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# CORRELATION OF THE LOCAL PROJECTION SYSTEM WITH THE NATIONAL SYSTEM

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**Keywords:** *stereographic projection, projection system, monogram*
**Abstract:** *In areas with border extension (localities, mining areas, hydrotechnics, etc.) it is advisable to establish the positions of the points in a local system, the methods used being simpler and the results more precise. However, it is necessary to transcalculate the coordinates from the local system to the national projection system. A transcalculation method is assumed to ensure efficiency and accuracy.*

## 1. Introduction

The works carried out in the field of terrestrial measurements use the stereographic projection with secant plane. This projection is part of the group of azimuthal perspective projections that can have the point of view at infinity (normal), outside the earth's surface (outer), on the earth's surface (stereographic) or in the center of the earth's surface (central)

The projection plane can be tangent or secant at the reference surface (spherical), and the point of tangency can be at the pole (polar), between the pole and the equator (horizontal) or on the equator (equatorial).

In Romania, the horizontal stereographic projection system (also called oblique) with secant plane is used. In the mining areas, the central projection system with the so-called sequential plane is also used gnomon [1].

It is necessary that the values of the coordinates set in the central projection system be transcalculated in the stereographic system by a direct and precise method presented below.

## 2. Coordinate equations in stereographic and central projection

It is known that a point P defined by the coordinates $u$ and $v$ on the surface of the sphere in the respective azimuthal projection has the coordinates $x, y$ given by relationships (fig. 1) [2]:

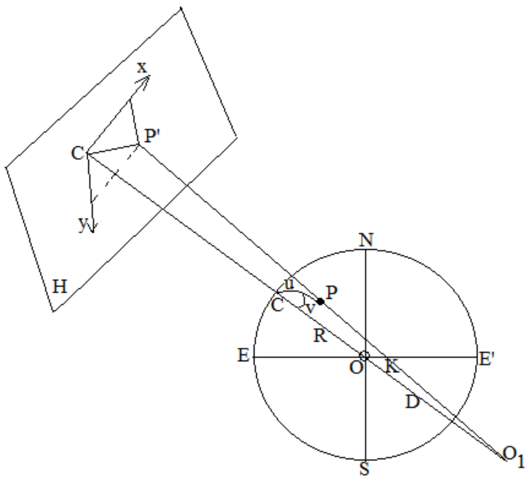


*Fig. 1*

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$$x = \frac{KR \sin v \cos u}{D + R \cos v}$$
$$Y = \frac{KR \sin v \sin u}{D + R \cos v} \qquad (1)$$

Formulas (1) correspond to the central (local) and stereographic projections that are transcalculated.
In central projection: $D = 0$ and $K = R$

$$x_c = \frac{R \sin v \cos u}{\cos v}$$
$$y_c = \frac{R \sin v \sin u}{\cos v} \qquad (2)$$

In stereographic projection: $D = R$ and $K = 2R$

$$x_S = \frac{2R \sin v \cos u}{1 + \cos v}$$
$$y_S = \frac{2R \sin v \sin u}{1 + \cos v} \qquad (3)$$

When calculating a large number of points, a monogram can be used from which the value of the constants is extracted $K_c$ from the central monogram and $K_S$ from the stereographic monogram using the equalities:

$$k_C = \frac{2}{K} \quad \text{and} \quad k_S = \frac{K}{2} \qquad (4)$$

where:

$$K = \frac{1+\cos v}{\cos v} \qquad (5)$$

The relation can be used:

$$k_S = \frac{1}{K_C} \qquad (6)$$

which determines its value $K_c$ or $K_S$ depending on which monogram is available and the other constant is calculated [3].

For the construction of monograms, the following are used:

$$K_C = \frac{2}{1 + \sqrt{1 + tg^2 v}}$$
$$K_S = \frac{1}{1 - tg^2 \frac{v}{2}} \qquad (7)$$

For the construction of the monogram we use the values: 0,5; 1; 5; 10; 20 and 50 km (table 1). Approximations were made for the intermediate values (table 2) based on a mathematical law of interpretation $\left(K_S = 2\Delta\delta \cdot \left(\frac{S}{5}\right)^2 \cdot 10^{-12}\right)$ [4].

*Table 1*

| $m$ | $v/2$ | $tg\frac{v}{2}$ | $tg^2\frac{v}{2}$ | $1 - tg^2\frac{v}{2}; K_c$ | $K_S = \frac{1}{1 - tg^2\frac{v}{2}}$ |
|---|---|---|---|---|---|
| 500 | $25^{cc}$ | 0,000039 | 0,000000001521 | 0,999999999848 | 1,000000001521 |
| 1000 | $50^{cc}$ | 0,000079 | 0,000000006241 | 0,999999993759 | 1,000000006241 |
| 5000 | $2^c49^{cc}$ | 0,000391 | 0,000000152881 | 0,99................ | ...................... |
| 10.000 | $4^c49^{cc}$ | 0,000783 | 0,000000613089 | 0,99................ | ...................... |
| 20.000 | $9^c98^{cc}$ | 0,001568 | 0,000002458624 | 0,99................ | ...................... |
| 50.000 | $24^c95^{cc}$ | 0,003919 | 0,000015358561 | 0,99................ | ...................... |

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*Table 2*

| $S\,[km]$ | $\frac{S}{5}$ | $\left(\frac{S}{5}\right)^2$ | $mm$ | $K =$ | |
|---|---|---|---|---|---|
| | | | | **approximatively** | **rigurous** |
| 50 | 10 | 100 | 7.650 | 1,000015300 | 1,00001538561 |
| 45 | .... | ..... | ....... | .................. | ....................... |
| 40 | .... | ..... | ....... | .................. | ....................... |
| 35 | | | | | |
| 30 | | | | | |
| 25 | | | | | |
| 20 | | | | | |
| 15 | | | | | |
| 10 | | | | | |
| 5 | | | | | |

To find the values of the constant $K_S$ from the monogram do so:
-it is pointed on the monogram on the scale 1/500.000 the stereographic coordinates $x$ and $y$.
-a proportional value of it is chosen $K_S$ (interpolation according to the equation of the line) value with which the transcalculation of the coordinates is done $x$ and $y$ finally obtaining the coordinates transcalculated in the central system [5].

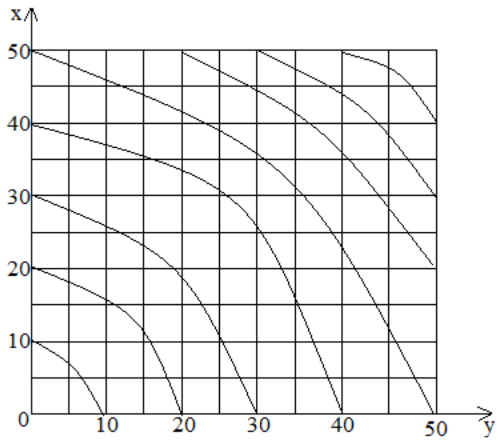


*Fig.2*

## 3. Conclusion

Smaller linear deformations compared to the national projection leading to qualitatively superior topographic documentations.

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