Contour Simplification with Defined Spatial Accuracy

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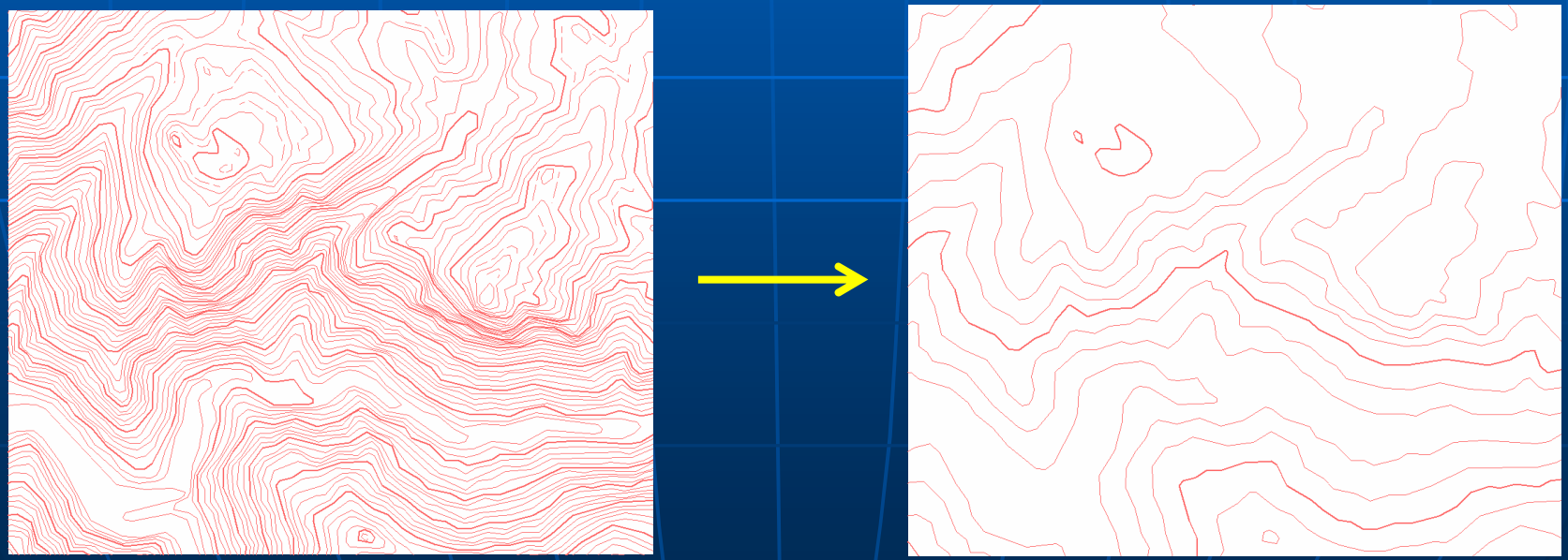
Workshop of the ICA Commission on Map Generalisation and Multiple Representation – June 25th 2006

1. CONTOUR SIMPLIFICATION:

Contours of larger scale maps and datasets can be retrieved through selection process from master datasets or can be derived via using digital terrain elevation models.

The Selection process of contours is not enough by itself for their display at varying scales. The contours should be simplified so as to have cartographically acceptable geometries for the target scale representation.



(25K)

(100K)

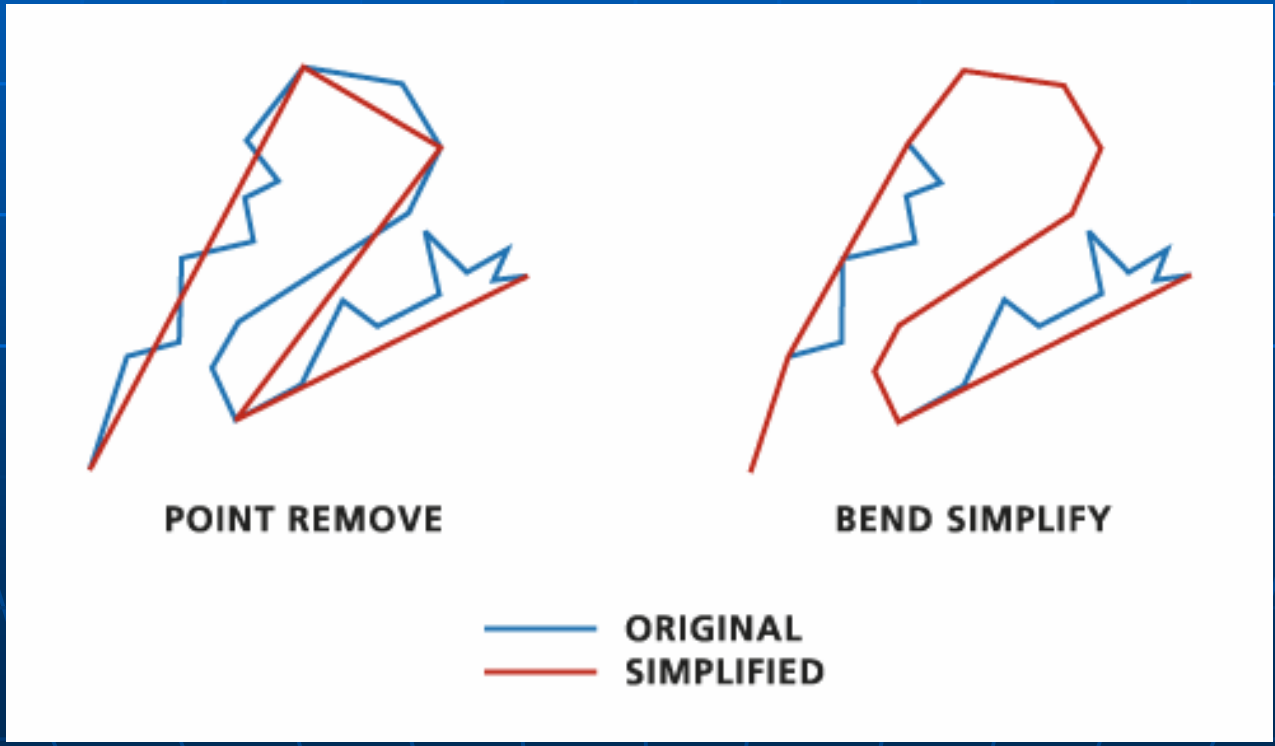
1. CONTOUR SIMPLIFICATION:

There are lots of line simplification algorithms. For contour simplification, suitable algorithms should be applied or developed. In contour simplification, aiming cartographically acceptable geometric shapes or representing geometric shapes with minimum number of points should not only constitute the criteria.

Furthermore, the simplified contours should bear some certain spatial accuracy.

2. HORIZONTAL POSITIONAL ACCURACY:

For the contour simplification being within the defined horizontal positional accuracy, simplification tolerance of line simplification algorithms, such as maximum distance, diameter of a circle, etc., can be used.



ESRI, 2006

2. HORIZONTAL POSITIONAL ACCURACY:

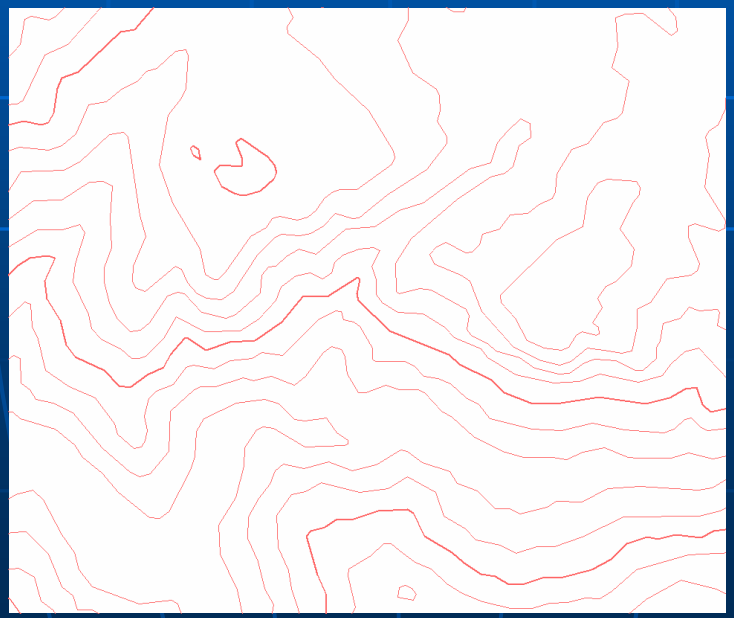
This may not be possible for some line simplification algorithms that use parameters such as deviation angle, etc.

In this case, buffer polygons of contours can be used for this purpose, which are created with a maximum horizontal positional change distance allowable.

3. VERTICAL POSITIONAL ACCURACY:

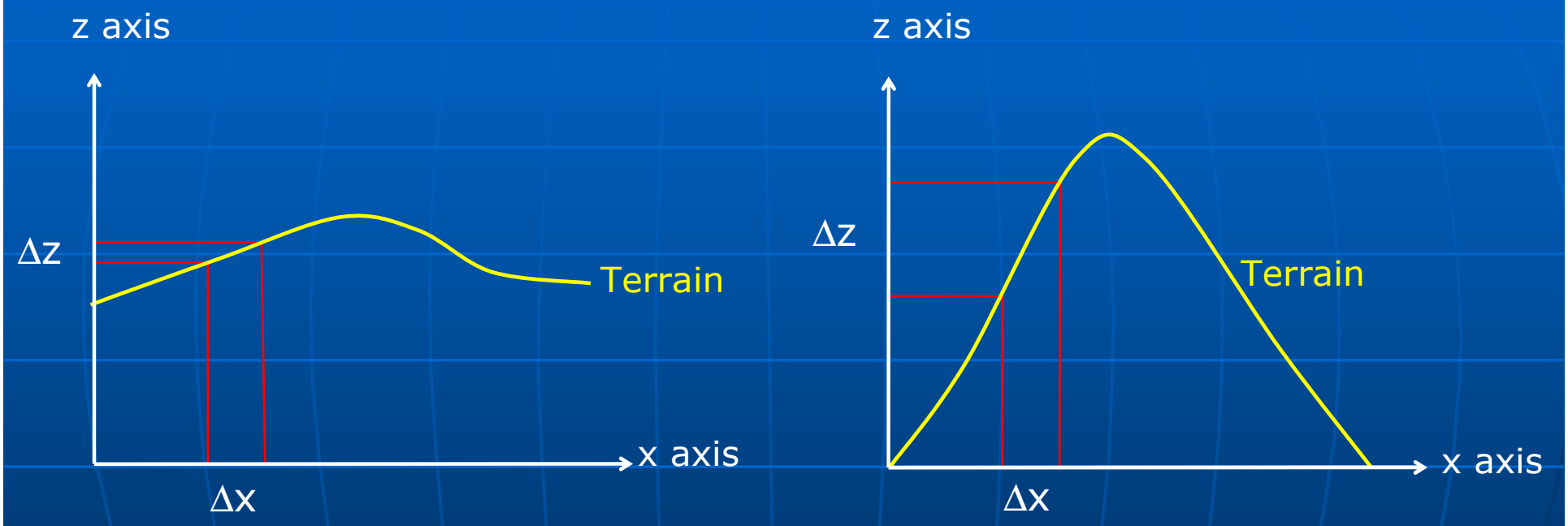
Contours are indeed 3D geometry shapes. Their third dimension is concealed on their geometry.

Horizontal positional changes in contours can cause some serious errors on their vertical positions. This may affect the analysis results made using this data.



(100K)

3. VERTICAL POSITIONAL ACCURACY:



Flat area

Mountaineous area

Profile Views of Terrains

3. VERTICAL POSITIONAL ACCURACY:

In this study, a methodology has been proposed to realize contour simplification within defined horizontal and vertical positional accuracy.

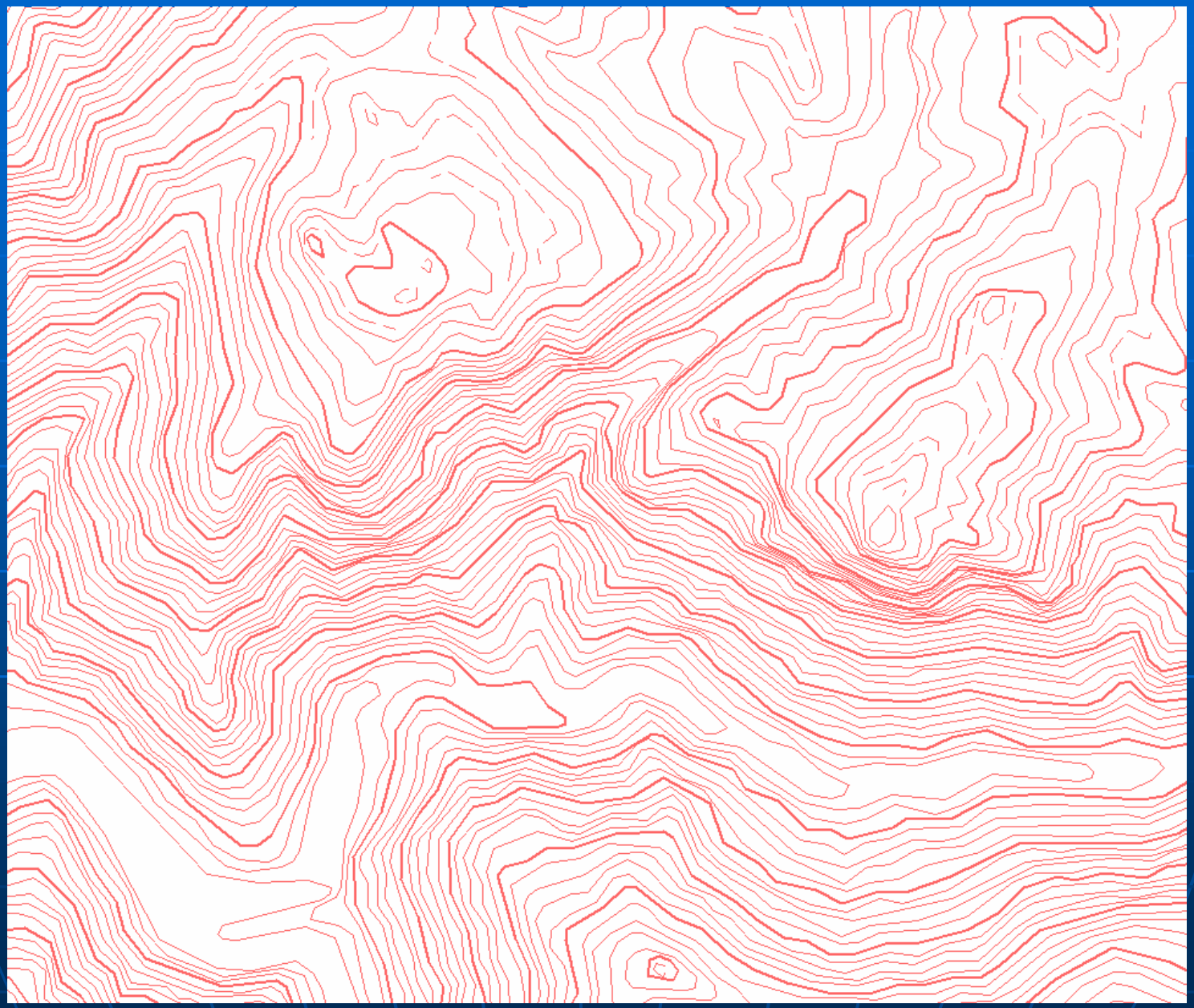
The methodology utilizes error band contours which are derived from digital terrain elevation data for their usage in the simplification of contours within the defined vertical positional accuracy.

Error band contours can be derived for the heights that construct the vertical borders of the error bands and can be used for this aim. Similar approach defined by Lee (2004) can be applied. At first, simplification with the specified tolerance can be applied to the contours and the line-crossings with the error band contours can be checked. If any is detected, then the involved line segments can be marked and a reduced tolerance will be applied to re-simplify these segments.

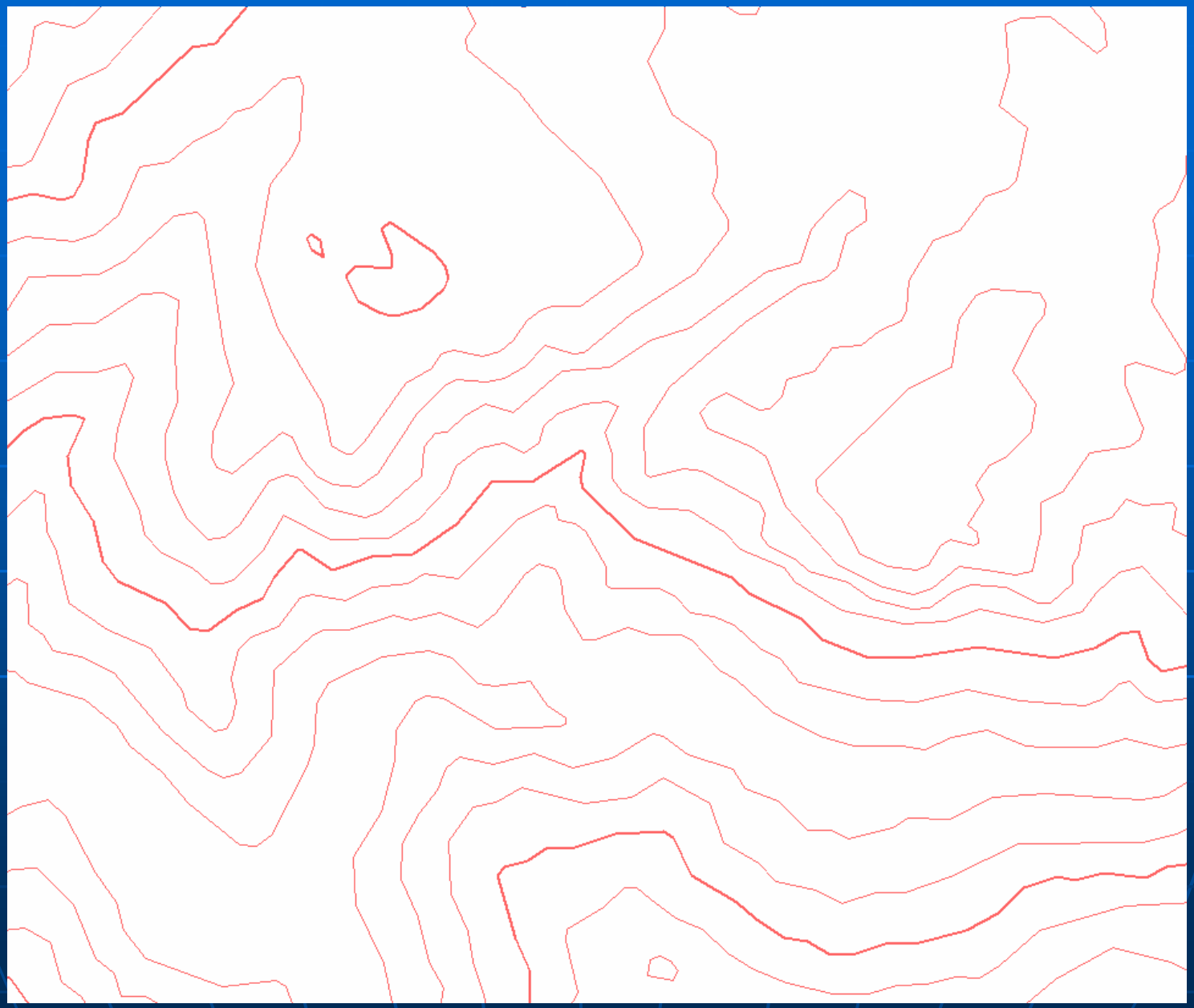
4. APLLICATION:

Contour simplification within defined spatial accuracy has been realized with an application.

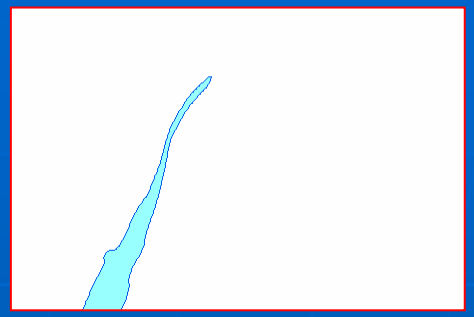
In the application, it is aimed to produce simplified contours for 100K scale topographic maps, using 25K scale contours which constitute the elevation data of master dataset.



25K Contours



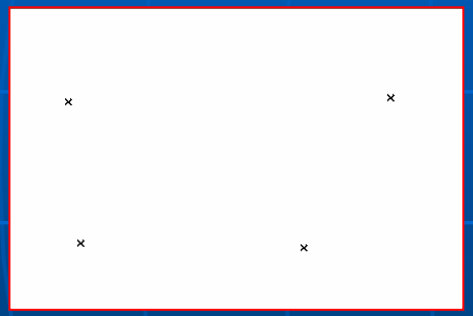
100K Contours



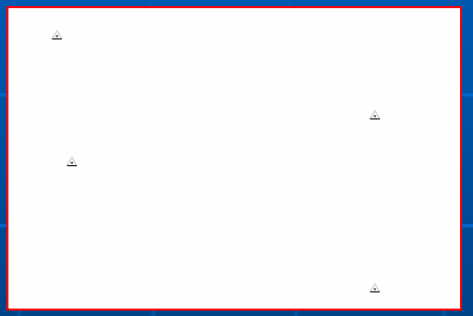
(Lake, Dam -25K)

(River, Stream - 25K)

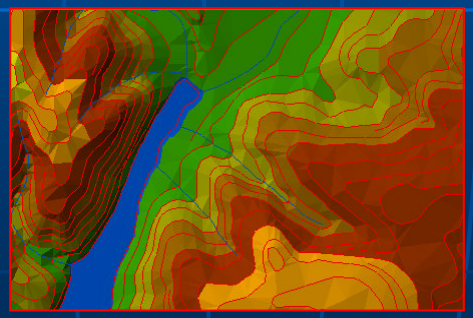
(Contours - 25K)



(Elevation points - 25K)

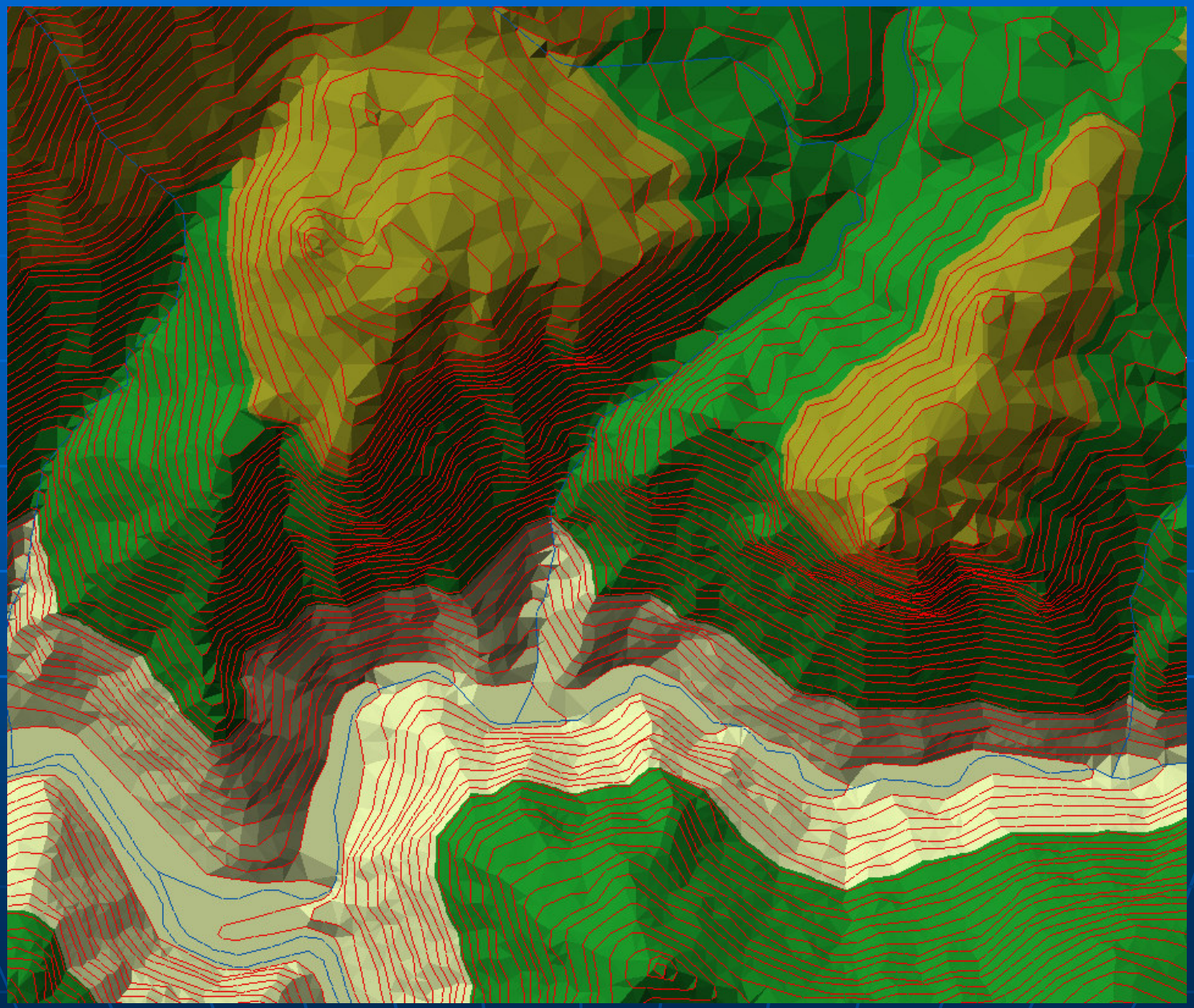


(GCP - 25K)

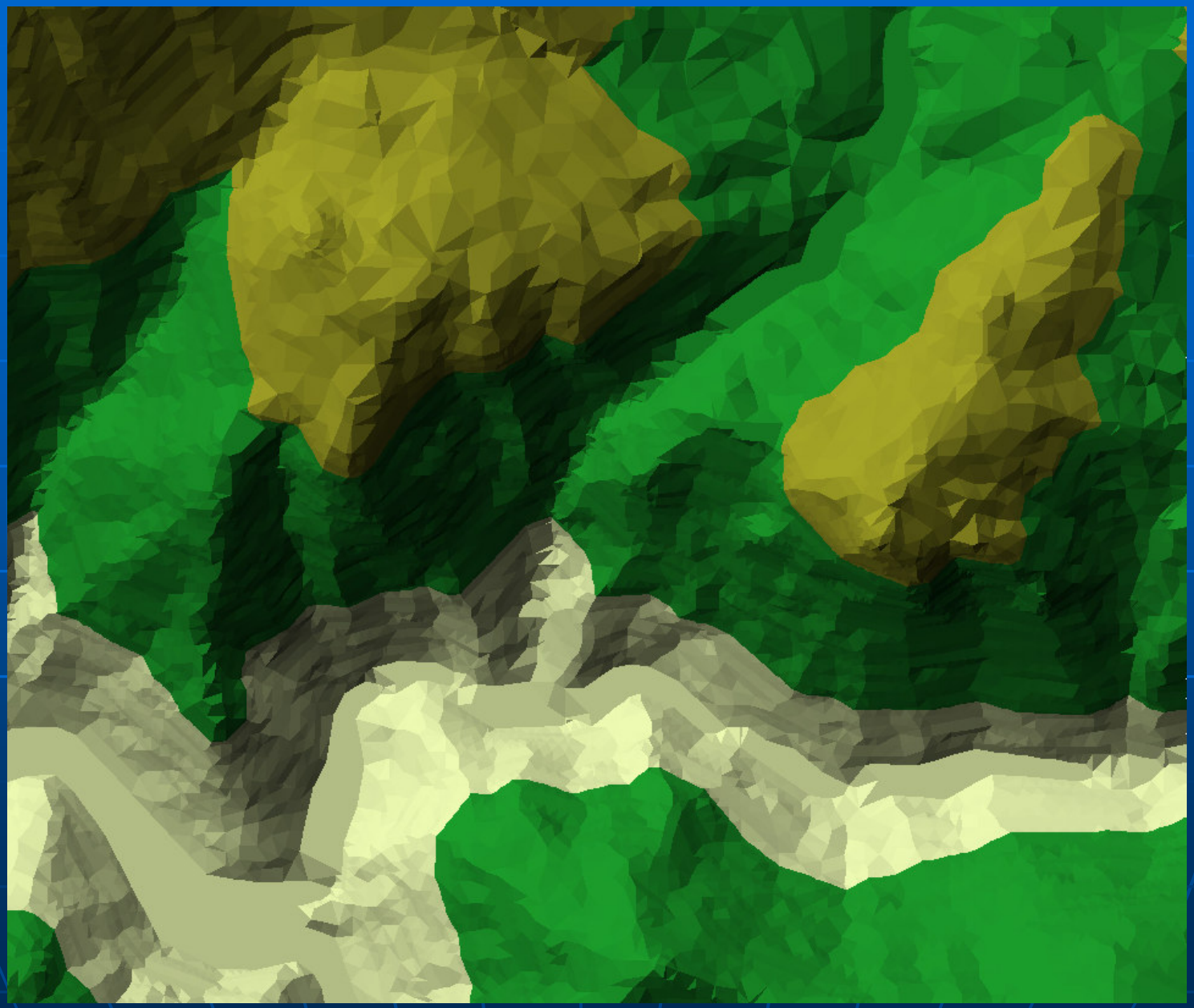


TIN

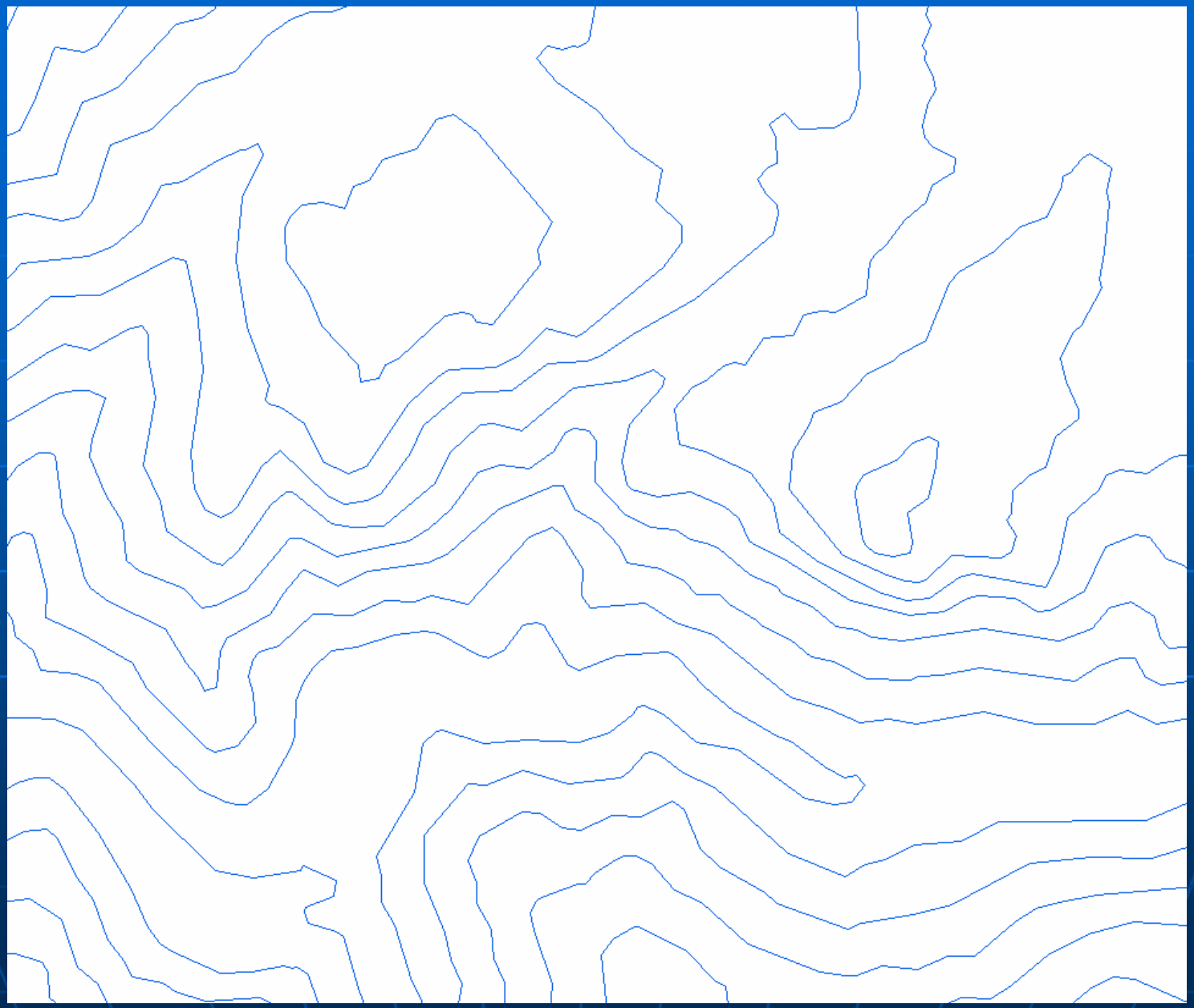
TIN creation using 25K Data



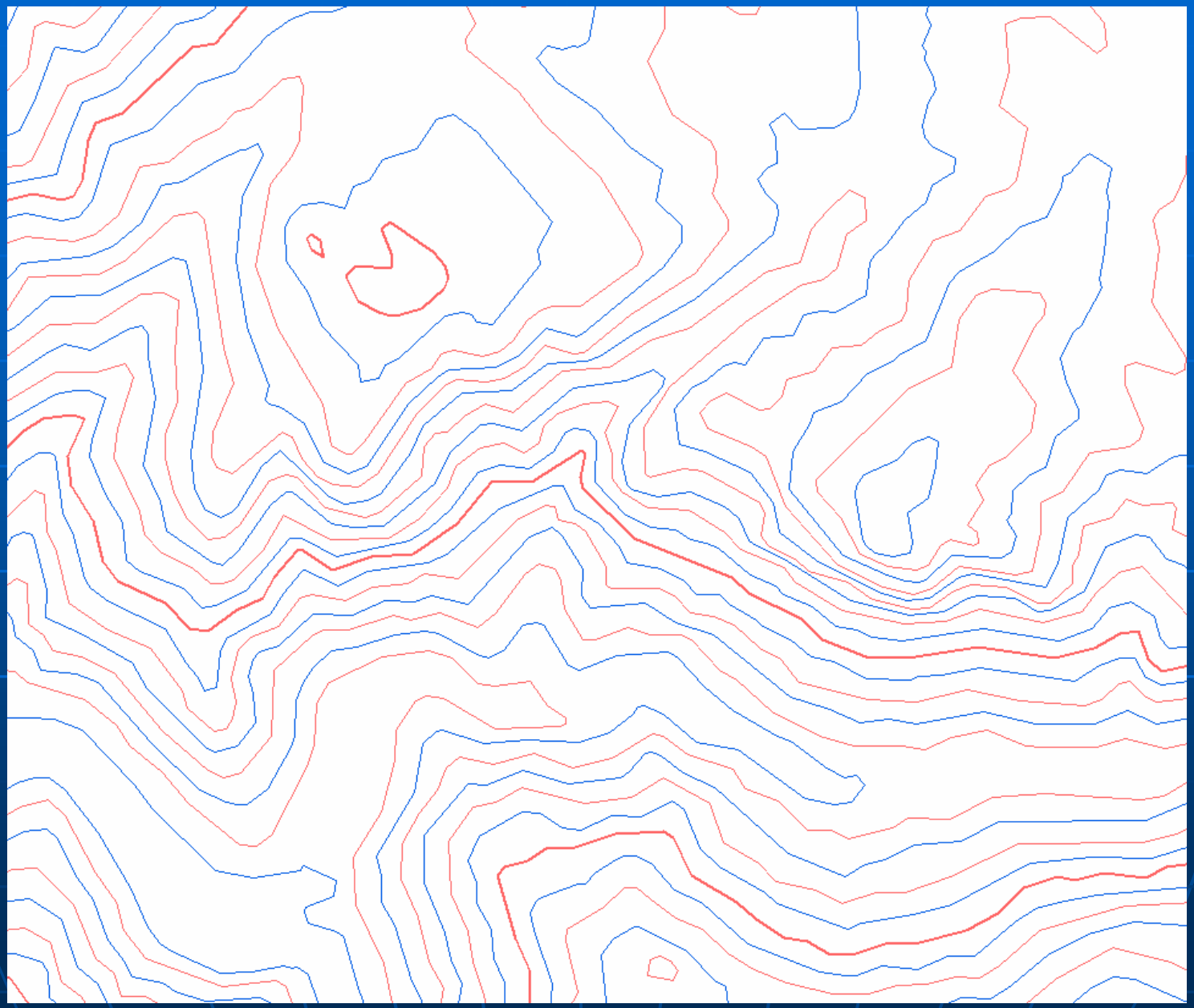
TIN from 25K Data



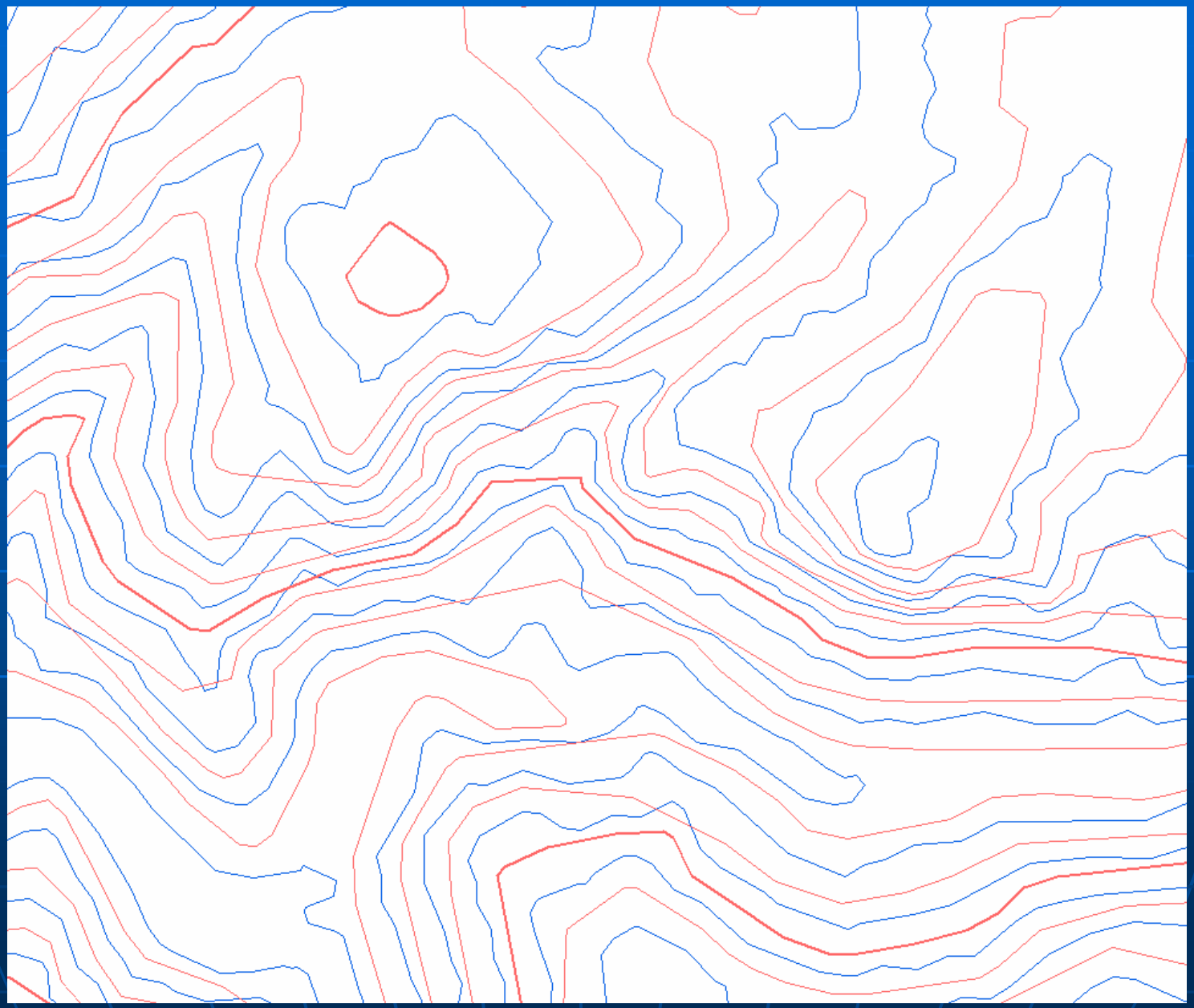
TIN from 25K Data



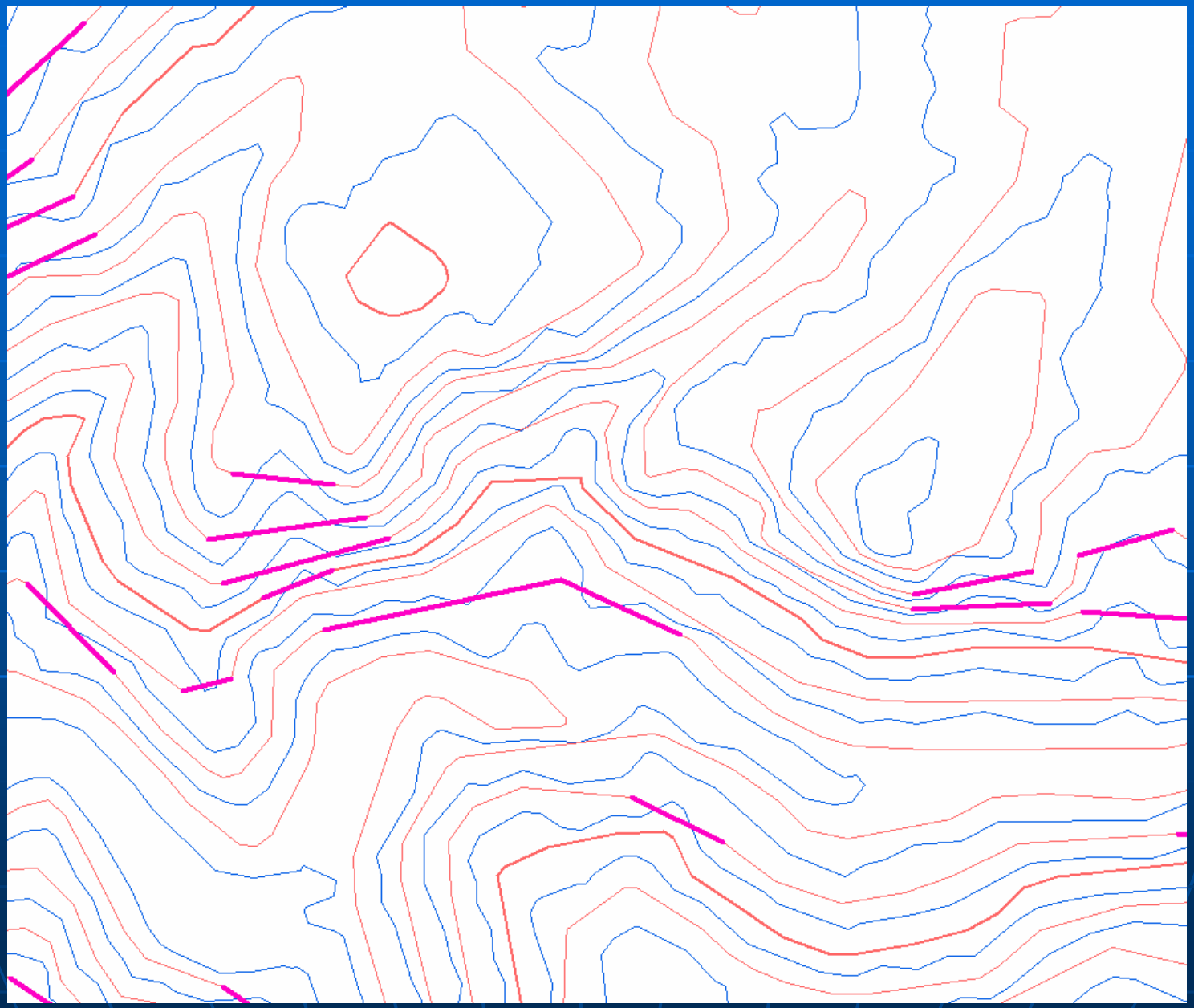
Error Band Contours are derived from TIN



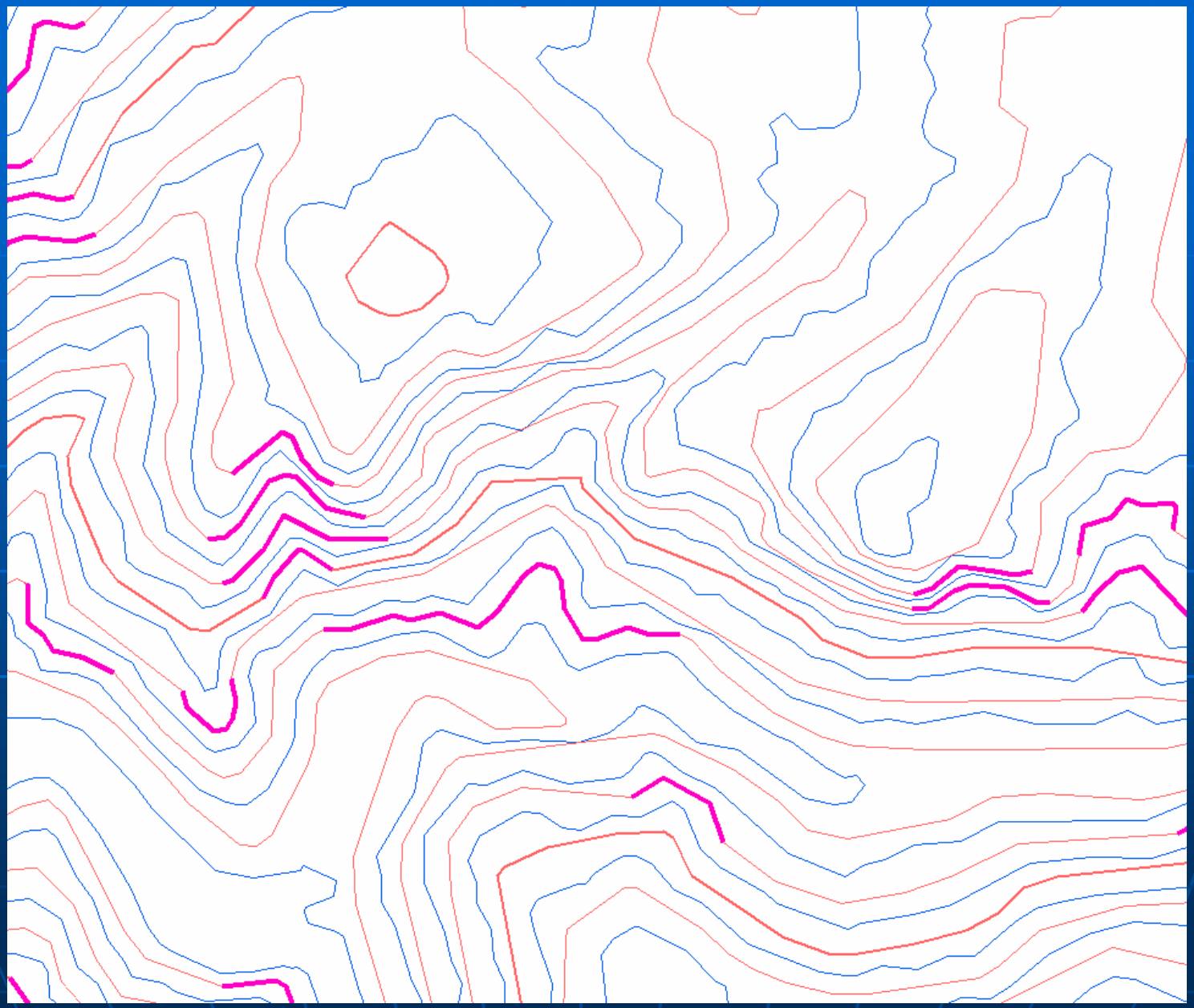
100K Contours with Error Band Contours



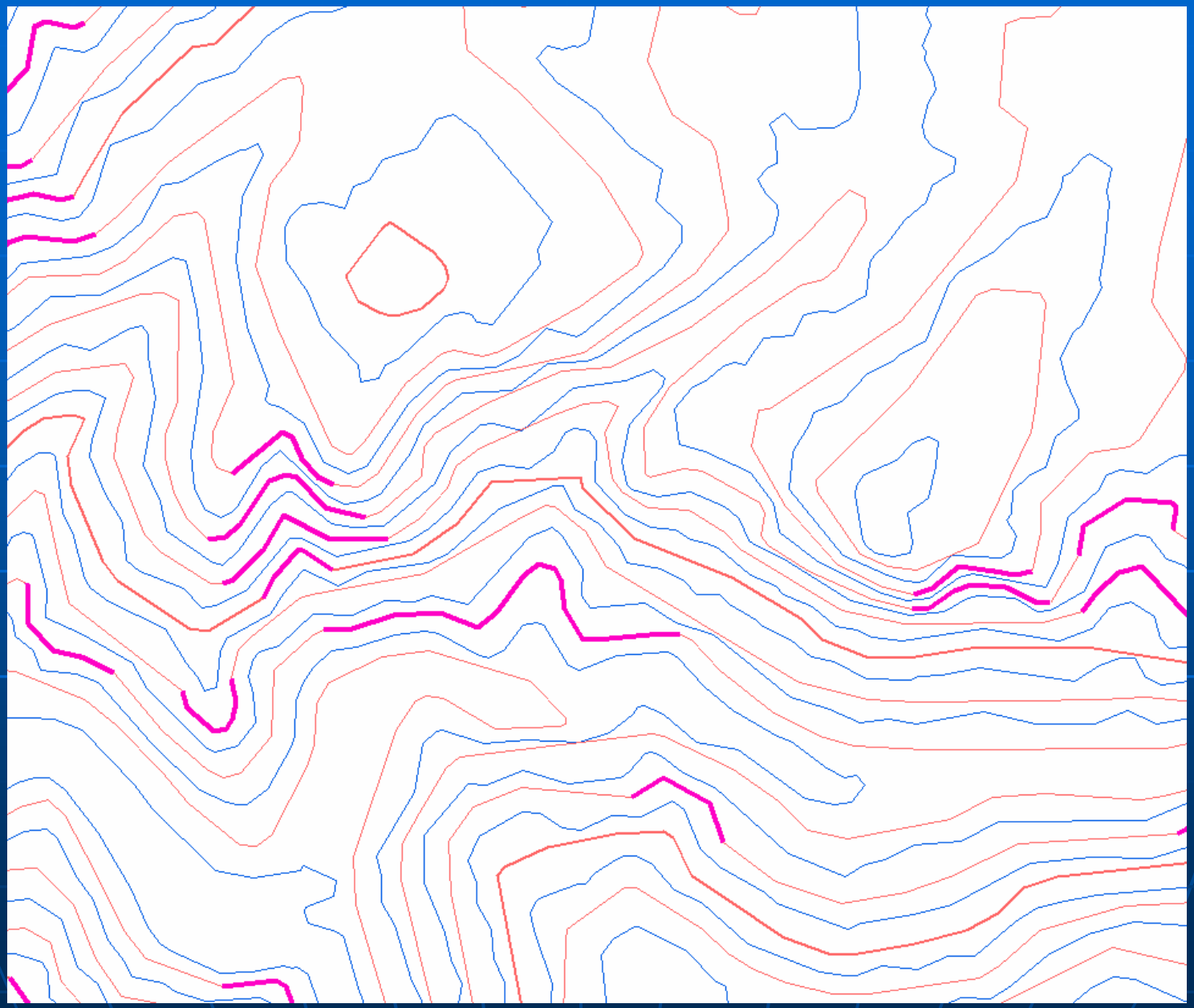
Contour simplification with Bendsimplify (tolerance-160m)



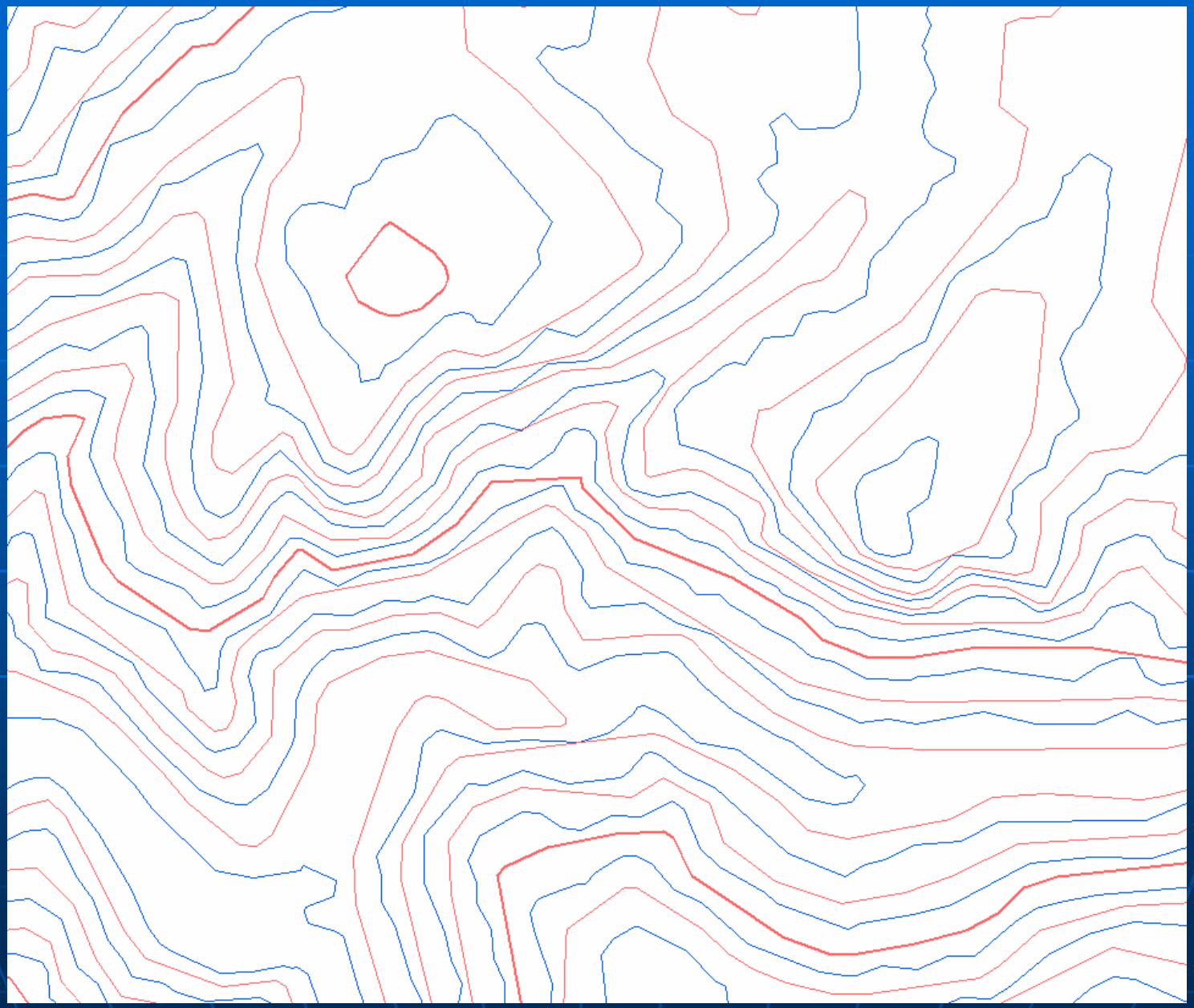
Line-crossings with the error band contours are checked



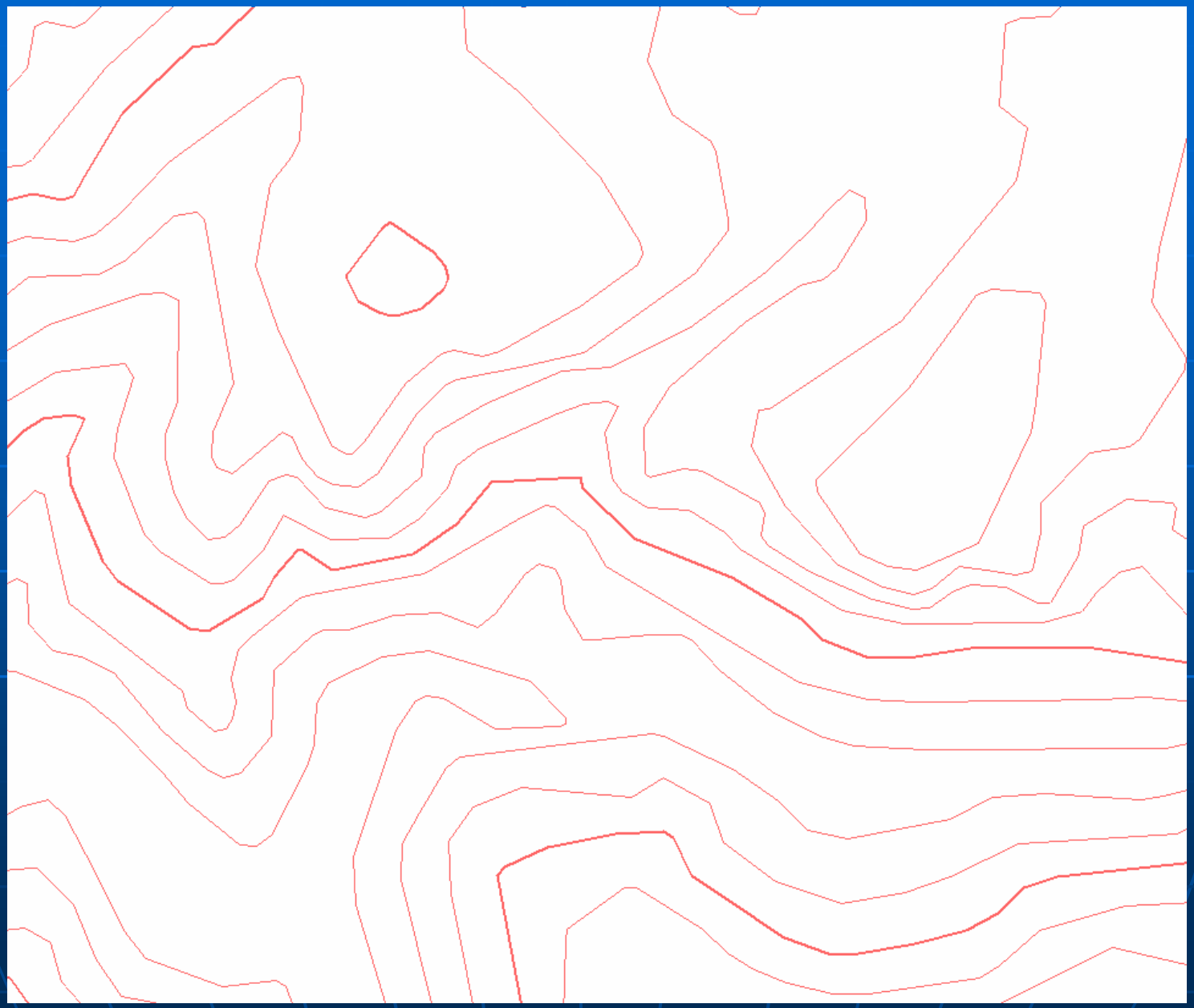
the involved line segments are marked



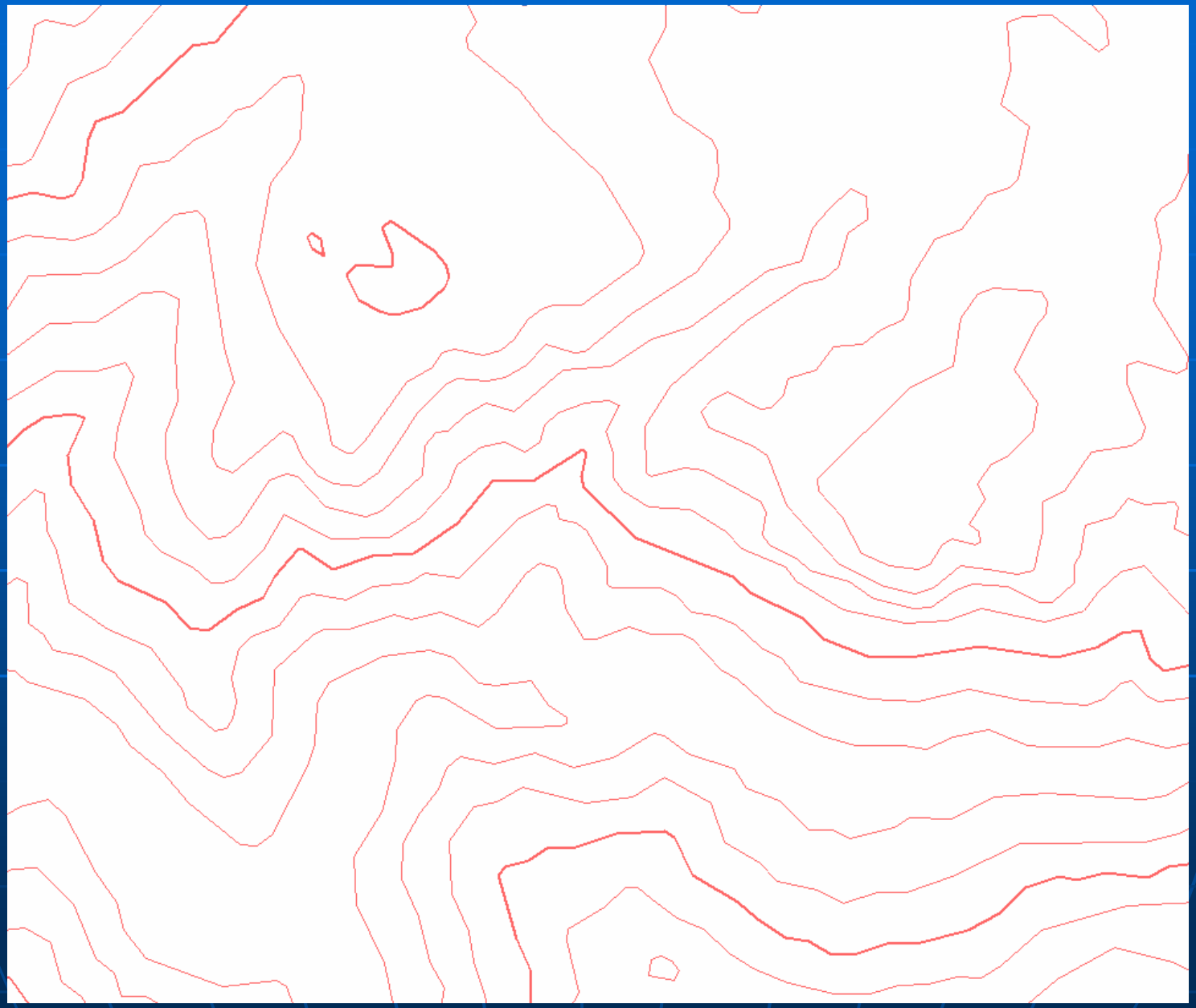
And a reduced tolerance (80m) is applied to re-simplify these segments



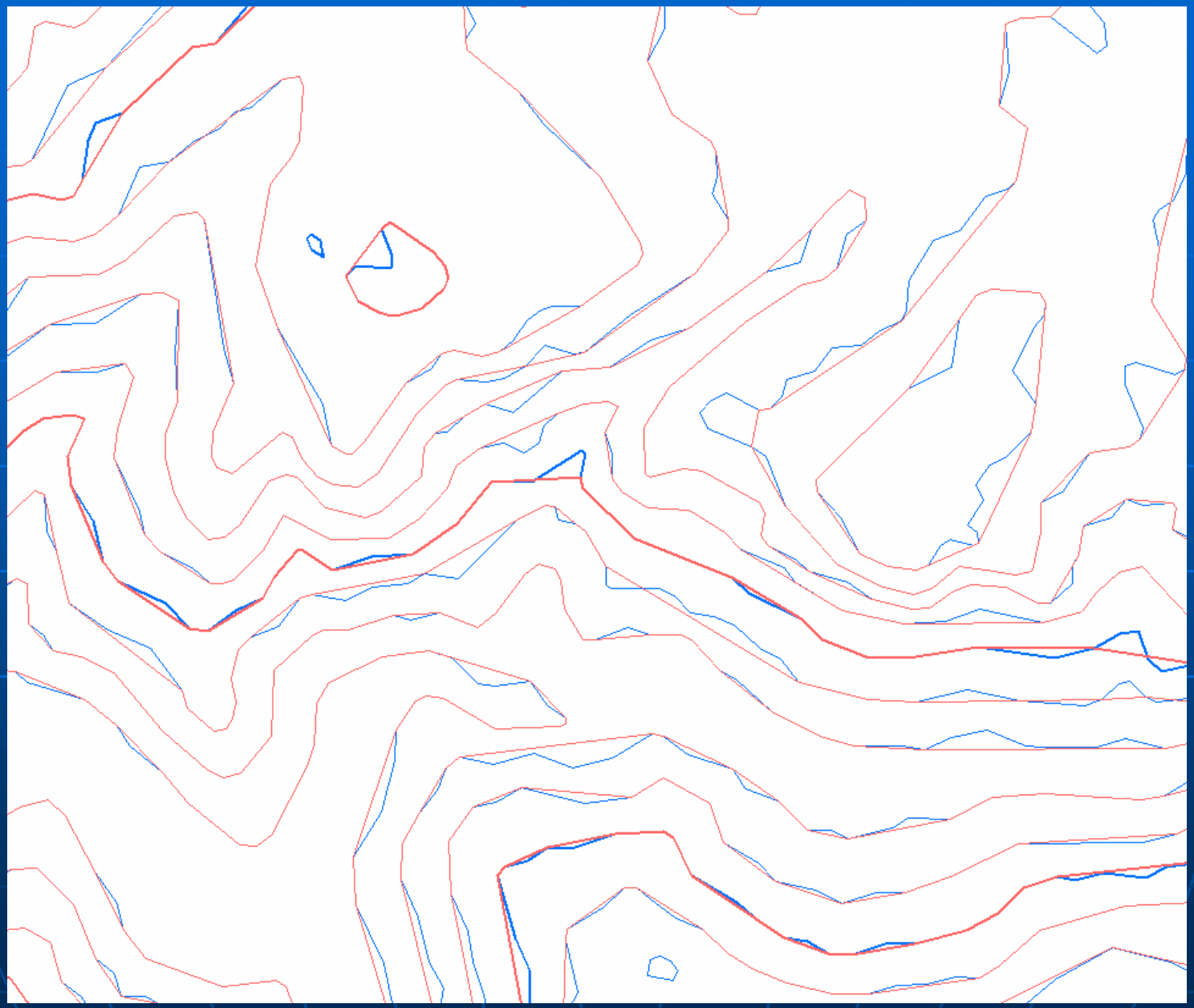
Simplified Contours with Error Band Contours (No line-crossing)



Simplified 100K Contours



25K Original Contours



Comparison

5. CONCLUSION AND RECOMMENDATION:

As a result, maximum horizontal positional changes of contours can be ensured being under defined accuracy by choosing appropriate simplification tolerance. And maximum vertical positional changes of contours can be ensured being within defined accuracy by maintaining simplified contours not crossing the derived error band contours.

Furthermore, selecting maximum vertical error tolerance smaller than the half of the contour interval will automatically avoid topological errors like line-crossings in the simplified contours.

Any line simplification algorithm can be used with this approach. The result of contour simplification will produce cartographically satisfied geometric shapes besides ensuring simplified lines being within defined horizontal and vertical spatial accuracy.

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