CONSIDERATIONS ON THE DEVELOPMENT OF GEODETIC NETWORK BY CLASSICAL AND GPS METHODS

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Abstract. *The paper was developed in order to determine solutions for optimizing geodetic networks in conjunction with technology development worldwide, but correlated with the existing situation in our country. Need to address this topic of study derived from a variety of objective, owing to the way they were made, developed and maintained the geodetic networks existing in the country.*

Keywords: Global Positioning System, triangulation, optimization.

INTRODUCTION

The development of geodetic network is done in order to increase the number of points with well-determined position, points that will form the basis for the development of geodetic networks or for raising or tracing works. The development of geodetic network can be done by classical or modern methods.

MATERIAL AND METHOD

THE DEVELOPMENT OF GEODETIC NETWORK BY CLASSICAL METHODS. The methods used to develop geodetic networks by classical methods are grouped into four main groups, namely: *the development of geodetic network through triangulation*, which in turn includes three sub methods: development through the intersection before, single or multiple (Fig. 1); development through the intersection back (retrointersection) (Fig. 2); development through combined intersections (Fig. 3); *the development of geodetic* network *through trilateration* (Fig. 4*); the development of geodetic network through polygonal trails (*Fig. 5*); developing networks through radiating method* (Vereş, 1998).

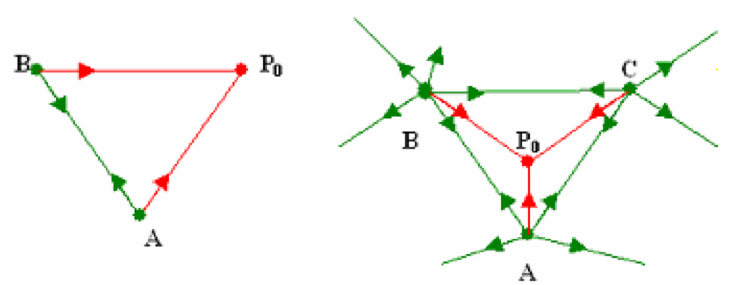

Fig. 1 The intersection before, single or multiple

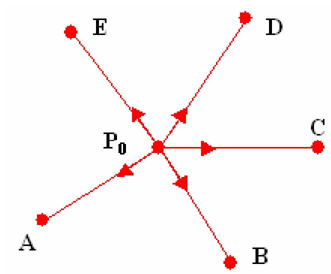

Fig. 2. Retrointersection

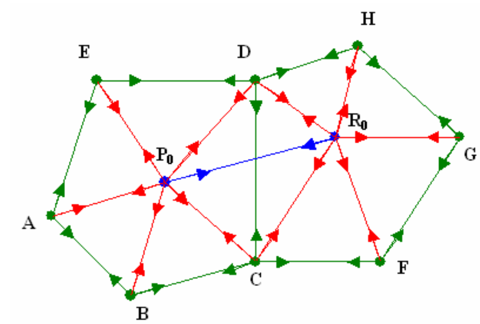

Fig. 3. Combined intersections

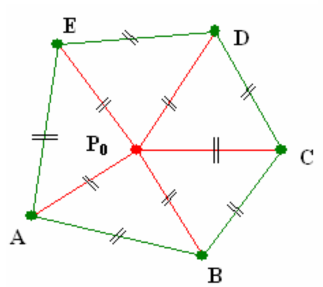

Fig. 4. Trilateration method

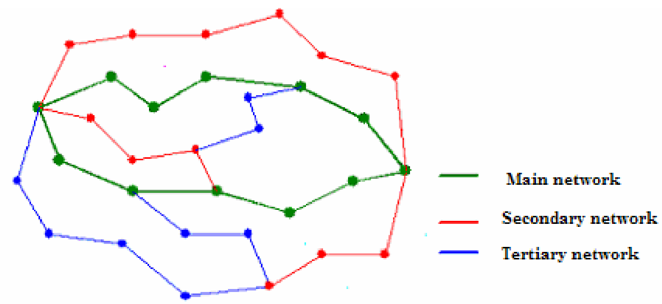

Fig. 5. Development method by polygonal routes

Given the development of geodetic networks by classical methods can draw the following conclusions: diversity of networks can be studied under various aspects: by form, the number of known elements, by destination or by the number of dimensions of space in which the network is located; regardless of network type, observations are made mainly on the angles and distances and, in some cases, on the orientations or coordinates; processing of observations is made generally by the method of least squares; data processing by conventional methods requires a large volume of calculations, wich lead to increased working time.

THE DEVELOPMENT OF GEODETIC NETWORK USING GPS TECHNOLOGY. The idea of automatically calculating of points position by measuring the distances became reality only recently when radio waves began to be used in navigation. The basic idea is to measure the time it takes to radio waves to travel a distance from broadcasting station to a special reception device (Fig. 6).

By multiplying the time needed to browse with the speed of radio wave is obtain distance between the transmitter and receiver. Time must be measured very accurately because the speed of radio wave is $3*10^5$ m / s, ie the speed of light, which means that the error of one microsecond is equivalent in units of distance with a position error of 300 m (Neuner, 1997).

The current stage of development for geodetic purposes may have resulted in the following considerations (Bălăcescu, 2004):

a) maximum accuracy requirements for the user $\sigma \leq \pm 1$ are not achieved only in the field 1-2 km, and over greater distances, up to 100 km, or for special configurations, even 1000 km. Unlike traditional methods, to creating geodetic networks using GPS technology, this high accuracy can be obtained directly from the distant support points. This depends essentially by the duration of observation and instruments performance. Also in favor of flexibility comes the fact that it can design network configurations adapted to the beneficiary needs, configurations even unacceptable in terms of classical, not influencing too much the precision potential. If we design new networks, where the choice of point position is made at the start, avoiding the eccentric stations, appear again typical GPS advantages: no need for visibility between points; almost constant precisely, regardless of the distance between points.

b) using GPS technology, the density of development or recovery points is much higher than for conventional technology, in a short time, with lower cost and high accuracy of determination.

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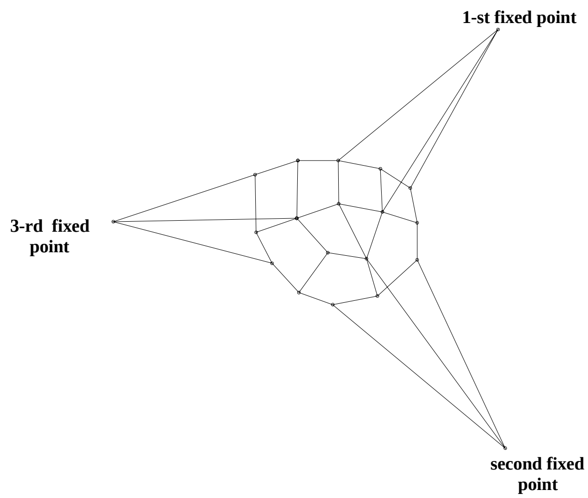


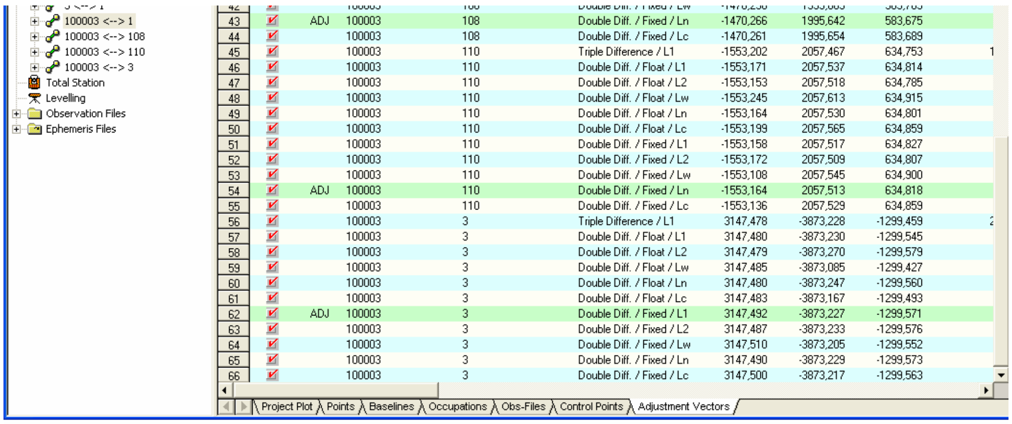
Fig. 6. The development of geodetic network using GPS technology

RESULTS AND DISCUSSIONS

The advantages offered and the global trends in the development of GPS technology, along with evolution of specific measurement devices, requires generalization and in our country, to use this technology. An important factor in designing such a network is the number of vectors that converge to a certain point. The existing cadastre rules in our country require that every point have at least three independent vectors. The GPS manuals provide that points to be connected by two vectors, each at least the third point to have three vectors.

Another important factor in network design is the distance between points. GPS manuals recommend a maximum length of 40 km for the static observations. Observations processing is made at the end of each day. Vectors can be processed in block or interactive to remove useless vectors (Bălăcescu , 2004).

The work programs provide information about data files, the type of observations and the antennas used. Any mistakes can be corrected now. Mathematical models of these measurements are based on a combination of gross measurements from receivers to satellites. These measurements are modeled in various combinations of L1 and L2 carrier phase and the pseudodistances. To resolve total ambiguities and the unknown position of the receiver, postprocessing uses algorithms in few squares using one or more of these combinations of measurements (Păunescu, Mocanu and Dimitriu, 2006).



43	ADJ	100003	108	Double Diff. / Fixed / Ln	-1470,266	1995,642	583,675
44		100003	108	Double Diff. / Fixed / Lc	-1470,261	1995,654	583,689
45		100003	110	Triple Difference / L1	-1553,202	2057,467	634,753
46		100003	110	Double Diff. / Float / L1	-1553,171	2057,537	634,814
47		100003	110	Double Diff. / Float / L2	-1553,153	2057,518	634,785
48		100003	110	Double Diff. / Float / Lw	-1553,245	2057,613	634,915
49		100003	110	Double Diff. / Float / Ln	-1553,164	2057,530	634,801
50		100003	110	Double Diff. / Float / Lc	-1553,199	2057,565	634,859
51		100003	110	Double Diff. / Fixed / L1	-1553,158	2057,517	634,827
52		100003	110	Double Diff. / Fixed / L2	-1553,172	2057,509	634,807
53		100003	110	Double Diff. / Fixed / Lw	-1553,108	2057,545	634,900
54	ADJ	100003	110	Double Diff. / Fixed / Ln	-1553,164	2057,513	634,818
55		100003	110	Double Diff. / Fixed / Lc	-1553,136	2057,529	634,859
56		100003	3	Triple Difference / L1	3147,478	-3873,228	-1299,459
57		100003	3	Double Diff. / Float / L1	3147,480	-3873,230	-1299,545
58		100003	3	Double Diff. / Float / L2	3147,479	-3873,270	-1299,579
59		100003	3	Double Diff. / Float / Lw	3147,485	-3873,085	-1299,427
60		100003	3	Double Diff. / Float / Ln	3147,480	-3873,247	-1299,560
61		100003	3	Double Diff. / Float / Lc	3147,483	-3873,167	-1299,493
62	ADJ	100003	3	Double Diff. / Fixed / L1	3147,492	-3873,227	-1299,571
63		100003	3	Double Diff. / Fixed / L2	3147,487	-3873,233	-1299,576
64		100003	3	Double Diff. / Fixed / Lw	3147,510	-3873,205	-1299,552
65		100003	3	Double Diff. / Fixed / Ln	3147,490	-3873,229	-1299,573
66		100003	3	Double Diff. / Fixed / Lc	3147,500	-3873,217	-1299,563

Fig. 7. Data processing

After network compensation, the program provides information on the accuracy with which each point was determined. It should be noted that this is a relative accuracy, of the points used.

A complete calculation of accuracy should include: accuracy of determining the initial points; riding precision and centering on the point; accuracy of measuring height etc.

In the figures below are presented a model of homogeneous network (Fig. 8) and a model of uneconomic network (Fig. 9) realized using GPS technology.

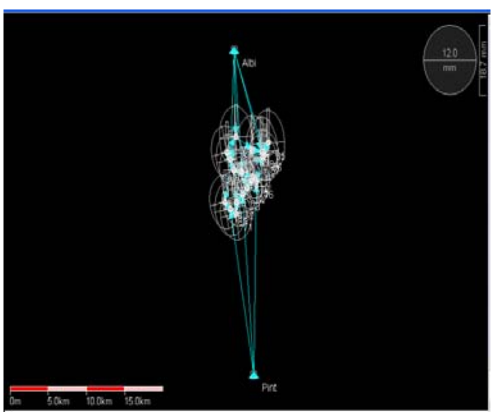


Fig. 8 Homogeneous network

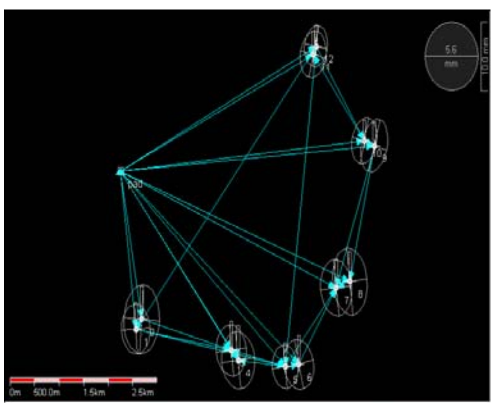


Fig. 9. Uneconomic network

CONCLUSIONS

Optimization goal is to increase the precision of geodetic network with a small volume of measurements.

A central modul of geodetic network optimization strategy is to use measurements of coordinate using technologies based on receiving signals transmitted from artificial Earth satellites, specialized in such operations. The determinations are made in the global positioning systems (GPS) and now are characterized by accuracy in the field of centimeters.

It is essential that with the development of computer technology to use mathematical models wich lead to a general analytical solution (regardless of regular or irregular geometry of the route used) of the optimum problem, with the additional requirement that the mathematical model to allow the achievement of software programs.

To improve the efficiency of measurement, in close correlation with the implementation, it requires endowment of specialists with modern measurement equipment (total station, GPS technology) to allow storage and transmission of measured data to the processed stations, via modem or fiber.

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