



Current Affairs

A Window on Software Engineering



Relative Elevation in Interpolation

(Selecting initial search parameters when interpolating based on relative elevation)

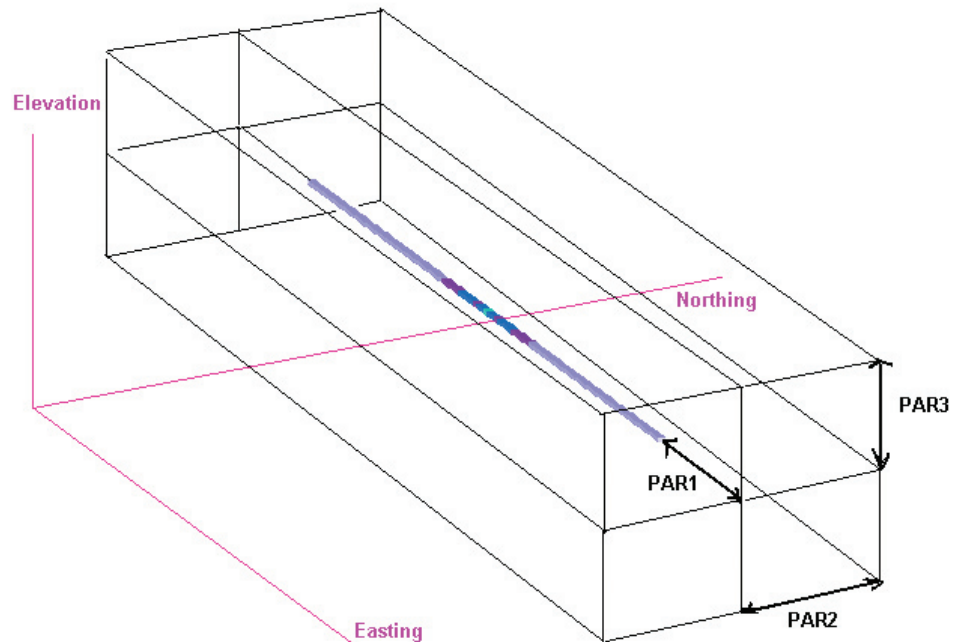
Interpolation programs in MineSight® can use “relative coordinates” instead of actual Easting, Northing, and Elevation when performing final ellipsoidal search and computing distances for inverse distance weights or kriging. Among relative coordinates, the one most often used is relative elevation. This article discusses using relative elevation in interpolation. The use of relative elevation is helpful to interpolate model items where mineralization follows a specific surface.

We will look at a rather common example: the relative elevation is the distance to a given surface. When this option is selected, the program uses composite and block elevations relative to the surface instead of the actual elevations. This methodology is similar to “unrolling a surface”. A new procedure **relev.dat** and a program **gnrelev.exe** are currently in testing and will soon be available. They are designed to calculate and store distances to a triangulated surface into both composite and model files.

When using relative elevations, you must be very careful in setting search parameters PAR1, PAR2, PAR3, PAR4, and PAR20.

Ellipsoidal search parameter PAR4 is applied to the relative coordinates.

If you are using relative elevation, you can specify PAR20 as a preliminary limit for relative Z when selecting composites that are to be used in interpolation for each block. By default PAR20 = PAR3. Before the search ellipsoid is applied, the set of composites is limited to ones with X-coordinate within PAR1,



"Initial search" region to load composites for the current model row.

Picture 1

Y-coordinate within PAR2, and the relative Z value within PAR20 of the corresponding block values.

When selecting PAR1, PAR2, and PAR20 make sure that the box defined by these parameters is big enough to contain the search ellipsoid.

However, before processing each given row the interpolation program (e.g. **m620v1**, **m624v1**, etc.) loads an “initial pool of composites”. Only those composites with **actual** Eastings, Northings, and Elevations within PAR1/PAR2/PAR3 distances from the row are selected (Picture 1).

This makes selection of PAR3 very important. It should be large enough to ensure that all composites with relative elevation within PAR20 range of the block's relative elevations on a row are included.

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The safest bet, though not necessarily optimal, is to set:

$$\text{PAR3} = \text{PAR20} + (\text{elevation range of the surface on the whole bench}).$$

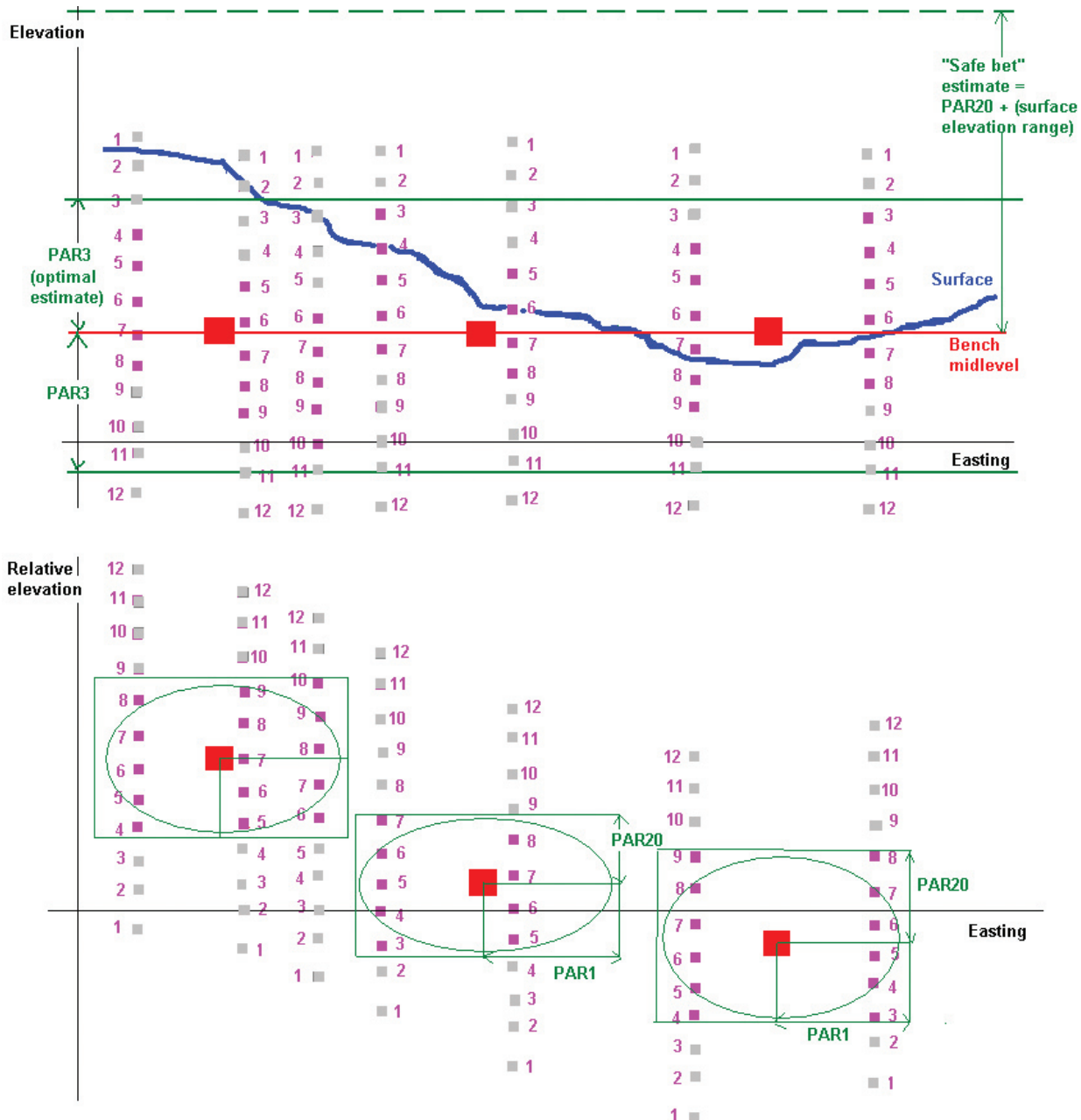
However, the larger PAR3, the larger is the pool of composites to be searched through for each block. This can visibly increase interpolation time.

You may want to bring PAR1 and PAR2 into play. Whether it is possible to improve the PAR3 estimate depends on how large the values of PAR1 and PAR2 are, and how gradually the surface elevation changes.

For each particular model block, we are interested in the surface elevation change on the distances at most PAR1 and PAR2 in Easting and Northing from block centers. If we know that over any rectangular area of size PAR1 x PAR2 the surface elevation changes not more than some value A, then we can use a better estimate for PAR3:

$$\text{PAR3} = \text{PAR20} + A.$$

In Picture 2, composites with Eastings (Northings) and relative elevation within PAR1 (PAR2) and PAR20 distances from corresponding values at the block centers are marked in purple.

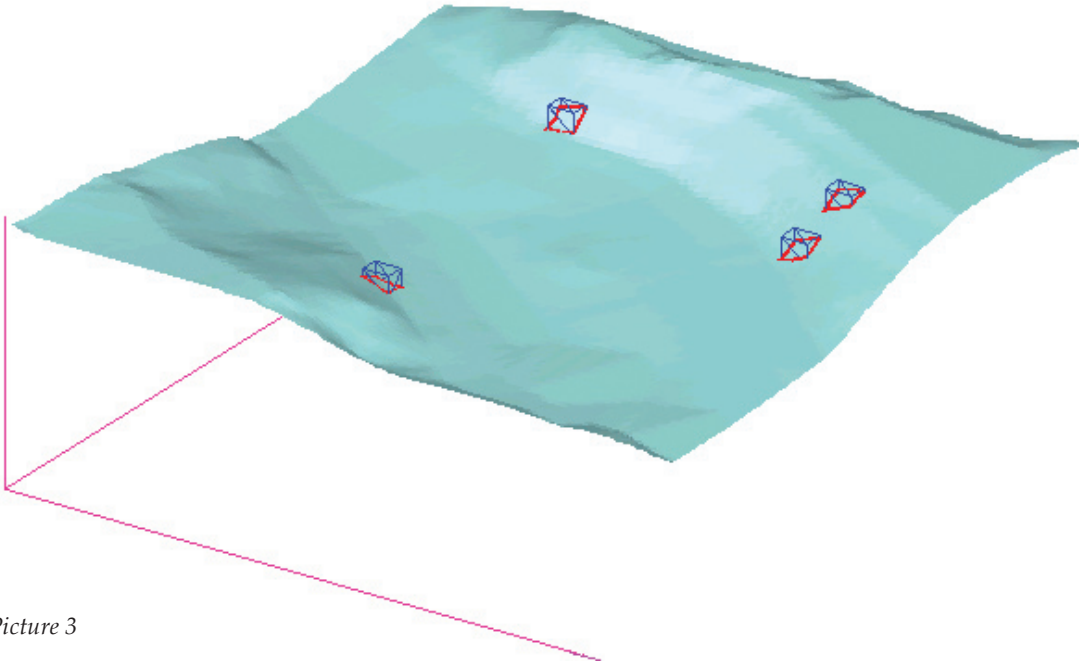


Picture 2

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For the surface shown in Picture 3, the elevation range of the whole bench is 250. If we take PAR1 and PAR2 into consideration we may reduce the elevation range estimate that is needed for PAR3 computation. For instance, if we use PAR1 = 100 and PAR2 = 75 we can limit areas of interest to rectangles of size 100 x 75. Manual inspection of the surface shows that the surface range on any of such rectangles does not exceed 80. Thus, we can reduce the value of PAR3 from (PAR20 + 250) to (PAR20 + 80).



Picture 3

Fine print. Computation of PAR3 estimation.

Let the surface defining relative elevations be defined by equation: $z = \text{surf}(x,y)$, and the relative elevation be the "vertical distance" to the surface: $z_{\text{rel}} = \text{surf}(x,y) - z$.

Each composite has actual coordinates (x, y, z) and a relative z coordinate z_{rel} . Each model block has actual coordinates (x, y, z) and a relative elevation item z_{rel} .

For blocks on one bench the value of z is fixed (it is toe or midpoint, depending on interpolation choices), but z_{rel} can be different (because the function surf depends on x and y).

Let us consider a composite with coordinates x, y, z , and $z_{\text{rel}} = \text{surf}(x,y) - z$, and a model block with coordinates x_0, y_0, z_0 , and $z_{\text{rel}0} = \text{surf}(x_0,y_0) - z_0$.

We know that $|x - x_0| < \text{PAR1}$, $|y - y_0| < \text{PAR2}$, $|z_{\text{rel}} - z_{\text{rel}0}| < \text{PAR20}$. We want to estimate the value of $|z - z_0|$.

Start with inverting equation for z_{rel} : $z = z_{\text{rel}} - \text{surf}(x,y)$, $z_0 = z_{\text{rel}0} - \text{surf}(x_0,y_0)$. Then

$(z - z_0) = (z_{\text{rel}} - z_{\text{rel}0}) + (\text{surf}(x_0,y_0) - \text{surf}(x,y))$. So, $|(z - z_0)| \leq |z_{\text{rel}} - z_{\text{rel}0}| + |\text{surf}(x,y) - \text{surf}(x_0,y_0)|$

Our goal is to choose PAR3 that will guarantee that all the composites with a z_{rel} value within PAR20 of $z_{\text{rel}0}$ have actual elevation coordinate z within PAR3 of block elevation value z_0 .

We can guarantee this if $\text{PAR3} \geq \text{PAR20} + |\text{surf}(x,y) - \text{surf}(x_0,y_0)|$.

The most straightforward estimate for the difference in surface values is the elevation range of the surface on the whole bench:

$\text{PAR3} = \text{PAR20} + (\max(\text{surf}(x,y)) - \min(\text{surf}(x,y)))$.

However, this may result in an unnecessarily large value of PAR3.

If you have some additional information about the surface and take PAR1 and PAR2 values into account, you may improve the PAR3 estimation.

Note that the composites of interest have x and y coordinates within PAR1 and PAR2 distances from x_0 and y_0 . Therefore, you are interested only in the change of surface elevation, while x coordinate changes within PAR1 and y coordinate changes within PAR2 range. This change can be less than the overall surface elevation change.

For instance, if you know that overall slope of the surface at all points is less than some value S then you can set:

$\text{PAR3} = S * \sqrt{\text{PAR1}^2 + \text{PAR2}^2} + \text{PAR20}$.