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Drawing contour lines

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The basic results of grid or triangle (Meshed Noise Map) calculations are levels in discrete points. Several steps need to be taken to derive the final contour lines from these results.

The first step towards the final contour lines is an interpolation. From the basic grid or triangle results the program finds the base points for the contour lines by interpolation. In the figure below this is illustrated with grid results and a single contour value (which is normally an integer value). The black crosses indicate the grid points. From the black grid values the green base points are found by interpolation.

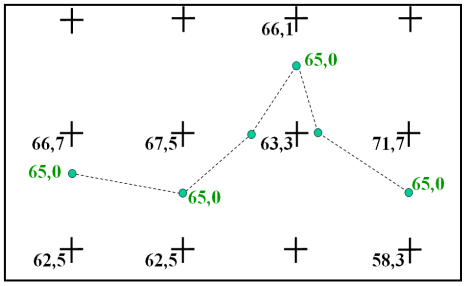

Fig 1 The base points for the contour line are found by interpolation

The next step weeds out 'unnecessary' base points. This filtering works almost the same way as the filter under Geo-Tools > More geometry tools > Filter (Shift+Ctrl+F) in the GeoDatabase. 3 consecutive points are evaluated stepwise from start to end of the line. The intermediate point is deleted if it deviates less than 'Filter width [m]' from the straight line between start and end point, see Fig 2. (Note: the filter in the GeoDatabase is 3 dimensional and besides that you must manually delete (Ctrl+Delete or just Delete) the points that the tool selects whereas the 'unnecessary' contour points are automatically deleted). The filter width is user definable via the map object types, see Fig 3.

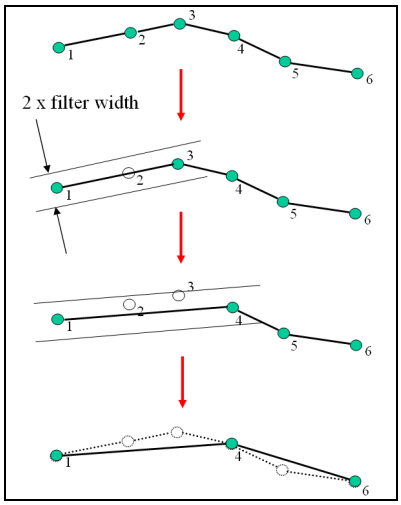

Fig 2 The filter deletes intermediate points found within the filter width

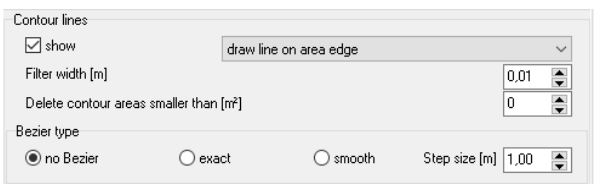

Fig 3 The filter width and Bezier type is selected via Map object types

For the final contour line you can choose to show it by drawing straight lines between the points that were left after the filtering. In that case select 'no Bezier'. Or you can choose between two different ways to smoothen the curve, 'exact Bezier' and 'smooth Bezier'. The 'exact Bezier' will force the curve to go through the remaining base points whereas the 'smooth Bezier' allows the curve to leave these points and smoothen the curve further, see Fig 4.

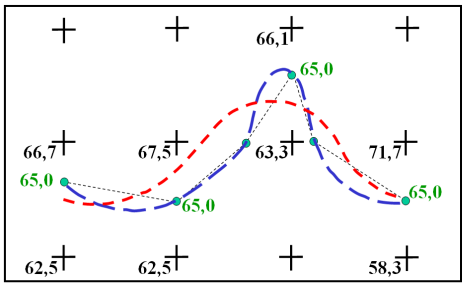

Fig 4 Final contour line with exact (blue line) and smooth (red) Bezier smoothening

The default filter width is 1 cm which for all practical purposes means no filtering. No matter what Bezier type you choose it will normally not be possible to make the contour lines look 'natural' if you use a filter that narrow.

On the other hand, you should take care not to increase the filter width too much. Increasing the filter width will make the contour lines 'move' here and there and thus change the original result. If you compare the upper and the lower curve in Fig 2 it is obvious that the filtering process modifies the curve (max 'modification' = filter width). It makes no sense to use filter widths beyond the receiver space. In general, the filter width should be kept far below the spacing. A filter width of 5 % to 10 % of the receiver distance will produce sensible contour lines in many cases.

The step size in [m], see Fig 3 and 5, defines the approximate distance between the points forming the final smoothen contour line. This parameter is only relevant for smoothed curves. The more you increase the step size the bigger risk that the final contour line will appear not as a smooth curve but as a 'jagged' line. This speaks for a fairly low step size; however, the more you decrease the step size the bigger the file will be if you export the contour lines to dxf, txt and shape files. A fair compromise depends on the scale of your map. On a map in scale 1:1000 and step size 1 m the contour lines will still appear as smooth curves whereas the curves will start getting jagged here and there if the step size is increased to 5 m.

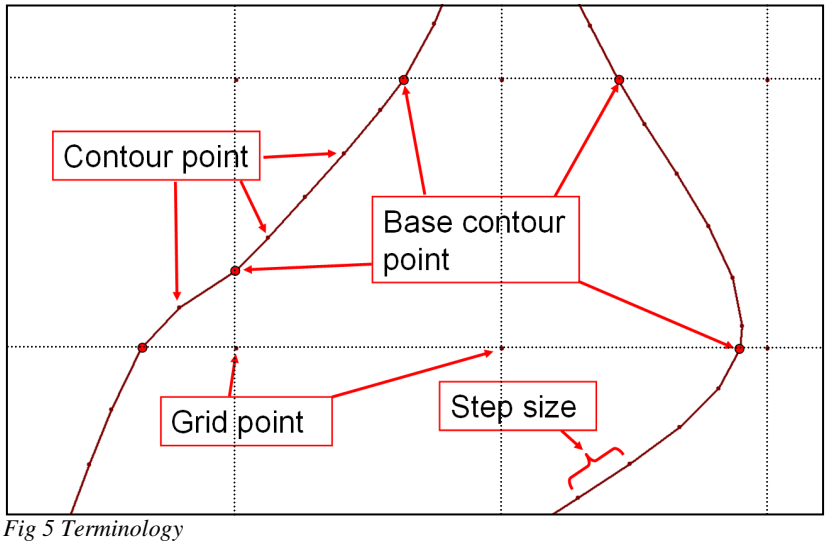

Fig 5 Terminology

Besides these tools there is a possibility to delete contour areas smaller than a user defined size, se Fig. 3. It cannot be avoided that one or a few calculation results within a small area are just above a certain threshold whereas the neighbouring receivers reach a result on the other side of this threshold. Without the use of this tool such a result will generate a small 'island' or 'bubble' in the contour zone which might look 'unnatural'. To delete tiny contour zones is of course the same as 'cheating' a bit; but since most contour maps suffer from filtering, interpolation and smoothening anyway maybe such a modification can be justified. Fig 6 shows an example.

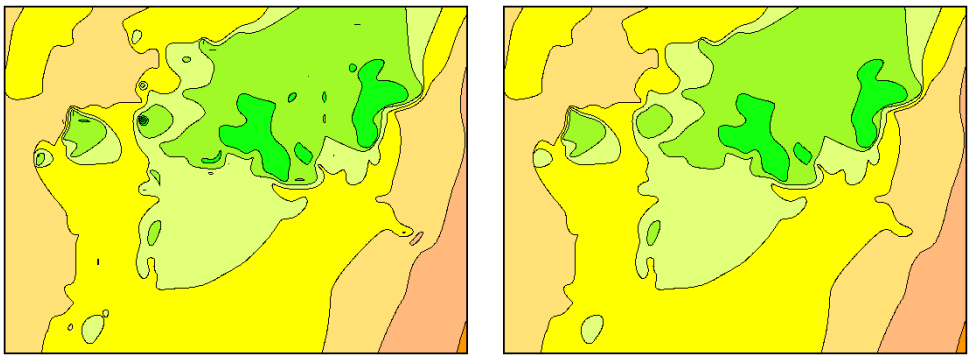

Fig 6 Contour map displayed without and with use of 'Delete contour areas smaller than x [m²]'

The feature 'draw line on/inside/outside area edge' (see Fig 3, Cartography module required) makes it possible to show the contour lines displaced relative to the edge of the contour areas to which they belong. It is rarely relevant to move contour lines this way. A parallel feature is available for the two general object types line and area; for further information please search for 'draw line on area edge' in the help files.

Examples

The following pages show the result of displaying a couple of contour lines with different parameter settings. The first picture Fig. 7 shows 'true value'. The shown 2 contour lines are obtained from a grid calculation without interpolation in the run set up and with extremely small grid space (0,2 m); the display is done with filter width 0,01 m ('no filtering') and no Bezier. The difference between the two contour values is 4 dB.

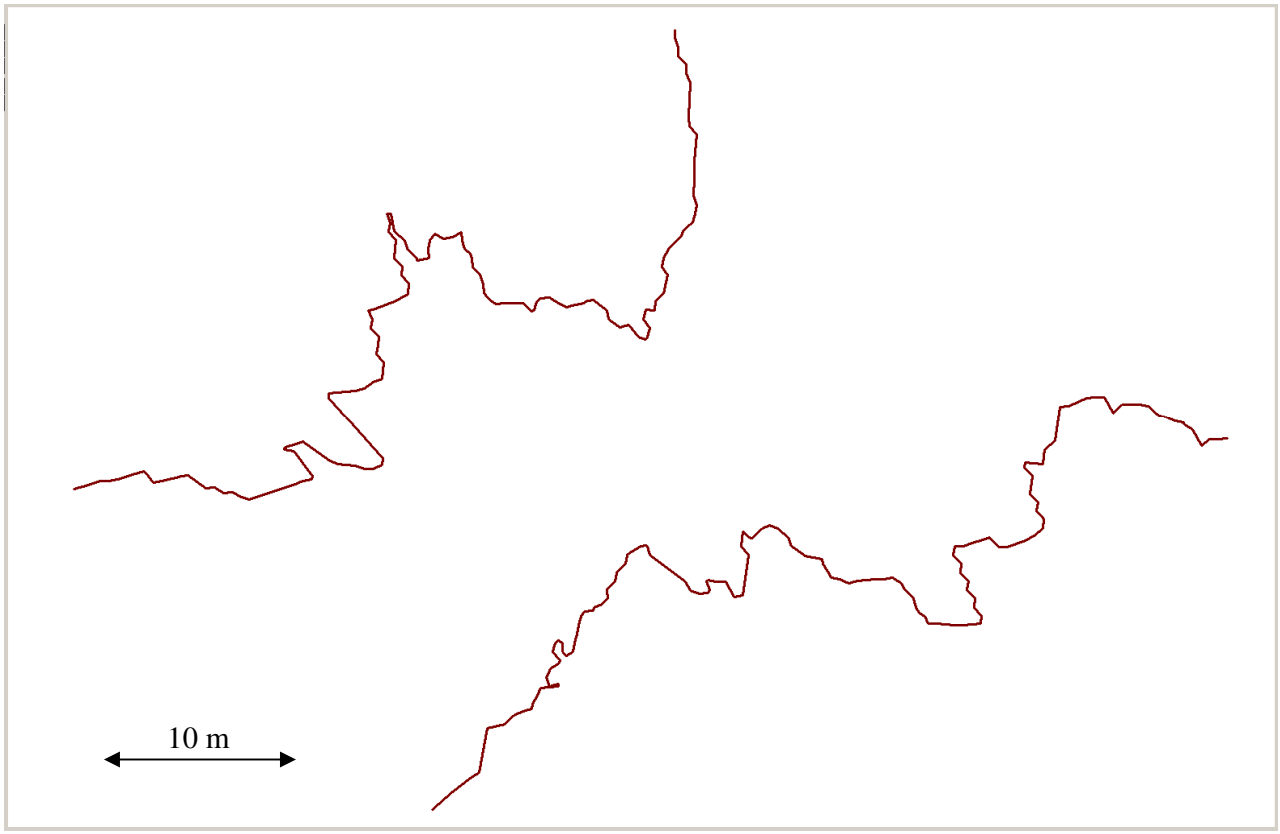

Fig 7 'True value', grid space 0,2 m, filter width 0,01 m, no Bezier

On the figures below the 'true value' is shown greyed out in the background for comparison. Other results are obtained from calculations with 5 m grid space (but still without interpolation in the run set up in order not to introduce inaccuracies which are not to be discussed in this Net Info). Conclusions are drawn on the last page of the document.

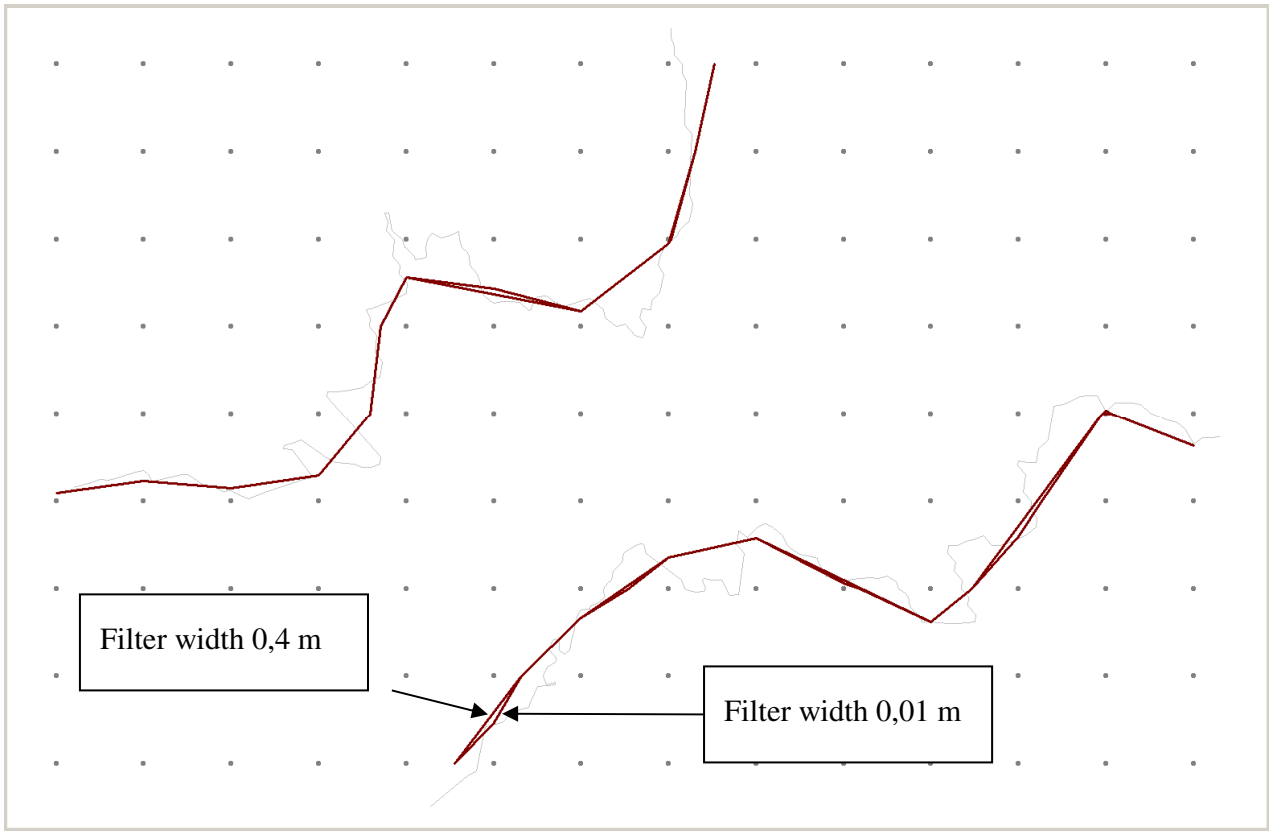

Fig 8 Grid space 5 m, filter width 0,01 m and 0,4 m, no Bezier

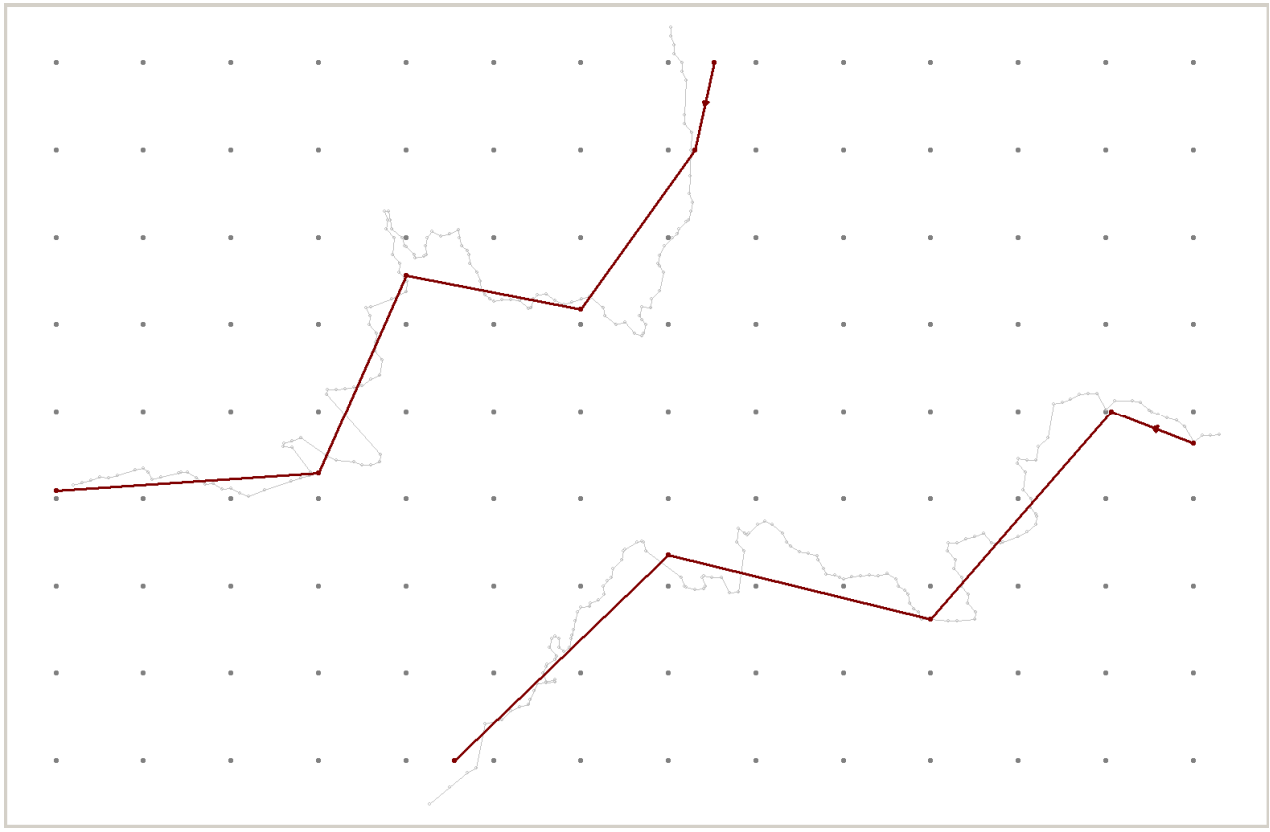

Fig 9 Grid space 5 m, filter width 2,5 m, no Bezier

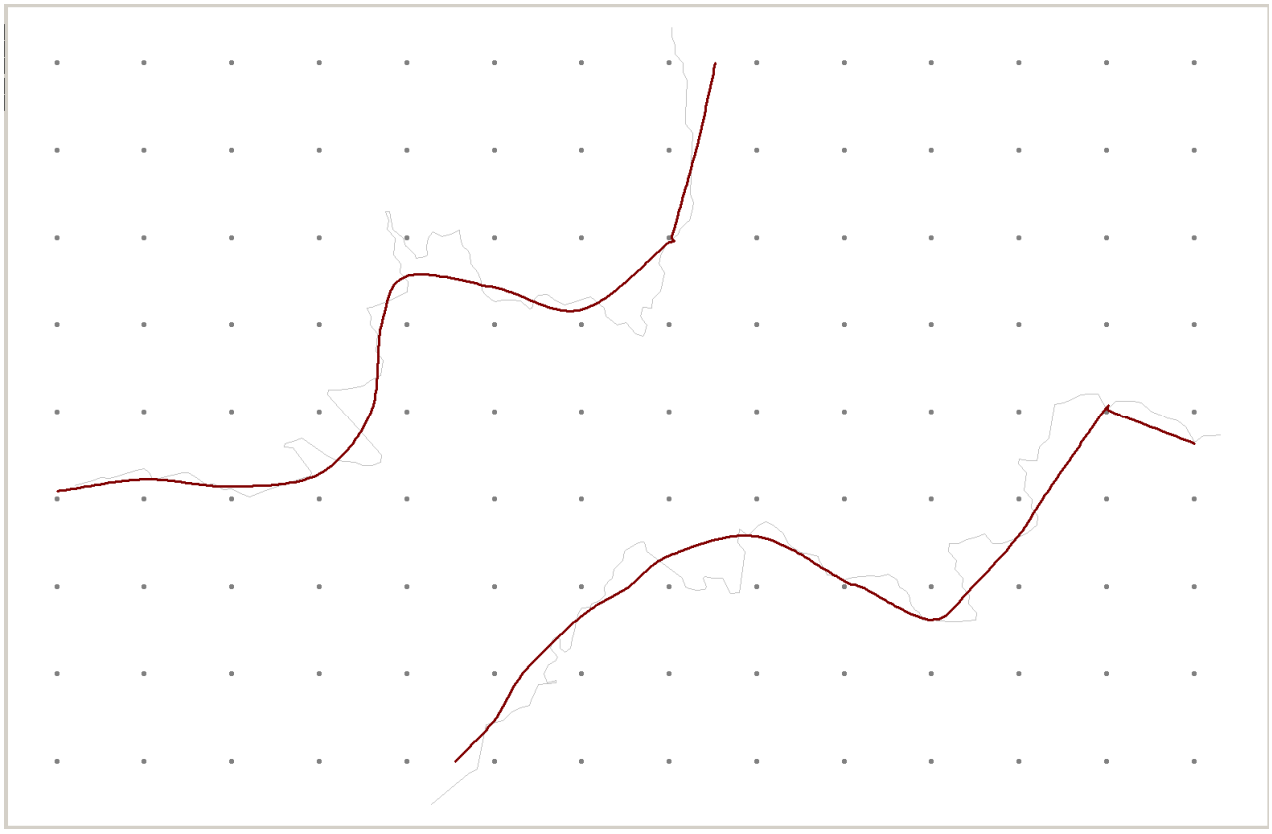

Fig 10 Grid space 5 m, filter width 0,01 m, exact Bezier, step size 0,2 m

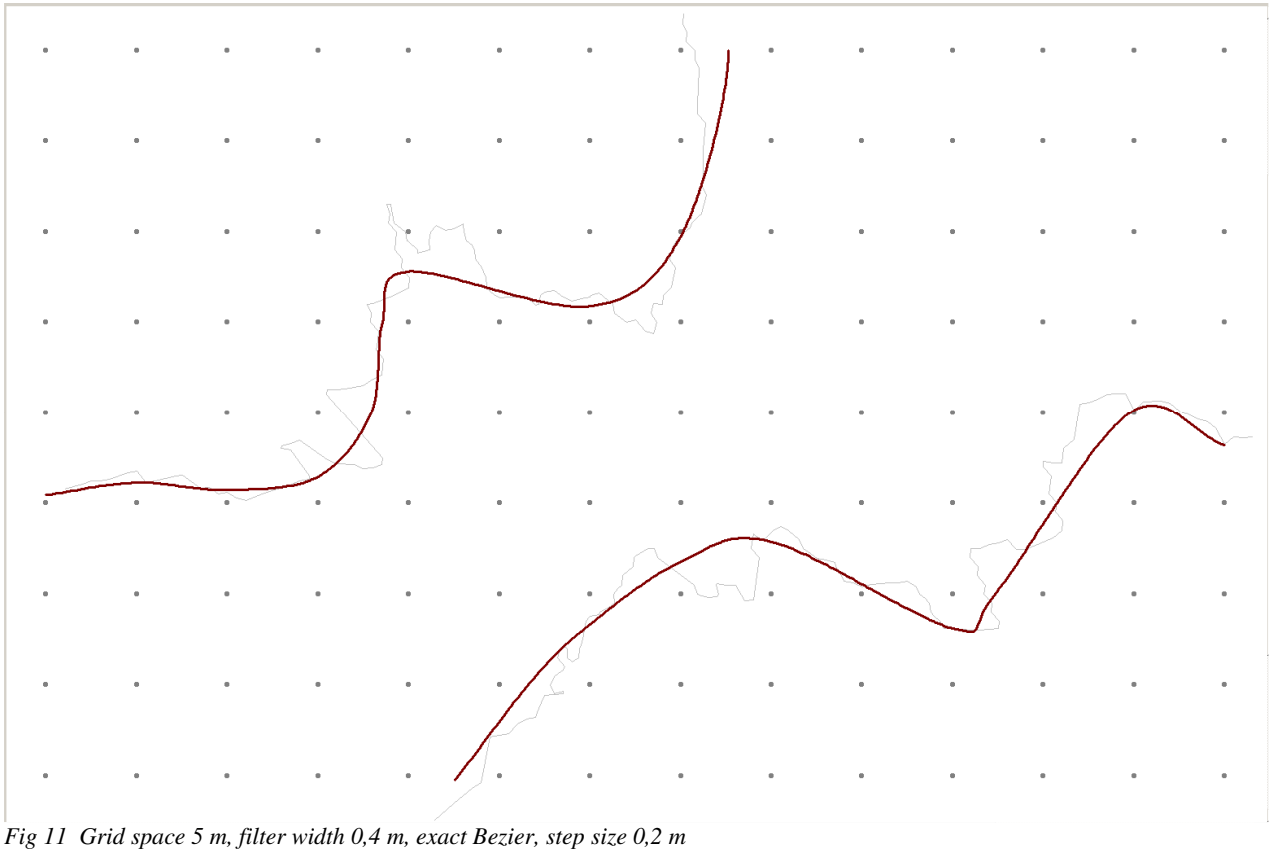

Fig 11 Grid space 5 m, filter width 0,4 m, exact Bezier, step size 0,2 m

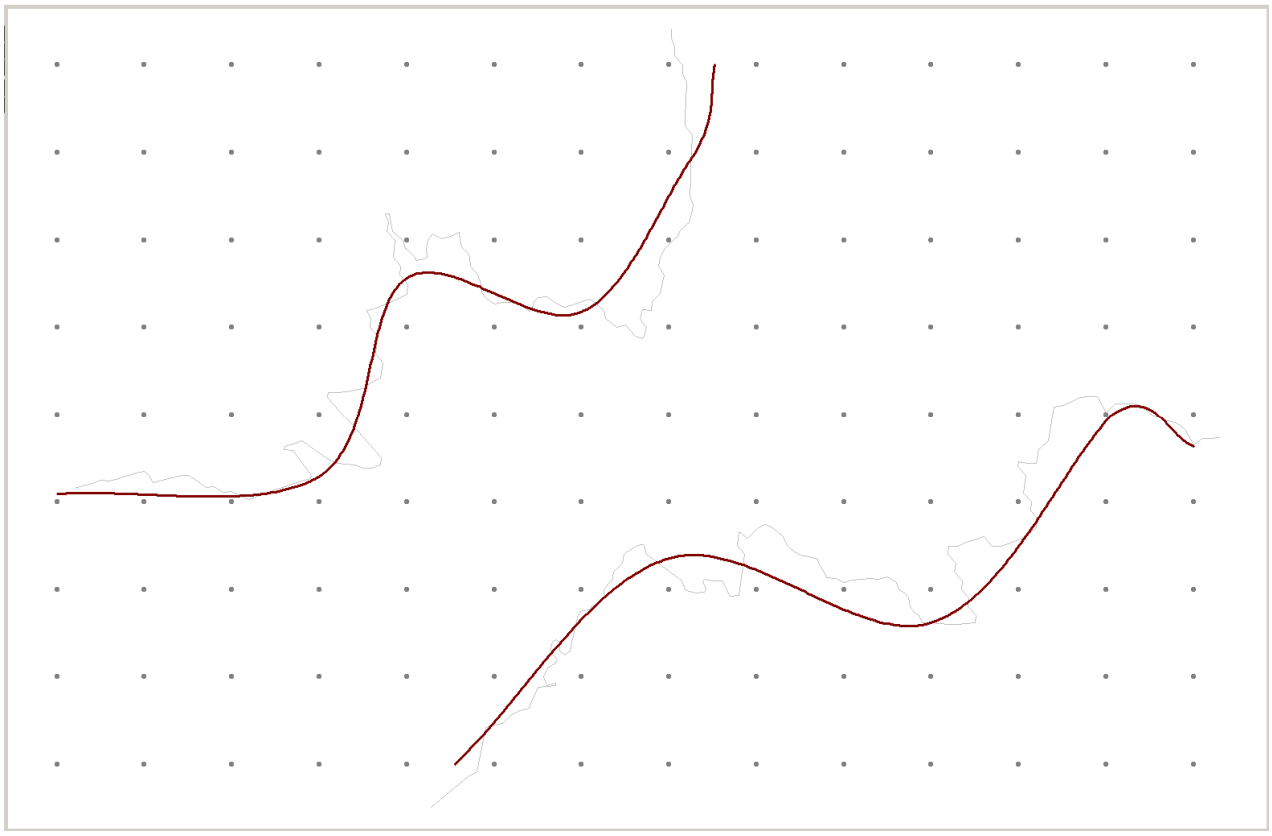

Fig 12 Grid space 5 m, filter width 2,5 m, exact Bezier, step size 0,2 m

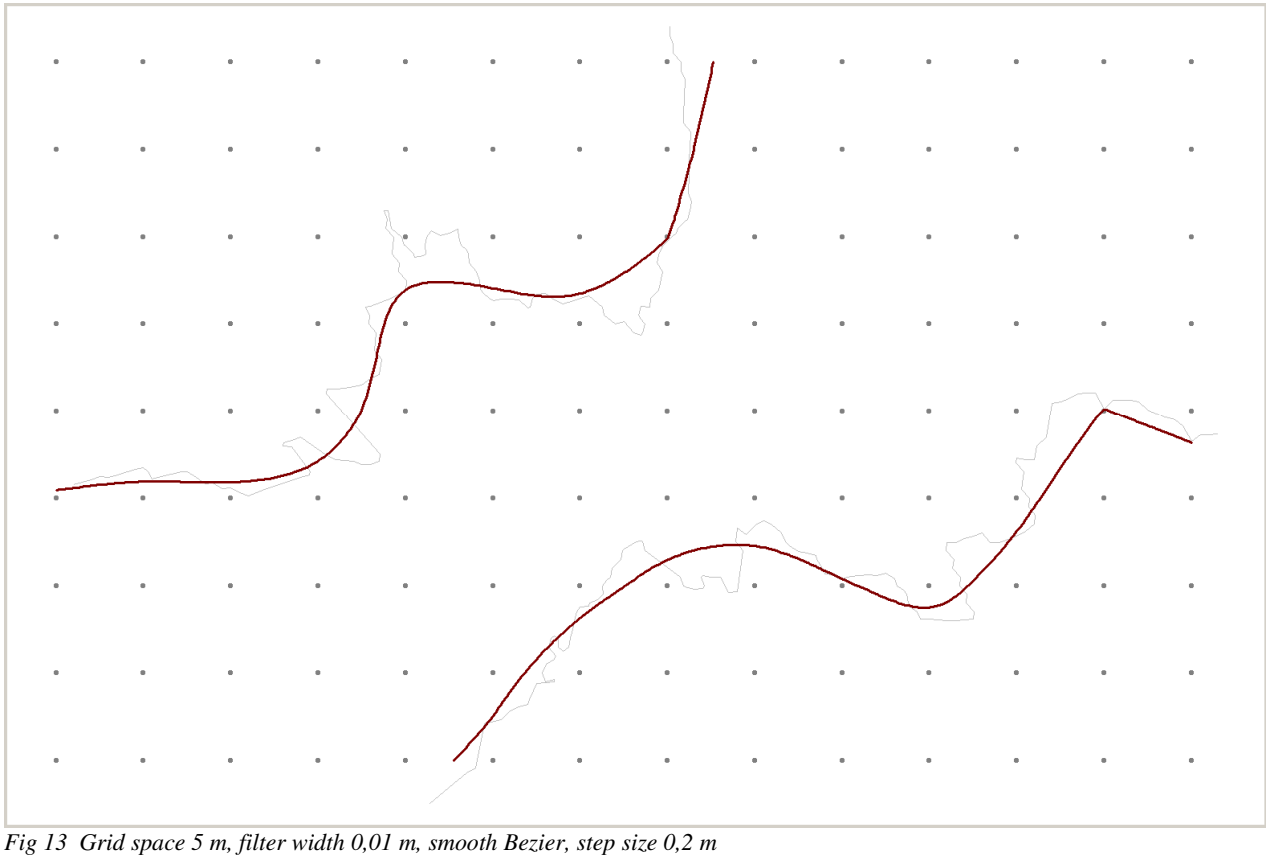

Fig 13 Grid space 5 m, filter width 0,01 m, smooth Bezier, step size 0,2 m

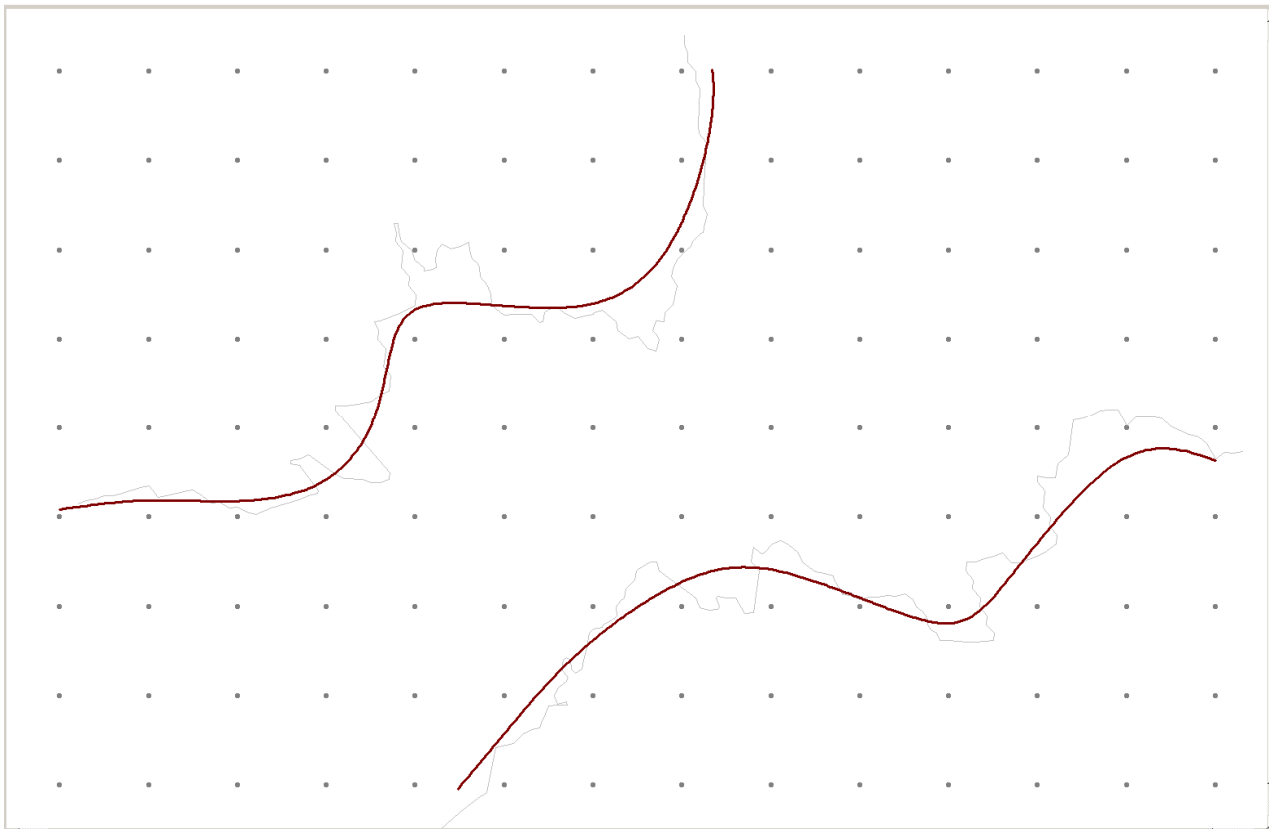

Fig 14 Grid space 5 m, filter width 0,4 m, smooth Bezier, step size 0,2 m

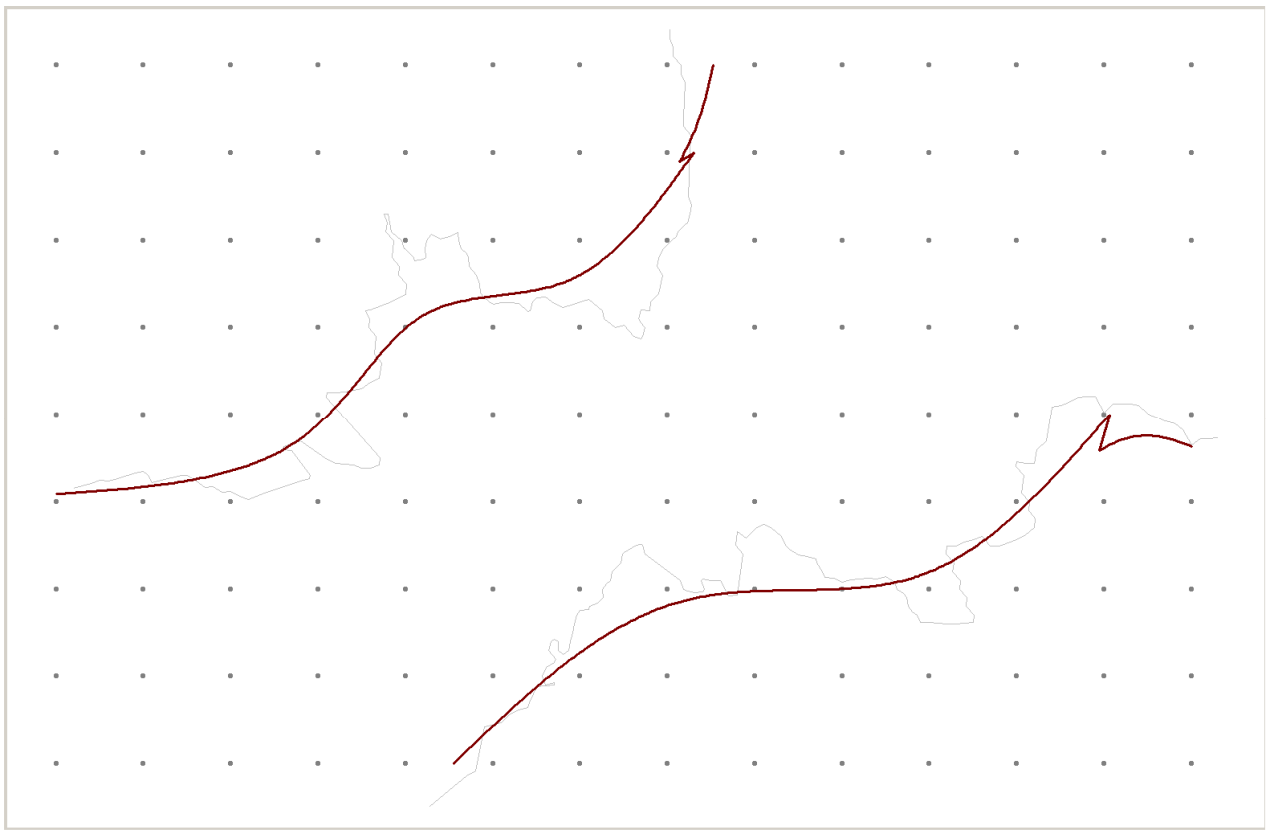

Fig 15 Grid space 5 m, filter width 2,5 m, smooth Bezier, step size 0,2 m

Conclusion:

Drawing contour lines from calculation results obtained in discrete points is pretty much left to the project engineer. It can be done in multiple ways and there are no or very little guidelines to lean upon. In this way you might say that there is no right nor wrong way to do it. If the result looks 'natural' the job is done.

Most contour lines are smoothened to look 'natural'. But a very rugged shape of the contour line is not necessarily 'unnatural'. See for example the 'true values' on Fig 7. However, we are so used to see smoothened contour lines that results from a very detailed calculation might look 'unnatural'.

If you want to draw very precise contour lines, there is no short cut to success: The receiver spaceing must be small. No interpolation, filtering or smoothening can compensate for a coarse receiver spacing.

'No Bezier' produces straight lines between base points which in general will look 'unexpected'.

Filter width should normally be max 10 % of the receiver spacing if the contour lines are smoothened.

Recommended step size depends on the scale of the map. The bigger step size the bigger risk for jagged contour lines. Choose the largest size that still displays the contour lines as smoothened curves.