立体像对的前方交会

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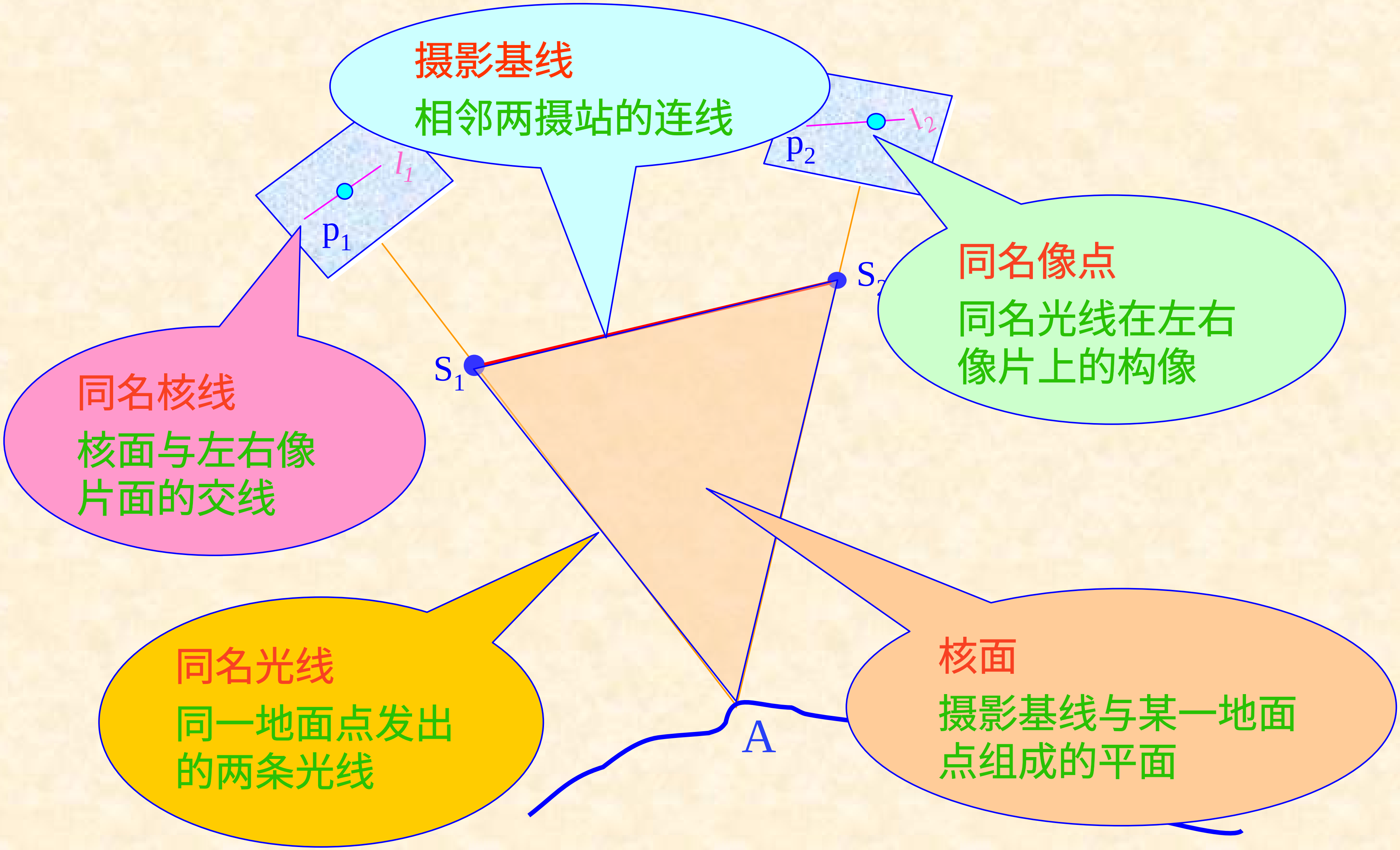
主要内容

一、立体像对的重要点线面

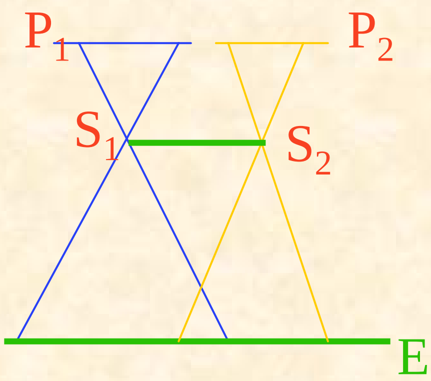
二、立体像对前方交会定义

三、前方交会的基本公式

一、立体像对的重要点线面

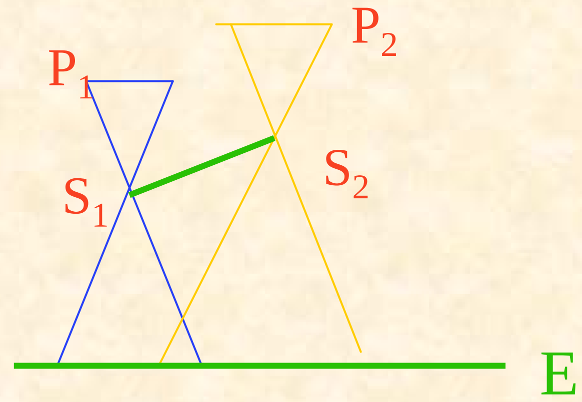


立体像对分类



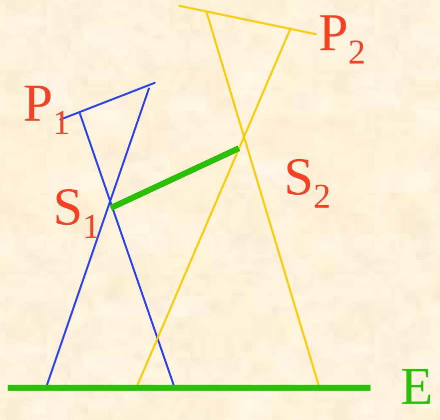
理想像对

相邻两像片水平、摄影基线水平组成的像对



正直像对

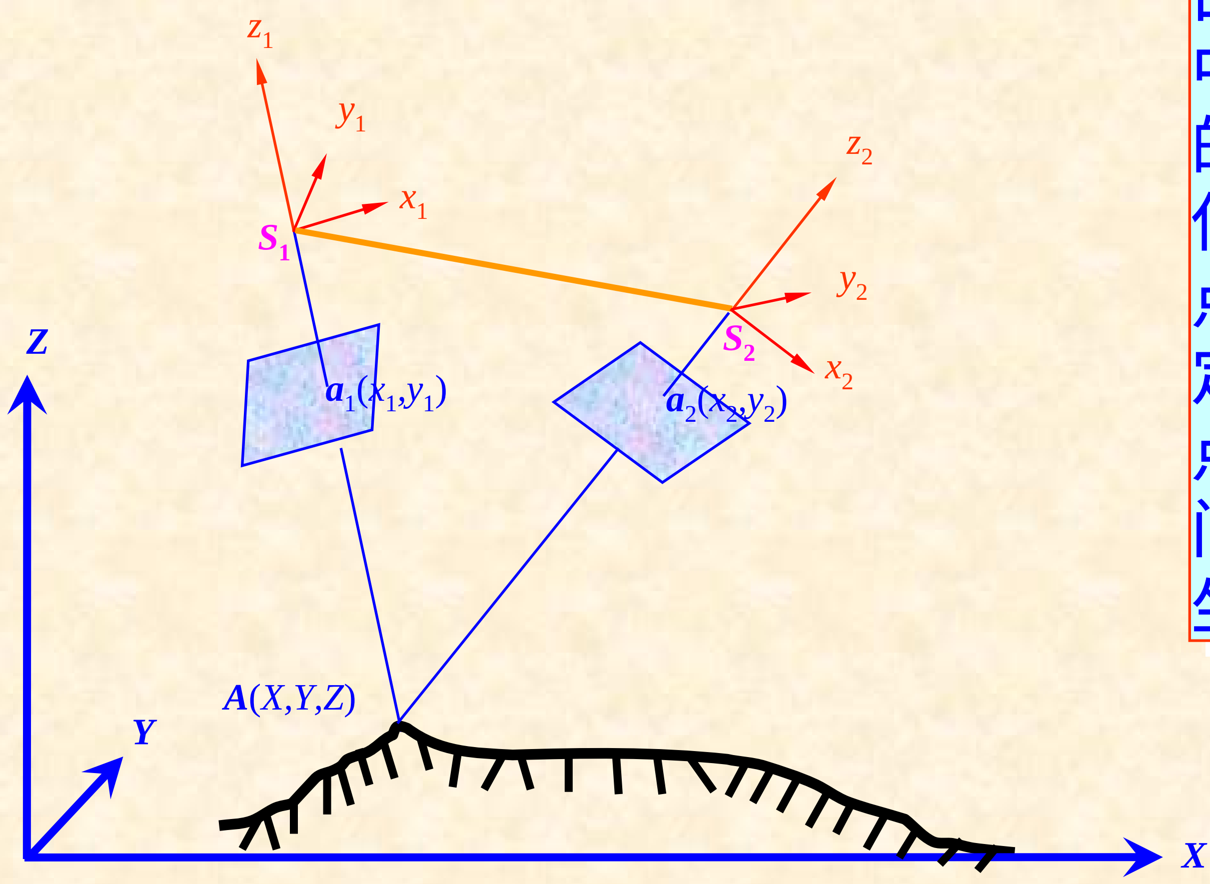
相邻两像片水平、摄影基线不水平组成的像对



竖直像对

相邻两像片不水平、摄影基线不水平组成的像对

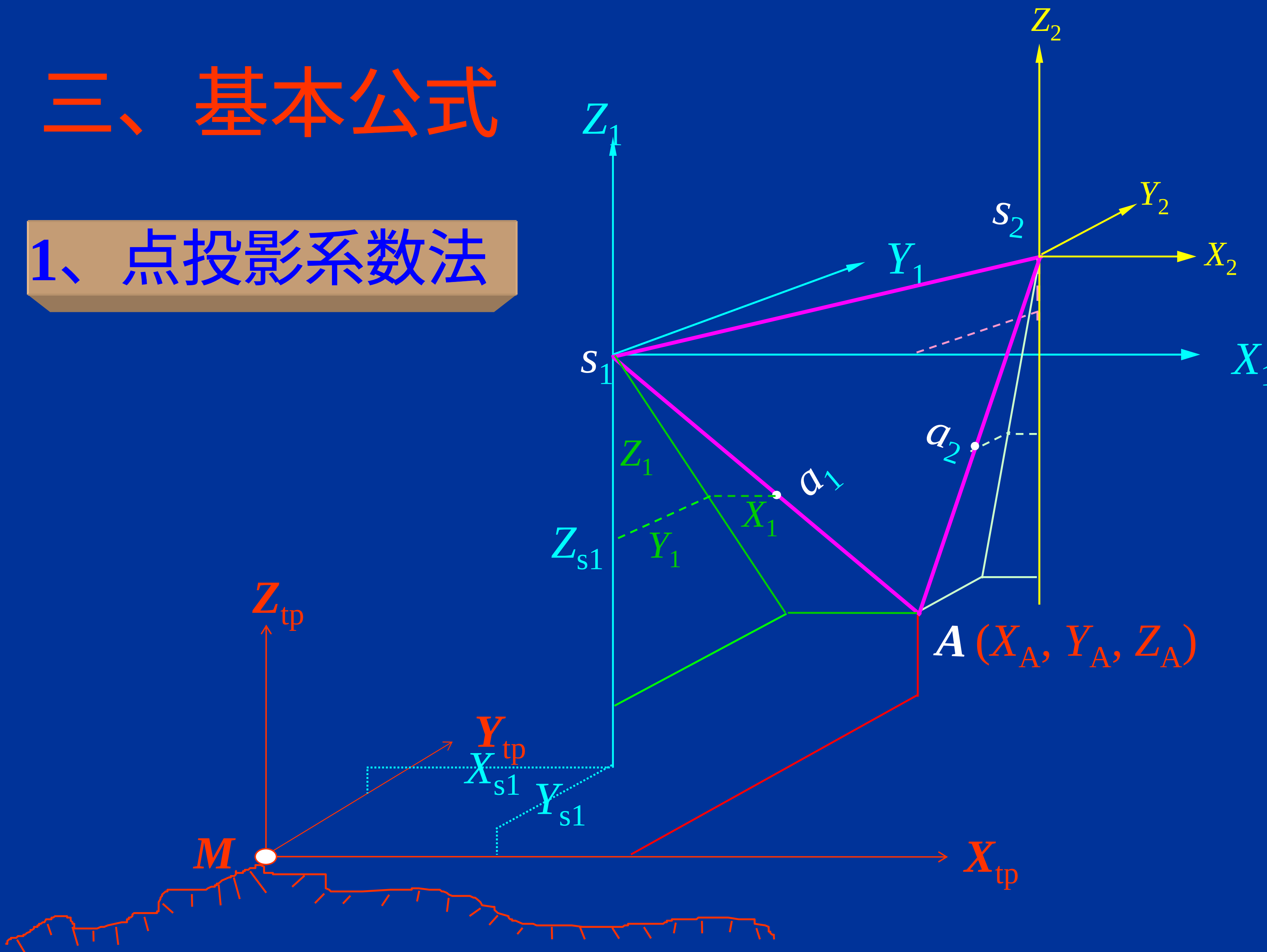
二、立体像对前方交会的定义



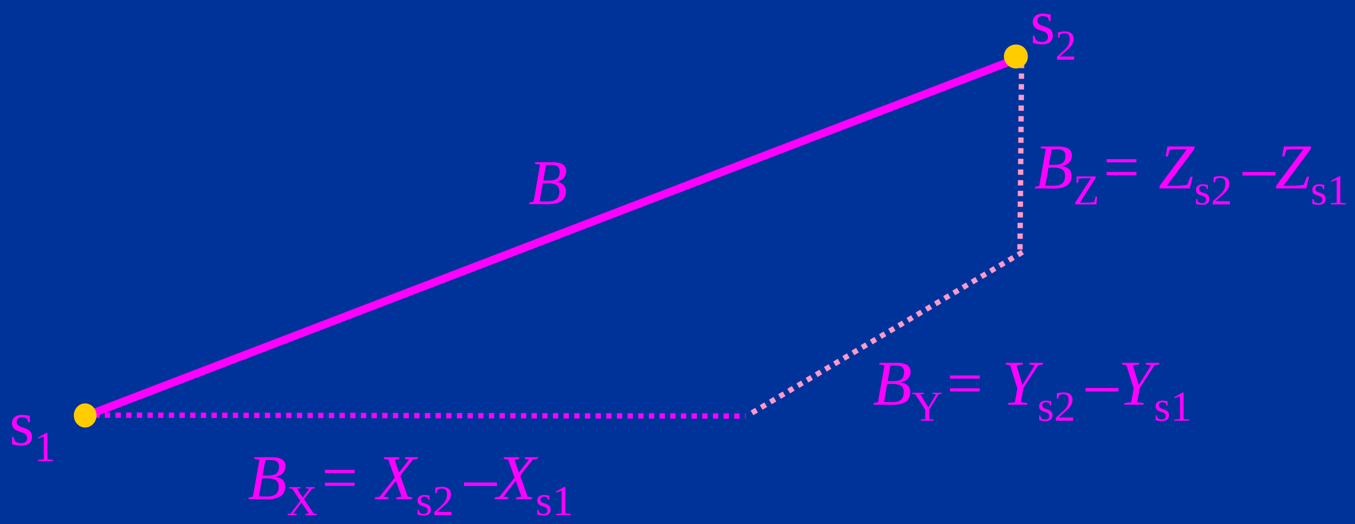
由立体像对中两张像片的内、外方位元素和像点坐标来确定相应地面点在物方空间坐标系中坐标的方法

三、基本公式

1、点投影系数法



摄影基线

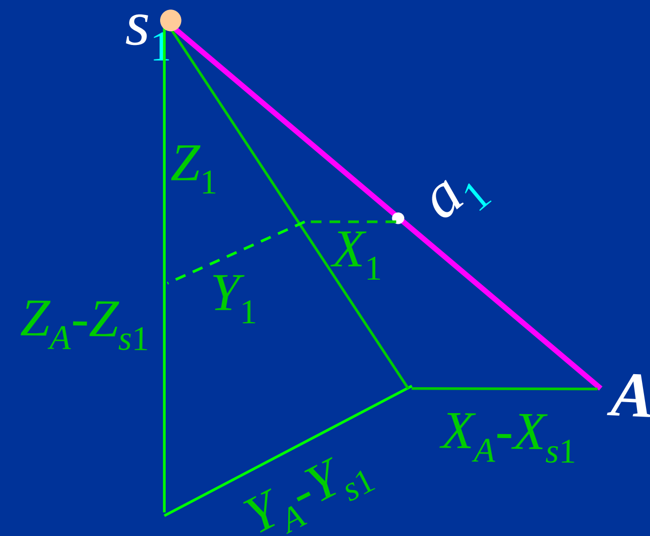


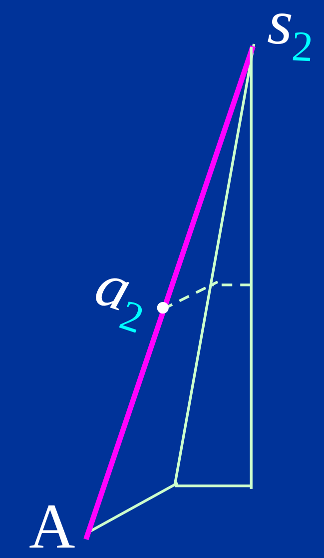
同名光线投影

$$\frac{S_1A}{S_1a_1}=\frac{X_A-X_{s1}}{X_1}=\frac{Y_A-Y_{s1}}{Y_1}=\frac{Z_A-Z_{s1}}{Z_1}=N_1$$

点投影系数

$$\frac{S_2A}{S_2a_2}=\frac{X_A-X_{s2}}{X_2}=\frac{Y_A-Y_{s2}}{Y_2}=\frac{Z_A-Z_{s2}}{Z_2}=N_2$$





点投影法前方交会

$$X_A = X_{s1} + N_1X_1 = X_{s2} + N_2X_2$$

$$Y_A = Y_{s1} + N_1Y_1 = Y_{s2} + N_2Y_2$$

$$Z_A = Z_{s1} + N_1Z_1 = Z_{s2} + N_2Z_2$$

$$Y_A = \frac{1}{2}[(Y_{s1} + N_1Y_1) + (Y_{s2} + N_2Y_2)]$$

$$B_X = X_{s2} - X_{s1} = N_1X_1 - N_2X_2$$

$$B_Y = Y_{s2} - Y_{s1} = N_1Y_1 - N_2Y_2$$

$$B_Z = Z_{s2} - Z_{s1} = N_1Z_1 - N_2Z_2$$

(1)、(3)式联立求解

$$N_1 = \frac{B_XZ_2 - B_ZX_2}{X_1Z_2 - X_2Z_1}$$

$$N_2 = \frac{B_XZ_1 - B_ZX_1}{X_1Z_2 - X_2Z_1}$$

理想像对的前方交会

$$B_X = X_{s2} - X_{s1} = B$$
$$B_Y = Y_{s2} - Y_{s1} = 0$$
$$B_Z = Z_{s2} - Z_{s1} = 0$$

$$\begin{bmatrix} X_1 \\ Y_1 \\ Z_1 \end{bmatrix} = \begin{bmatrix} x_1 \\ y_1 \\ -f \end{bmatrix}, \quad \begin{bmatrix} X_2 \\ Y_2 \\ Z_2 \end{bmatrix} = \begin{bmatrix} x_2 \\ y_2 \\ -f \end{bmatrix}$$

$$N_1 = N_2 = \frac{B}{p}$$

$$X_A = X_{S1} + \frac{B}{p} x_1 = X_{S1} + B + \frac{B}{p} x_2$$
$$Y_A = Y_{S1} + \frac{B}{p} y_1 = Y_{S1} + \frac{B}{p} y_2$$
$$Z_A = Z_{S1} - \frac{B}{p} f = Z_{S2} - \frac{B}{p} f$$

$$y_1 = y_2$$
$$q = y_1 - y_2 = 0$$

$$p = x_1 - x_2 = \frac{f}{Z_A - Z_{S1}} B = \frac{B}{m_A}$$

计算过程

- 获取已知数据 $x_0, y_0, f, X_{S1}, Y_{S1}, Z_{S1}, \varphi_1, \omega_1, \kappa_1, X_{S2}, Y_{S2}, Z_{S2}, \varphi_2, \omega_2, \kappa_2$
- 量测像点坐标 x_1, y_1, x_2, y_2
- 由外方位线元素计算基线分量 B_X, B_Y, B_Z
- 由外方位角元素计算像空间辅助坐标 $X_1, Y_1, Z_1, X_2, Y_2, Z_2$
- 计算点投影系数 N_1, N_2
- 计算地面坐标 X_A, Y_A, Z_A

三、基本公式

2、严密解法

- 已知值 $x_0, y_0, f, X_S, Y_S, Z_S, \varphi, \omega, \kappa$
- 观测值 x_1, y_1, x_2, y_2
- 未知数 X, Y, Z
- 泰勒级数展开共线条件方程

$$v_x = \frac{\partial x}{\partial X}\Delta X + \frac{\partial x}{\partial Y}\Delta Y + \frac{\partial x}{\partial Z}\Delta Z + x^0 - x$$

$$v_y = \frac{\partial y}{\partial X}\Delta X + \frac{\partial y}{\partial Y}\Delta Y + \frac{\partial y}{\partial Z}\Delta Z + y^0 - y$$

共线条件方程

$$x - x_0 = -f\frac{a_1(X - X_s) + b_1(Y - Y_s) + c_1(Z - Z_s)}{a_3(X - X_s) + b_3(Y - Y_s) + c_3(Z - Z_s)} = -f\frac{\overline{X}}{\overline{Z}}$$

$$y - y_0 = -f\frac{a_2(X - X_s) + b_2(Y - Y_s) + c_2(Z - Z_s)}{a_3(X - X_s) + b_3(Y - Y_s) + c_3(Z - Z_s)} = -f\frac{\overline{Y}}{\overline{Z}}$$

$$\begin{bmatrix} \overline{X} \\ \overline{Y} \\ \overline{Z} \end{bmatrix} = \begin{bmatrix} a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \\ a_3 & b_3 & c_3 \end{bmatrix} \begin{bmatrix} X - X_s \\ Y - Y_s \\ Z - Z_s \end{bmatrix} = \boldsymbol{R}^{-1} \begin{bmatrix} X - X_s \\ Y - Y_s \\ Z - Z_s \end{bmatrix}$$

误差方程

$$v_x = a_{11}\Delta X + a_{12}\Delta Y + a_{13}\Delta Z + x^0 - x$$
$$v_y = a_{21}\Delta X + a_{22}\Delta Y + a_{23}\Delta Z + y^0 - y$$

竖直摄影情况下，可取$\varphi=\omega=0$，保留κ，则

$$a_{11} = \frac{f}{H}\cos\kappa$$
$$a_{12} = \frac{f}{H}\sin\kappa$$
$$a_{13} = \frac{x}{H}$$

$$a_{21} = -\frac{f}{H}\sin\kappa$$
$$a_{12} = +\frac{f}{H}\cos\kappa$$
$$a_{13} = +\frac{y}{H}$$

本讲参考资料

教材

张剑清，潘励，王树根 编著，《摄影测量学》，武汉大学出版社

参考书

1、李德仁，周月琴 等编，《摄影测量与遥感概论》，测绘出版社

2、李德仁，郑肇葆 编著，《解析摄影测量学》，测绘出版社