

Georeferencer X – Tool for Automatic Georeferencing of the Topographic Maps

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Keywords: Automatic Georeferencing, Ground Control Points, Scanned Maps, OpenCV, GDAL

Abstract:

A military topographic map of Serbia on the scale of 1:25 000, published by the Military geographical institute in the second half of the 20th century, represents a valuable secondary data source in the manufacture of the modern digital topographic maps. The primary source of geospatial data for the production of the digital topographic maps is high-resolution digital aerial photogrammetric images, the digitalized and georeferenced topographic maps are used to improve the interpretation of images and easier classification of geographical elements.

Old military topographical maps are valuable historical cartographical heritage, especially as an example of the standardized production of a series of maps. Since, the map frame was designed in accordance with (Peterca et al., 1974), each map sheet has the same frame.

This paper presents the Georeferencer X – tool for automatic georeferencing of scanned sheets of topographic maps. Due to the homogeneity of the map sheets production process, this method can be used for georeferencing entire topographic map editions.

Georeferencer X was implemented by using Python programming language including OpenCV (Computer Vision) library for identification of Ground Truth Points (GCP) and GDAL (Geospatial Data Abstraction Library) library for georeferencing. Automatic georeferencing is based on the identification of map content corner points and assigning adequate geographical coordinates to those points as GCP points, which is made by detection of frame corners with added constant empirical pixel difference. Identification of GCP points was done two steps. In the first step, the best matching between scanned maps and markers representing frame corners was performed in order to enable a rough determination of the image coordinates of the endpoints of the map sheet.

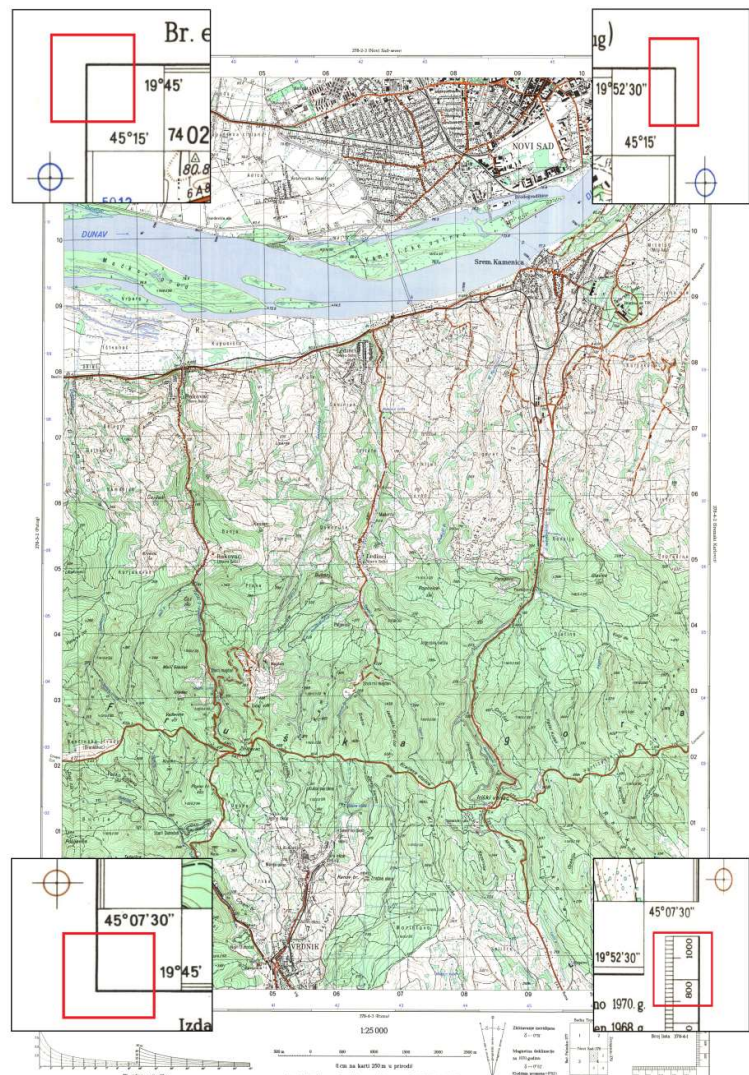


Figure 1. Topographic map sheet 1:25 000 with highlighted sample marks used to identify the endpoints of the map sheet.

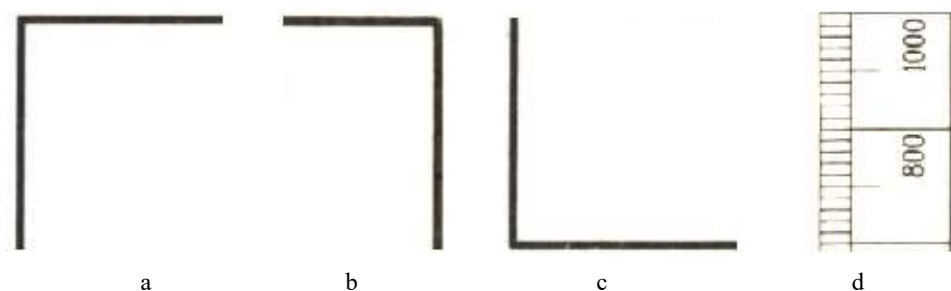


Figure 2. Samples for identifying the corners of the map sheet (a - northwest corner, b - northeast corner, c - southwest corner, d - southeast corner).

In the second step, the matching process was repeated to provide the best matching between detected GCP points and closely located markers representing the intersection of the meridian and parallels (map content corner points). The process is performed individually for each point so that precise coordinates of the endpoints of the map sheet are obtained.

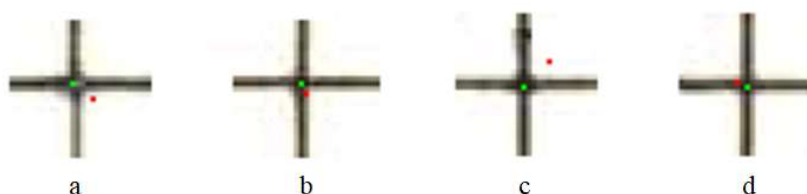


Figure 3. Examples of rough (red pixel) and precise (green pixel) locating the end points of the map sheet (a - northwest point, b - northeast point, c - southwest point, d - southeast point).

The georeferencing is performed by assigning the geographical coordinates to the detected endpoints based on the known coordinate domain for each map sheet. The coordinates of the north-western endpoint of the map sheet are calculated from the nomenclature number of the map sheet, which is taken from the file name of the scanned map, and defined coordinate differences are added to it.

With minor changes, the tool can be applied to other types of maps as well as to various cartographic editions scanned at the same resolution. The changes would be reflected in the taking of other specific samples from the maps as well as in the finding empirical measures for locating pixels of interest.

As manual georeferencing of a large number of map sheets with four points is a time and labor-intensive process, automatic georeferencing is performed in a few seconds per map sheet without human interaction. Sheets of topographic maps georeferenced by an automatic tool have shown satisfactory accuracy for use in production processes. Since the usage of existing topographical maps, as a relevant data source during the production of the digital topographic map, has been based on manual georeferencing it is expected that Georeferencer-X improve and speed up the map-making process.

References

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