



## **Automated georeference of the 1: 20,000 Romanian maps under Lambert-Cholesky (1916-1959) projection system**

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Before the 1918 Union, the Romanian territories were subject of several dominations, for which reason the cartographic data base for each Romanian province was different from an area to another. Starting from the second half of the 19th century, Valachia, Moldavia and Dobrogea (Dacia Pontica or Scitia Minor) field mapping was made, implicitly cartographic representations, different as structure. The projection systems used, the chosen geoid, the nomenclature and the distribution of the map pages were not uniform. For an example, the Bessel ellipsoid and the Cassini cross cylindrical projection were used especially to the eastern side of the Zimnicea central meridian (23 degree east from Paris), while to its western side the Bonne conic equivalent projection was used, as defined on the Clarke ellipsoid (Năstase, 1975, pages 86-87). In the other Romanian provinces, such as Transylvania, Romanian Banat, Bessarabia (Moldavia Republic) and Southern Bucovina, the major part of the cartographic products (surface contour maps) were made as polyhedral projections.

During the World War I, when artillery was a redoubtable weapon a necessary idea was born to articulate an unitary cartographic projection concerning the entire Romanian territory, which should respond to the principle of conformity. Between 1916-1917, pursuant to the above argued measure, a new datum/location surface, a new projection system and a new nomenclature were introduced. The Lambert projection system was used as modified by the French land surveyor, the mathematician and officer Andre Louis Cholensky. He was born in 1875 in Mont Guyon and passed away on the battle field in Northern France in the month of August 1918. During September 1916 up to February 1918, following the Franco-Romanian military convention, he was a Commander of the Geographic Department of the Romanian Army (Brezinsky-Gross-Cholensky, 1996). The calculations for passing from the various projections (as previously mentioned), into the Lambert-Cholensky projection, were made by the Romanian officers.

The basic map, called „Plan Director de Tragere” was drafted under 1:20000 scale in 2118 drawings, covering all the Romanian territory. Under graphical aspect, such drawings had a 75 cm length (the equivalent of 15 km of land), respectively 50 cm (the equivalent of 12 km of land). Usually, at the upper part of the map, frequently to the left side, less frequently to the right side, the drawings nomenclature appeared, made following the principle: the first two letter meant the columns number and the last two characters represented the lines number. So, the drawing whose south-west corner had the Cartesian co-ordinate of 10 km, 20 km would have received the codification 1020.

The manual georeference of the entire map sheets database is a meticulous and time consuming process. To overcome this disadvantages and to increase the rectification precision an automated procedure was created. The whole process of raster sheets georeference is done by a specially developed tool which relay on radon transform to extract, even in degraded and noisy conditions of original rasters, all the straight lines and form a graticule network. Then, by knowing the sheets spatial positions out of its labeling schema, all intersection points in the graticule are labeled with correct coordinates, so by this way sheets are rapidly batch georeferenced in the most accurate fashion.