

Georeferencing of Historical Military Mappings and Later Map Internet Publishing

J. Cajthaml

`jiri.cajthaml@fsv.cvut.cz`

Department of Mapping and Cartography, Faculty of Civil Engineering, Czech Technical University, Thákurova 7, 166 29 Prague, Czech Republic

Old maps are valuable source of information about our landscape. It is very important to make these data accessible for as many experts as we can. There are some possibilities how to do that. It has been published [1], that the best way how to make this data more accessible, is to scan original maps, georeference them and publish them within the frame of web map services. I am interested in this field of study for 3 years. I would like to present results of my work in every part of this process.

In the beginning there must be data. If I am talking about old maps from the area of Czech republic, I am focused on historical military mappings of Austria-Hungarian Empire. Older maps are not suitable for georeferencing, because of their scale and preciseness. Historical military mappings were created for the whole empire in 18th and 19th century.

1st military mapping was first systematic geodetic survey in Austria-Hungarian Empire. It was done in the Czech lands in 1764-1768. The scale of maps is 1 : 28 800. Unfortunately, graphical base for these maps were enlargements of older Müller maps, no geodetic measurement was done. Therefore, maps are very imprecise. I was trying to georeference these maps using some identical points on the map. The result was similar to other research done [2]. The positional accuracy of these maps is about hundreds meters (from 200m to 1000m depending on map sheet).

2nd military mapping was done in the Czech lands in 1819-1858. The mapping has been preceded by trigonometric measurement for cadastral survey. Therefore, these maps are much more precise than 1st military mapping. For the area of Czech republic, 2 coordinate systems were used (11 for the whole empire). The scale of maps is 1 : 28 800. In every coordinate system every map has round coordinates of corners of map sheet. If we found transformation of these coordinates to some contemporary system, we can easily georeference these maps and then compare them with other contemporary data. Transformations from coordinate systems used in Austria-Hungarian Empire to contemporary coordinate system S-JTSK was invented by doc. Čada from West Bohemian University in Pilsen. 2nd military mapping is main dataset I used within the frame of my research.

3rd military mapping was done in Czech lands in 1870-1883. The scale of maps is 1 : 25 000. Unfortunately, these maps are not scanned yet, because of many map sheets missing. I hope, maps will be found and I will be able to continue my research on these maps.

Back to 2nd military mapping. If I wanted to georeference maps to contemporary system I had to compute coordinates of corners of map sheets. In my first dataset, I used S-JTSK coordinates computed by doc. Čada. In my second dataset, I transformed corners to UTM (Universal Transverse Mercator projection, zone N33). Transformation was done using PROJ.4, open source transformation software.

Coordinates of corners of map sheets were imported into KOKES geodetic software. This software was chosen from variety of possible software due to high speed of transformation. Then every scanned map was opened and transformed to corner coordinates. There are many types of transformation of raster data. After initial testing phase, I decided for

projective transformation. This transformation is non-residual for 4 points and so rasters are precisely placed. Very difficult is to find exact position of corner on the map. 150 years old maps are destructed specially in corner areas. For right transformation key, affinity was tested. The error of affine transformation for map sheets was maximally 30 meters. After transformation of every map sheet, the data was prepared for later internet publishing. From the native format of KOKES (BMP) was data transformed to TIFF format. This format was chosen for possibility of transparency of saved raster. LZW compression was used for reducing data amount.

If we have prepared rasters in one coordinate system, we can publish them on the Internet. The best way how to do that is WMS service. WMS is web service defined by OGC (Open GIS Consortium). Using this service, georeferenced raster data can be published on the Internet. For my data publishing, UMN MapServer software was used, because of well WMS implementation. If I wanted to publish such great amount of data as raster data from the whole Czech republic I had to increase the speed of MapServer WMS reply. For every map sheet I created pyramids (overviews) in 9 scales. Using this method, only needed overviews can be sent. The second method of increasing is to index the data. Native indexing of MapServer was used – tileindexing. Rasters are indexed as tiles by shapefile (SHP) vector file. After these improvements, data are distributed by WMS in acceptable speed.

In this moment, two raster datasets are distributed through WMS: Bohemia (originally in Gusterberg coordinate system) and Moravia (originally in St. Stephan coordinate system). Both parts are distributed in UTM coordinate system. Very interesting part of research is to join these datasets into one. There is need to mask the Bohemia-Moravian boundary and then the whole area of Czech republic can be distributed together. I am working on that now.

The other possibility of old maps publishing is web application, where anyone can view the data. This application was created and is being improved. It is based on UMN MapServer CGI application. Web page contains standard mapserver features as zoom or pan. These features are based on JavaScript library msCross. Other JavaScript functions enable interactive coordinate displaying. The newest improvement is possibility of zooming to any village or town in Czech republic. The database of all villages in the country was created in the relational database PostgreSQL. On the web page AJAX (Asynchronous JavaScript And XML) function connects this database and generates the index of villages after writing some characters into text field. This index contains hypertext links which references to map zoomed to selected village.

References:

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