**Adaptive Search Ellipsoid: A new practical algorithm for local anisotropies in mineral resource estimation**

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Current practices in mineral resource estimation challenges resource engineers to make further analysis of locally varying anisotropies. They require either sub-domaining of a geological, mineral domain or locally aligned search ellipsoid for varying anisotropies caused by geological uncertainties.

This paper presents a novel algorithm designed to enhance estimation accuracy by systematically addressing these anisotropies. The algorithm proceeds through a series of steps: 1) directional semi-variograms at every 15º direction, 30º tolerance angle, 2) autofitting of exponential, gaussian, spherical models with trust region algorithm by minimizing their RMSEs, 3) selection of the best models among exponential, gaussian, spherical with lowest RMSE at each directional algorithm, 4) selection of the longest range from the best variogram models to use as a radius of sample filtration. 5) filtration of samples by the global range at each estimation point and iterate 1-4, 6) calculation of the grades at each estimation point by using the best fit models with their individual search ellipsoid’s direction, range, nugget, sill in ordinary kriging estimator.

In this approach, we used Walker Lake data as a case study and considered 470 samples as a single domain, creating 725 estimation points at a 10x10 grid. We resulted as the gaussian is the best model fitted with 0.028 RMSE, 105 º azimuth and 73 m range in step 1-4 and 312 spherical, 212 exponential and 201 gaussian models at step 5. In step 6, grades of these points were estimated by individual search ellipsoids which adapted to the local anisotropy directions with individual dimensions. The adaptive approach yielded a 7% increase in R-squared values over a single-model autofit strategy and showed a closer alignment between the estimated and exhaustive data, as evidenced by probability plots and grade-tonnage curves, substantiating the efficacy of the proposed algorithm in capturing and leveraging local anisotropies.