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POLYNOMIAL TRANSFORMATION OF CASSINI COORDINATES TO UTM COORDINATES ON THE EXCEL SPREADSHEET

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INTRODUCTION

- The Cassini Soldner Projection was used in the earliest surveys in Kenya and the grid units are in feet.
- (UTM) is often preferred to Cassini because of difficulty in measuring scale and direction on Cassini.
- A need therefore arises from time to time for conversion of coordinates from cassini to UTM and vice versa.

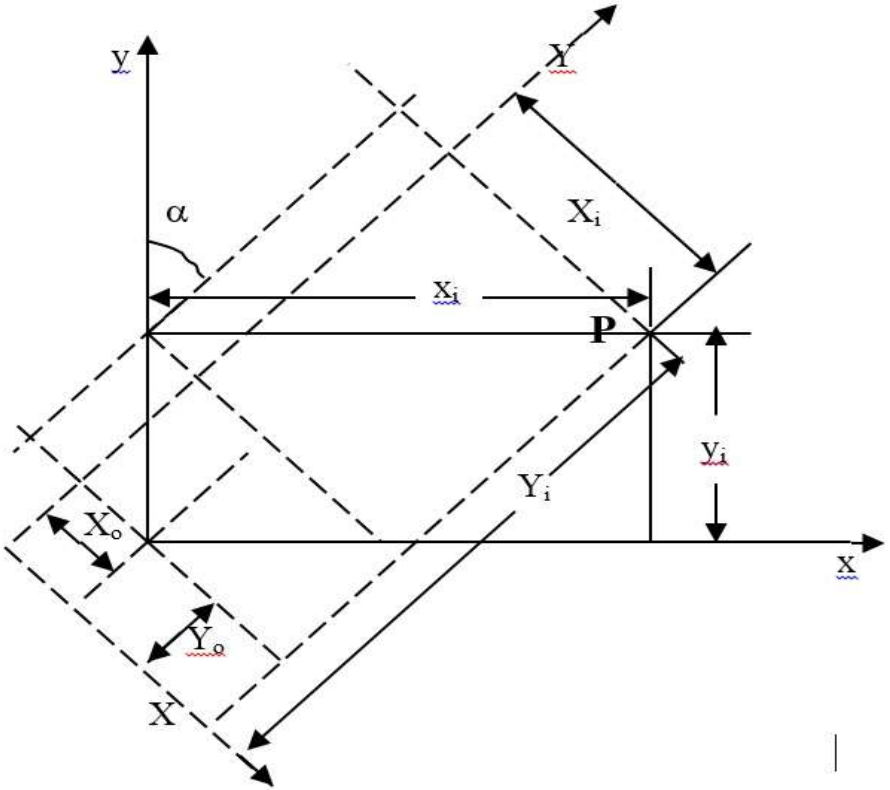
COORDINATE TRANSFORMATION

- Where the target coordinate reference system is based on a different datum to the source reference system. This can be accomplished by :-

1. Transformation by use of polynomials of degree 2, 3 or higher.

2. Computing the geographical coordinates from the grid coordinates in both systems for the common points to compute a seven parameter transformation of a scale, three rotation elements, and three translation elements.

FIGURE 1



2nd DEGREE POLYNOMIAL

- The general second degree polynomial is given by: -

$$X = A_o + A_1 x + A_2\ y + A_3 x^2 + A_4\ xy + A_5\ \ y^2$$

$$Y = B_o\ \ + B_1\ x + B_2\ y + B_3\ x^2 + B_4 xy + B_5\ y^2$$

This general second order degree polynomial can be written in matrix form as follows:

$$\begin{pmatrix} X_i \\ Y_i \end{pmatrix} = \begin{pmatrix} A_1 x + A_2 y + A_3 x^2 + A_4 xy + A_5 y^2 \\ B_1 x + B_2 y + B_3 x^2 + B_4 xy + B_5 y^2 \end{pmatrix} + \begin{pmatrix} A_o \\ B_o \end{pmatrix} + \begin{pmatrix} v_{xi} \\ v_{yi} \end{pmatrix}$$

2nd DEGREE POLYNOMIAL CONTINUED

The above equation can be written in matrix form as follows

$$\begin{pmatrix} X_i \\ Y_i \end{pmatrix} = \begin{pmatrix} x & y & x^2 & xy & y^2 & 0 & 0 & 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 & x & y & x^2 & xy & y^2 & 0 & 1 \end{pmatrix} + \begin{pmatrix} A_1 \\ A_2 \\ A_3 \\ A_4 \\ A_5 \\ B_1 \\ B_2 \\ B_3 \\ B_4 \\ B_5 \\ A_o \\ B_o \end{pmatrix} + \begin{pmatrix} v_{xi} \\ v_{yi} \end{pmatrix}$$

EXAMPLE

	A	B	C	D	E	F	G	H	I	J
1	TRANSFORMED COORDINATES									
2										
3	STATION	CASSINI (feet)		UTM (metres)						
4		NORTHINGS	EASTINGS	NORTHINGS	EASTINGS					
5										
6	1	-54102.10	-182848.40	9861717.501	221784.696		9861717.500	221784.700	-0.0005	0.0036
7	2	-54093.10	-128079.90	9861732.899	238487.309		9861732.900	238487.300	0.0013	-0.0089
8	3	-54089.00	-91567.50	9861742.701	249621.395		9861742.700	249621.400	-0.0008	0.0054
9	4	-144786.50	-182828.20	9834060.900	221813.704		9834060.900	221813.700	0.0005	-0.0036
10	5	-144775.60	-128066.60	9834079.401	238514.591		9834079.400	238514.600	-0.0013	0.0089
11	6	-144770.80	-91559.20	9834091.099	249647.405		9834091.100	249647.400	0.0008	-0.0054
12	7	-90366.30	-128075.00	9850671.500	238497.600		9850671.500	238497.600	0.0000	0.0000
13	8	-90369.00	-146330.20	9850666.099	232930.513					
14	9	-126639.30	-128069.60	9839610.081	238508.702					

SOLUTION FOR THE TWELVE PARAMETERS

0,304875211	A1
-0,000216198	A2
-2,56154E-10	A3
-7,66805E-11	A4
2,50167E-10	A5
0,000214365	B1
0,304877265	B2
3,48808E-11	B3
-5,08559E-10	B4
-3,11581E-11	B5
277528,2466	Ao
9878255,154	Bo

CONCLUSION

- 2nd and 3rd polynomıal transformatıon give same results.
- Excel is easy to use; no prior programming knowledge as functıons are in built.
- Computed coordinates can be copied and plotted on AUTOCAD/GIS
- Transformed coordinates should be checked in the field.

THE END