

Photogrammetry II

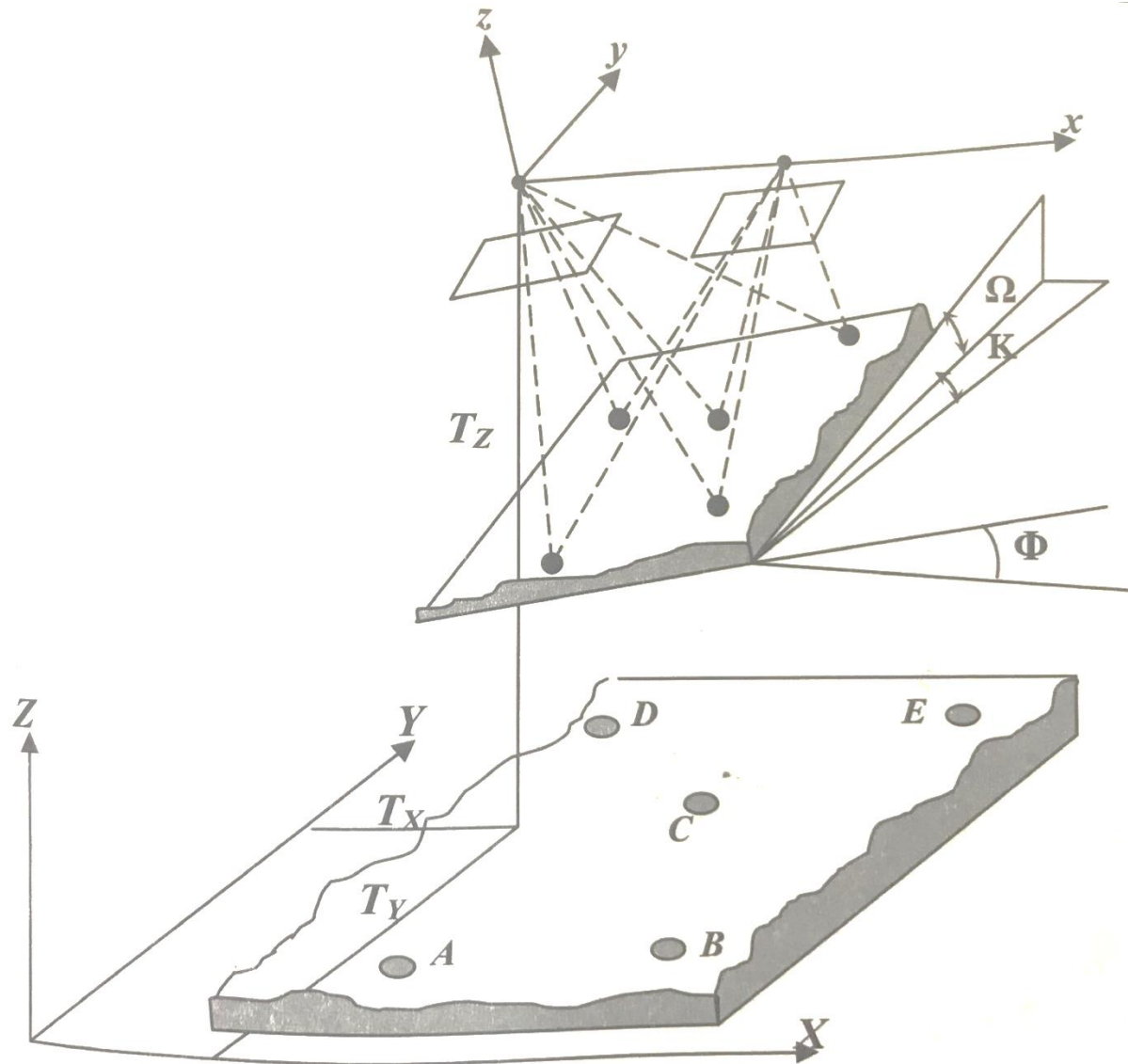
3rd Stage

The Geometry of Aerial Stereo-Pair

Luma Khalid Jasim

E-mail : luma.k@coeng.uobaghdad.edu.iq

Analytical Absolute Orientation



Analytical Absolute Orientation

- $$\begin{bmatrix} X \\ Y \\ Z \end{bmatrix} = s * M(\Omega, \phi, \kappa) * \begin{bmatrix} x \\ y \\ z \end{bmatrix} + \begin{bmatrix} T_x \\ T_y \\ T_z \end{bmatrix}$$

- Whereas :-

- X,Y,Z :Ground Coordinate

- x,y,z :Model Coordinate

- $M(\Omega, \phi, \kappa)$:Rotation Matrix

- $T_x T_y T_z$:Translation Distances

- $E = s . M . X + E_0$

- Note: (2 Horizontal G.C.P&3 Vertical G.C.P) minimum number of point require to do Analytical Absolute Orientation

Analytical Absolute Orientation

M7

M43

Three Dimensional
Conformal Coordinate
Transformation

M4
Planimetry

M3
Altimetry

compute
Coefficients

Convert the
coordinates
of the model

compute
Coefficients

Convert the
coordinates
of the model

Three Dimensional Conformal Coordinate Transformation

- $X = sx' + T_x = s(m_{11}x + m_{21}y + m_{31}z) + T_x$
- $Y = sy' + T_y = s(m_{12}x + m_{22}y + m_{32}z) + T_y$
- $Z = sz' + T_z = s(m_{13}x + m_{23}y + m_{33}z) + T_z$
- $\bar{X} = sM^T X + T$

- $\bar{X} = \begin{bmatrix} X \\ Y \\ Z \end{bmatrix} \quad \text{and} \quad T = \begin{bmatrix} T_x \\ T_y \\ T_z \end{bmatrix}$

Three Dimensional Conformal Coordinate Transformation

- $a_{11} = m_{11}x_p + m_{21}y_p + m_{31}z_p$
- $a_{12} = 0$
- $a_{13} = [(-\sin \varphi \cos K) x_p + \sin \varphi \sin K (y_p) + \cos \varphi (z_p)] s$
- $a_{14} = (m_{21}x_p - m_{11}y_p) s$
- $a_{15} = a_{26} = a_{37} = 1$
- $a_{16} = a_{17} = a_{25} = a_{27} = a_{35} = a_{37} = 0$
- $a_{21} = m_{12}x_p + m_{22}y_p + m_{32}z_p$

Three Dimensional Conformal Coordinate Transformation

- $a_{22} = (-m_{13}x_p - m_{23}y_p - m_{33}z_p)s$
- $a_{23} = [(\sin \omega \cos \varphi \cos \kappa)x_p + (-\sin \omega \cos \varphi \sin \kappa)y_p + (\sin \omega \sin \varphi)z_p]s$
- $a_{24} = (m_{22}x_p - m_{12}y_p)s$
- $a_{31} = m_{13}x_p + m_{23}y_p + m_{33}z_p$
- $a_{32} = (m_{12}x_p + m_{22}y_p + m_{32}z_p)s$
- $a_{33} = [(\sin \omega \cos \varphi \cos \kappa)x_p + (\cos \omega \cos \varphi \sin \kappa)y_p + (-\cos \omega \sin \varphi)z_p]s$
- $a_{34} = (m_{23}x_p - m_{13}y_p)s$
- ${}_{3n}A^7 {}_7X^1 = {}_{3n}L^1 + {}_{3n}V^1$

Three Dimensional Conformal Coordinate Transformation

- ${}_{3n}A^7 = \begin{bmatrix} a_{111} & a_{112} & a_{113} & a_{114} & 1 & 0 & 0 \\ a_{121} & a_{122} & a_{123} & a_{124} & 0 & 1 & 0 \\ a_{131} & a_{132} & a_{133} & a_{134} & 0 & 0 & 1 \\ a_{211} & a_{212} & a_{213} & a_{214} & 1 & 0 & 0 \\ a_{221} & a_{222} & a_{223} & a_{224} & 0 & 1 & 0 \\ a_{231} & a_{232} & a_{233} & a_{234} & 0 & 0 & 1 \\ a_{n11} & a_{n12} & a_{n13} & a_{n14} & 1 & 0 & 0 \\ a_{n21} & a_{n22} & a_{n23} & a_{n24} & 0 & 1 & 0 \\ a_{n31} & a_{n32} & a_{n33} & a_{n34} & 0 & 0 & 1 \end{bmatrix}$

Three Dimensional Conformal Coordinate Transformation

$$\bullet \quad {}_7X^1 = \begin{bmatrix} ds \\ d\omega \\ d\varphi \\ d\kappa \\ dT_x \\ dT_y \\ dT_z \end{bmatrix} \quad {}_{3n}L^1 = \begin{bmatrix} X_1 - (X_1)_0 \\ Y_1 - (Y_1)_0 \\ Z_1 - (Z_1)_0 \\ X_2 - (X_2)_0 \\ Y_2 - (Y_2)_0 \\ Z_2 - (Z_2)_0 \\ \cdot \\ \cdot \\ X_n - (X_n)_0 \\ Y_n - (Y_n)_0 \\ Z_n - (Z_n)_0 \end{bmatrix} \quad {}_{3n}V^1 = \begin{bmatrix} v_{x_1} \\ v_{y_1} \\ v_{z_1} \\ v_{x_2} \\ v_{y_2} \\ v_{z_2} \\ \cdot \\ \cdot \\ v_{x_n} \\ v_{y_n} \\ v_{z_n} \end{bmatrix}$$

Computation of Approximate value for S.P.R.O

- $(AB)^2 = \left[\frac{x_b}{f} (H - h_b) - \frac{x_a}{f} (H - h_a) \right]^2 + \left[\frac{y_b}{f} (H - h_b) - \frac{y_a}{f} (H - h_a) \right]^2$
- $X = x \left[\frac{H-h}{f} \right] \quad Y = y \left[\frac{H-h}{f} \right]$
- $E = aX - bY + c$
- $N = ay + bX + d$
- Whereas :-
- $E, N =$
- $X, Y =$
- $K = \tan^{-1} \frac{a}{b} \quad , \quad X_L = c \quad , \quad Y_L = d$

References

- Wolf, Paul.R. and Dewitt, Bon A.,Elements of Photogrammetry with applications in GIS, 3rd ed., McGraw-Hill,New York, 2000
- بشار سليم عباس، فنار منصور ، ميثم البكري ، المسح التصويري التحليلي، الطبعة الاولى ، اثناء
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