Comparative Analysis of several contour line generation methods and softwares

G. Nagy*, Zs. Ungvári†
*Óbuda University, Alba Regia Technical Faculty, Institute of Geoinformatics,
† Eötvös Lóránd University, Faculty of Informatics, Institute of Cartography and Geoinformatics
nagy.gabor@amk.uni-obuda.hu
ORCID ID: 0000-0001-9453-2291
ungvarizs@map.elte.hu
ORCID ID: 0000-0001-6084-2195

***Abstract*—Contour lines are a traditional method of the visualization of terrain. The geographic information systems use digital elevation models, but the visualization of the terrain sometimes needs contour lines which are generated from the digital elevation model. This paper compare and analyze some methods and software which can generate contour line maps from a digital elevation model. The results are compared with other contour line generationg methods and the classical contour line maps.**

***Index Terms*—contour line, digital elevation model, geographic visualization**

I. Introduction

The contour lines are a frequent method to show the terrain surface. In the past, the classical paper-based maps stored the knowledge about the terrain elevation in this way. Nowadays, we create contour line maps from the digital elevation models for visualizing the elevation.

In this paper we study some program and method, and analyze the created contour lines.

II. Source data and the study sites

The study based on an 25 meter resolution digital elevation model, which covered the (400000, 0) and (1000000, 400000) positions in the hungarian national grid (EOV). The elevation model was made from SRTM[1], [2] (Shuttle Radar Topography Mission) one arcsec (about 30.9 and 21 meters in this latitude) resolution filled[3] dataset. This dataset contains total area of Hungary and some territory of the surrounding countries.

We chose twenty study sites in this dataset, in different topography regions. The Figure 1. shows the location of these study sites and the Table I. gives the corner coordinates and the countour line interval, which will be applied in the following studies. The study sites are not only from Hungary, some mountain area (1, 12, 18) are from neighbouring countries. Every study sites is an 5000x5000 meters square.

III. Data processing

Contour lines are generated by different software and options. The created contour lines are stored in SHP (shape) files.

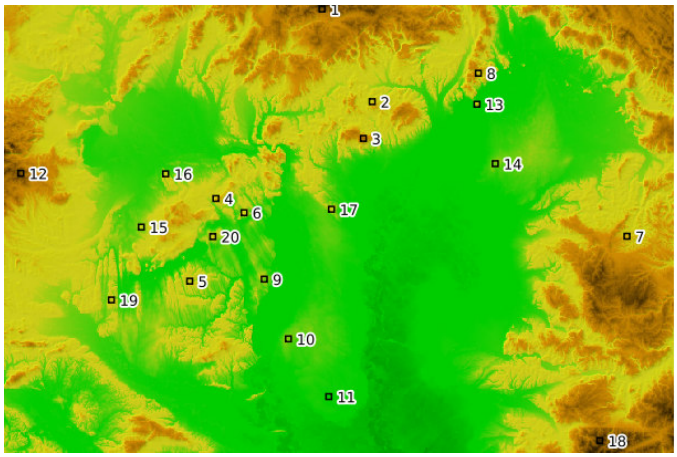

Figure 1. The study sites with the site number and the 5x5 km squares of these areas. The southwest corner is the (400000,0) and the northeast corner is the (1000000,400000) point in the Hungarian National Grid (EOV)

Table I
The location of the study sites and intervals of contour lines

id	minY	minX	maxY	maxX	interval
1	682300.0	394500.0	687300.0	399500.0	50.0
2	727300.0	311500.0	732300.0	316500.0	20.0
3	719400.0	278600.0	724400.0	283600.0	25.0
4	587200.0	224800.0	592200.0	229800.0	10.0
5	563800.0	150800.0	568800.0	155800.0	5.0
6	612500.0	212100.0	617500.0	217100.0	10.0
7	955600.0	191000.0	960600.0	196000.0	10.0
8	822400.0	337000.0	827400.0	342000.0	20.0
9	630600.0	152600.0	635600.0	157600.0	5.0
10	652200.0	99100.0	657200.0	104100.0	5.0
11	688400.0	47400.0	693400.0	52400.0	5.0
12	412400.0	247400.0	417400.0	252400.0	50.0
13	821200.0	309200.0	826200.0	314200.0	20.0
14	837600.0	256000.0	842600.0	261000.0	5.0
15	520400.0	199200.0	525400.0	204200.0	20.0
16	542200.0	246900.0	547200.0	251900.0	10.0
17	690800.0	215200.0	695800.0	220200.0	10.0
18	931200.0	8000.0	936200.0	13000.0	50.0
19	493600.0	134000.0	498600.0	139000.0	10.0
20	584500.0	190700.0	589500.0	195700.0	5.0

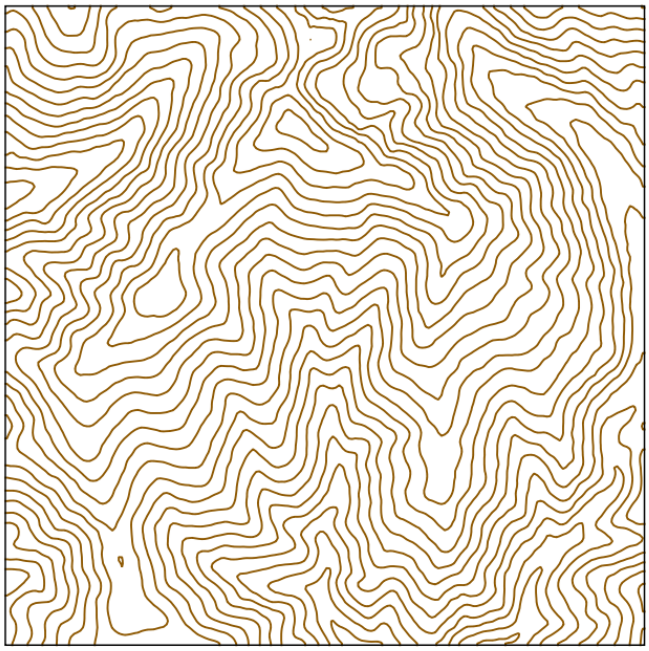

Figure 2. Contour lines in site 1, generated by GDAL `gdal_contour` program

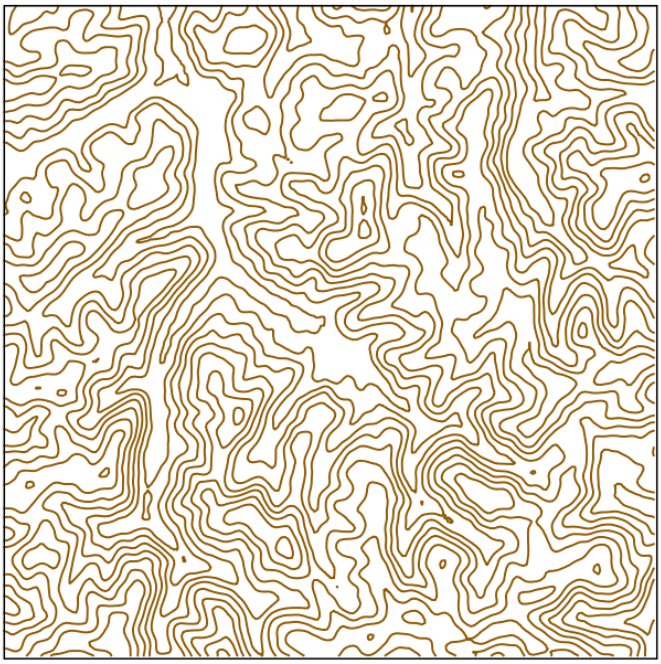

Figure 3. Contour lines in site 2, generated by Global Mapper program

The first set of contour lines is the `gdal_countour` program from the GDAL[4] (Geospatial Data Abstraction Library). This is an element of an open source toolkit, the program can be used in command line. Some other program (for example QGIS) use this tool for creating contour lines from an elevation model. (An example in the site 1 is in the Figure 2.)

We also have created countour lines with Global Mapper[5]. The second set of contour lines was created with default setting. (An example in the site 2 is in the Figure 3.)

The third set of countour lines was created with the the smooth option. This option provides curved countour lines. (An example in the site 7 is in the Figure 4.)

IV. Comparative Analysis

We can see some difference between the contour line sets. The difference is smaller in the mountain areas, for example in Figure 6., and bigger in plains, for example in Figure 8.

The hills (see in Figure5.) are between in the mountains and plain areas. The Figure 7. presents different regions in one view (mountains is east part, and areas with smaller slope angles in west).

We also compare the generated contour lines with classical topographic maps, the 1:10000 scale “civilian” maps, in the tile number 54-242. Figure 9. and Figure 10. show these comparsions.

The left sides of these figures are the classical topography maps (which contains more content than the contour lines), and the right sides are the gdal_contour generated contour lines.

The topography map made from an different elevation model, this may cause mostly the differences.

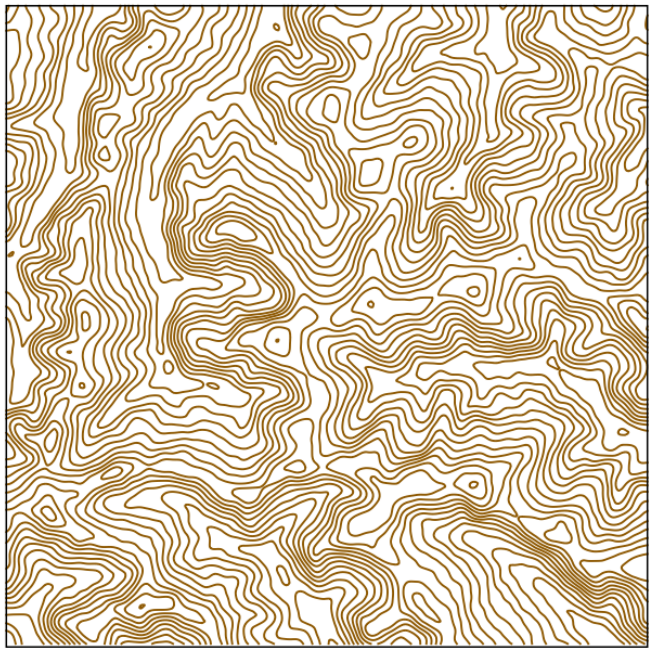

Figure 4. Contour lines in site 7, generated by Global mapper program with smooth option

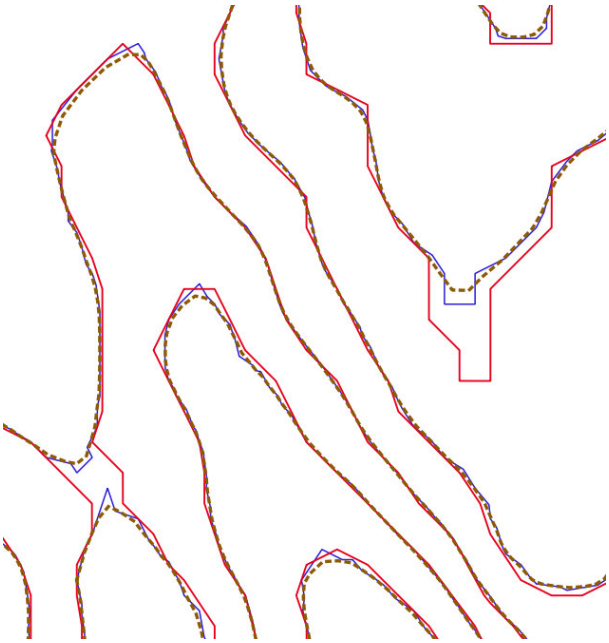

Figure 5. Different contour lines with 5 meter interval in a part of site 5 (approx 566500, 154100 EOV coordinates). The red line is from the `gdal_contour`, the blue is from the Global Mapper. The brown dotted line is the smoothed version of the Global Mapper contours.

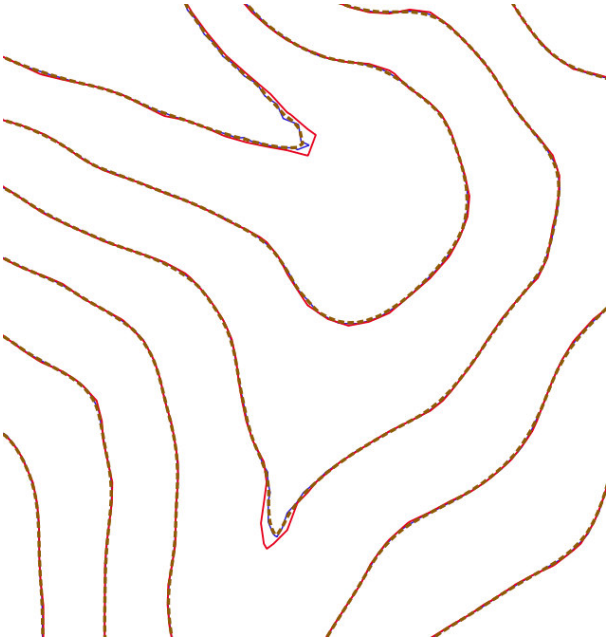

Figure 6. Different contour lines with 50 meter interval in a part of site 1 (approx 685800, 397600 EOV coordinates). The red line is from the `gdal_contour`, the blue is from the Global Mapper. The brown dotted line is the smoothed version of the Global Mapper contours.

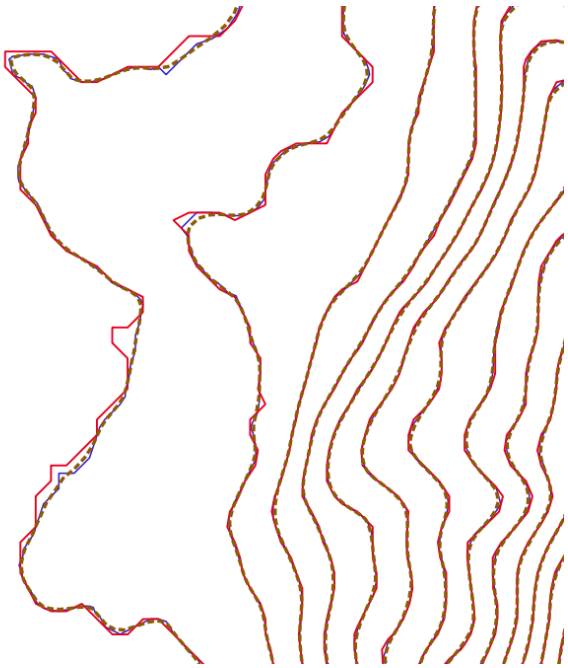

Figure 7. Different contour lines with 10 meter interval in a part of site 4 (approx 588200, 228600 EOV coordinates). The red line is from the `gdal_contour`, the blue is from the Global Mapper. The brown dotted line is the smoothed version of the Global Mapper contours.

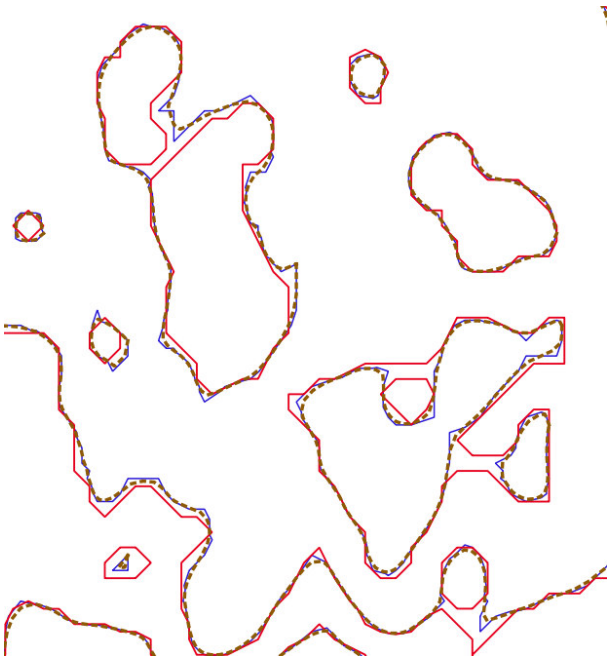

Figure 8. Different contour lines with 5 meter interval in a part of site 14 (approx 840500, 258300 EOV coordinates). The red line is from the `gdal_contour`, the blue is from the Global Mapper. The brown dotted line is the smoothed version of the Global Mapper contours.

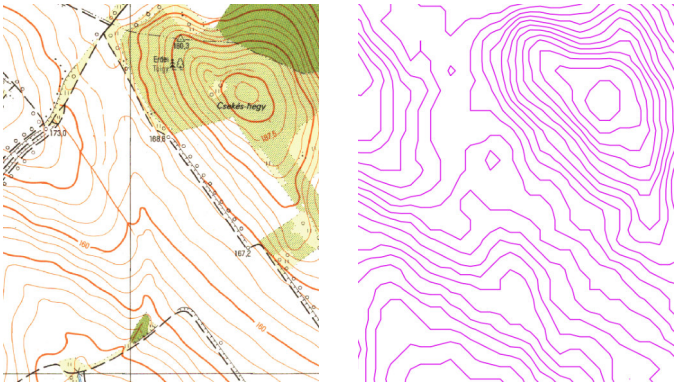

Figure 9. Contour lines in a topographic map (1:10000 scale), and generated by `gdal_contour` from STRM model. The interval of contour lines is 2.5 meters on both maps

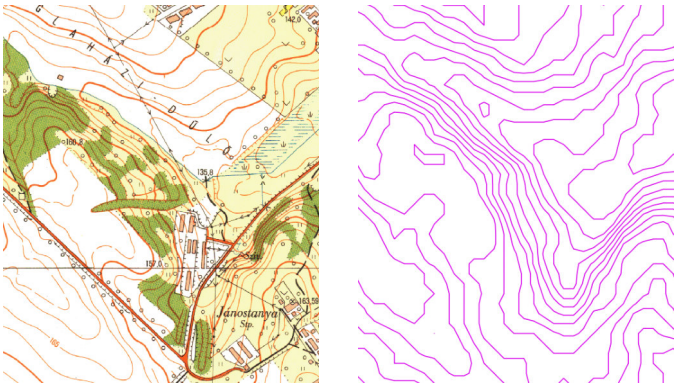

Figure 10. Contour lines in a topographic map (1:10000 scale), and generated by `gdal_contour` from STRM model. The interval of contour lines is 2.5 meters on both maps

V. Conclusion

The contour lines, which have been created by different programs or parameters, have some differences. The differences are larger in plain areas, the contour lines in mountain regions (larger slope angle) are very similar from different methods.

Smoothing options can create better look, because the classical contour lines (and the real terrain) is also smoothed.

The optimal settings of the contour line generation is depend from the terrain of the visualized area.

References

[1] J. J. Van Zyl, "The Shuttle Radar Topography Mission (SRTM): a breakthrough in remote sensing of topography," *Acta Astronautica*, vol. 48, no. 5, pp. 559–565, 2001.

[2] E. Rodriguez, C. S. Morris, and J. E. Belz, "A global assessment of the SRTM performance," *Photogrammetric Engineering & Remote Sensing*, vol. 72, no. 3, pp. 249–260, 2006.

[3] A. Jarvis, H. I. Reuter, A. Nelson, E. Guevara *et al.*, "Hole-filled SRTM for the globe Version 4," *available from the CGIAR-CSI SRTM 90m Database (http://srtm. csi. cgiar. org)*, 2008.

[4] F. Warmerdam, "The geospatial data abstraction library," in *Open source approaches in spatial data handling*. Springer, 2008, pp. 87–104.

[5] D. B. Rahe, "Product review: Global mapper gis software," *Soil Survey Horizons*, vol. 49, no. 2, pp. 40–40, 2008.