mines include the identification of different components of the mineralogy and geochemistry.

This study aims to develop an efficient updating framework based on a sequential ensemble filtering on a compositional environment (Tolosana-Delgado (2013)). The importance of respecting as well physical conservation principles has long been recognised. During the data assimilation procedure, the mass of each component should be preserved within each ensemble member through the procedure used to update the model. Different approaches to constraining ensemble based Kalman filters have been presented (Janjić and others (2014)) as solutions of a set of regularized least squares optimization problems. Some of these have been formulated by imposing non-negativity constrains or by using transform methods such as anamorphosis, at the price of violating mass preservation. Compositional approaches supersede this problem by dealing with the positivity condition and the mass preservation implicitly through assimilating log-ratios instead of the original components.

After a detailed literature review, a compositional sequential ensemble filter approach adapted to specific application in mining is presented. Method validation results are presented for a 2D case study in a fully controllable environment. After validation, a sensitivity analysis investigates the effects of different parameters and derived practical implementation aspects for an effective application.

This research is part of the European Union funded "Real Time Mining" project, which aims at developing a new framework to reduce uncertainties during the block extraction process. New sensor based technology will provide georeferenced information about mineralogy and grades by taking images of the mine face, during block extraction from the muckpile, or via sensors installed on the conveyor belt about the mean composition of the ores. Based on a discrete time event simulation, the project will test the capabilities of incorporating sensor imaging information as pointwise data and of mean compositions as block data.

## References

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