România is situated in central Europe, in the northern part of the Balkan Peninsula. Its territory is marked by the Carpathian Mountains, the southern border is the Danube River, and the eastern border is the Black Sea. Bordering countries are Ukraine to the north, Moldova to the northeast, Bulgaria to the south, Yugoslavia to the southwest, and Hungary to the northwest. The highest point is Moldoveanu at 2543 m (8,343 ft), the lowest point is at sea level. Traces of human existence date back to the Lower Paleolithic Period (approximately two million years B.P.), and relatively stable populations in România were found beginning with the Neolithic Period (7000 to 8000 B.P.). Strabo, a famous geographer and historian in the age of Emperor Augustus, wrote that “the Dacians have the same language as the Getae;” the basic difference is that the former inhabited the mountains and Transylvania, while the latter settled in the Danube River valley. The Romanians are the only descendants of the Eastern Roman stock, and their language is one of the romance languages. România has been referred to as a “Latin island in a sea of Slavs.” România, a Republic, is composed of the old principalities of Wallachia, Modovia, and Transylvania. Its latest constitution is dated December 8, 1991.

The Austro-Hungarian Empire was surveyed at a time when topographic surveys were based partially on geometry and partially on art. The topographer, more an artist than a surveyor, proudly made the map by himself. Therefore, the proverb: “There are plenty of surveyors, but few topographers.” Maps are no longer produced by ingenious topographer-artists, but by a team of specialists like those who are members of ASPRS. The Second Topographical Survey (in România) of the Austro-Hungarian Empire was the Franzsische Aufnahme of 1806 to 1869 that utilized the Cassini-Soldner Grid of Vizakna, Sibiu (Hermannstadt) Observatory for Transylvania, România. The original coordinates of the Cassini Grid origin used from 1817-1904 were \( \phi_0 = 45^\circ 50' 25.430'' \) North and \( \lambda_0 = 41^\circ 46' 32.713'' \) East of Ferro, geodetically determined from Vienna. As per the European geodetic convention of the time, no false origin was employed and coordinates were computed with quadrant signs. This Grid was cast on the von Zach 1812 ellipsoid where \( a = 6,376,385 \) m and \( 1/f = 310 \).

While still a part of the Austro-Hungarian Empire, Constantin Barozzi (1833 to 1921) helped in the Viennese measurement of the Slobozia geodetic base and in the triangulation chain that connected Dobrogea to Transylvania. By 1870,
Barozzi was appointed as the chief (and founder) of the Scientific War Dépôt, the national military mapping department of România. The third topographic survey of the Austro-Hungarian Empire (Neue Aufnahme) was conducted from 1869 to 1896 and was based on the St. Anna Datum of 1840, located in Arad, România. The origin was at Arad South Base: $\Phi_0 = 46^\circ 18' 47.63''$ North and $\lambda_0 = 39^\circ 06' 54.19''$ East of Ferro (geodetically determined from Vienna). This Datum was originally referenced to the Zach 1812 ellipsoid, but the Austrians introduced the Bessel 1841 ellipsoid as a new standard for the empire in 1869 where $a = 6,377,397.155$ m and $1/f = 299.1528$. The defining azimuth to Kurtics was determined astronomically, but the angular value was not published and is now lost. The Arad 1840 Base length was 8,767.578 m. The metric system was legally established in 1872, and the 1:25,000 mapping scale was introduced along with the polyeder (polyhedral) projection to eliminate inconsistencies in map sheet lines. Remember that in past columns I have pointed out that the polyhedral projection is mathematically equivalent to the local space rectangular (LSR) coordinate system that is commonly used in computational photogrammetry. Of course, back then they did not transform first to the Earth-centered Geocentric Coordinate System and then perform a 3 by 3 rotation secant or tangent to the surface of the ellipsoid the way we do now. (It’s trivial with Fortran or C, but mind-boggling with tables of logarithms).

A chain from St. Anna base line to Sibiu (Hermannstadt) Observatory was computed in 1846. The computations again were based on the Zach 1812 ellipsoid and St. Anna was used as a starting point. From these computations for Sibiu Observatory, the following values were obtained: $\phi = 45^\circ 50' 28.95''$ North, $\lambda = 41^\circ 46' 39.00''$ East of Ferro, and the azimuth to Presbe $\alpha = 359^\circ 16' 33.78''$. If these values are compared with the values derived in 1870 from Vienna University using the Bessel 1841 ellipsoid: $\phi = 45^\circ 50' 25.97''$ North, $\lambda = 41^\circ 46' 31.66''$ East of Ferro, and the azimuth to Presbe $\alpha = 359^\circ 16' 43.24''$. The result of this “bust” was that the cartographic adjustments were a nightmare for nearly a century when trying to fit other datums to Românian sheets.

Thanks to John W. Hager, the Constanta Datum established by the Russians in the 19th century originated at the minaret of the main mosque in Constanta where $\Phi_0 = 44^\circ 26' 07.2832''$ North and $\lambda_0 = 26^\circ 01' 00.207984''$ East of Greenwich. The reference azimuth to Cotroceni, originally observed in 1895, was $\alpha_o = 127^\circ 01' 53.005''$. A Roussilhe Stereographic Grid was developed with its projection center near the geographic center of the country. The defining parameters are $\phi_o = 51^\circ 05' 54''$ North, $\lambda_o = 28^\circ 51' 213.51''$ East of Greenwich, $FE = FN = 500$ km, and $m_o = 0.9996666666$. Because the origin is near Kronstadt (now Brasov), it came to be known as the “Stereographic Projection with Kronstadt as Central Point.”

After WWII, România was introduced to the Soviet “System 42” Datum with its origin at Pulkovo Observatory, where $\Phi_0 = 59^\circ 46' 18.55''$ North and $\lambda_0 = 30^\circ 19' 42.09''$ East of Greenwich. The reference azimuth to Signal A is $\alpha_o = 317^\circ 02' 50.62''$, and the new ellipsoid used is the Krassovsky 1940 where $a = 6,378,245$ m and $1/f = 298.3$. The stan-
standard grid used in the former U.S.S.R. and most former satellite countries is the Russia Belts Gauss-Krüger Transverse Mercator where the grid parameters are identical to the UTM except that the Russia Belts have a scale factor at origin on the Central Meridian equal to unity. However, România did not go along with that for its internal use, even though the Soviets used their Russia Belts for military topographic mapping of the country. The “Stereo 70” was developed for România based on the Hristow Oblique Stereographic projection. The projection center was selected as φ₀ = 45° North and λ₀ = 25° East of Greenwich, and associated parameters were FE = FN = 500 km and m₀ = 0.999750. Example computation of fire support. Secrecy of positional data and topographic have absolutely nothing to do with successful coordination native topographic maps and existing native geodetic control in the recent past have clearly demonstrated that existing of security is quite out of date and futile. Military operations suppression of spatial data distribution for military purposes al government charging fair market value for data, the total – spatial data. Although there is little difficulty in a nation is going to be largely dependent on the free availability of information from System 42 in România to WGS 84 Datum as ∆X = +28 m ±3 m, ∆Y = –121 m ±5 m, and ∆Z = 177 m ±3 m, and this is based on four collocated points computed in 1997. The U.S. National Geodetic Survey assisted the government of România with the establishment of the România High Accuracy Reference Network, and, for station Dealul Piscului on System 42, φ = 44° 24´ 22.383´ N, λ = 26° 06´ 44.126´ E, and H = 89.275 m; and, on, EURF89, φ = 44° 24´ 22.71021´ N, λ = 26° 06´ 38.74635´ E, and h = 124.520 m. The International Boundary Treaties of România indicate that the border of the country is largely monumented or along streams and rivers. Interestingly, the boundary with Hungary distinguishes between navigable streams that are defined by the thread of the main channel or thalweg, and non-navigable streams that are defined by the geographical center or medium filium acquae. Thanks for help go to Russell Fox of the Ordnance Survey, Giles André of the Defence Geographical Centre, Dave Doyle of the National Geodetic Survey, and John W. Hager. The successful development of countries in the 21st century is going to be largely dependent on the free availability of spatial data. Although there is little difficulty in a national government charging fair market value for data, the total suppression of spatial data distribution for military purposes of security is quite out of date and futile. Military operations in the recent past have clearly demonstrated that existing native topographic maps and existing native geodetic control have absolutely nothing to do with successful coordination of fire support. Secrecy of positional data and topographic maps only hurts the local economy and discourages foreign investment. It is hoped that the formerly “closed societies” will move to a more enlightened philosophy regarding GIS technology.

**UPDATE**

Transylvania had an unsettled history in the 20th century. As a result of the repeated changing of the region between Hungary and Romania and of the Soviet dominance between 1945-1990, several map grid systems have been introduced. Besides the old Hungarian ‘Marosvásárhely’ Stereographic system and the Romanian Stereo-70 system, the Soviet-type Gauss-Krüger projection was also introduced. These grids can be handled together with the world’s quasi-standard, the UTM system, using this small MS Excel table, Viteaz.

Viteaz is a MS Excel table that allows you to convert UTM, Soviet-type Gauss-Krüger, Romanian Stereo-70 and old Hungarian ‘Marosvásárhely’ Stereographic coordinates. You can enter your input in any of the listed projections and will be given the result in all the three other systems. Viteaz can be downloaded from [http://sas2.elte.hu/tg/viteaz2.xls](http://sas2.elte.hu/tg/viteaz2.xls).

Romania has 74 GPS RTK Continuously Operating Reference Stations at approximately 70 km spacing. The National (relative – Ed) Gravity Network of 1st and 2nd order (about 270 points) was observed by the Ministry of Defense – Topography and Cartography Directorate. The country has four points determined by Absolute Gravity.

Astrogeodetic leveling was part of a research project culminating in November of 2015. Results showed accuracies of (xi,eta) of ±0.500” and ±0.745”, respectfully with a Topcon M505AX with a CCD chip. (In comparison, LSU has issued a Purchase Order (2019) to the University of Latvia, Institute for Geodesy & GeoInformatics for a Digital Zenith Camera that has an accuracy of ±0.100” in both components—after one hour’s observation—automatically.)


1 [http://sas2.elte.hu/tg/viteaz_en.htm](http://sas2.elte.hu/tg/viteaz_en.htm)

The contents of this column reflect the views of the author, who is responsible for the facts and accuracy of the data presented herein. The contents do not necessarily reflect the official views or policies of the American Society for Photogrammetry and Remote Sensing and/or the Louisiana State University Center for GeoInformatics (C4G). This column was previously published in *PE&RS*. 

---

**Ad Index**

Resonon | www.resonon.com | Cover 2