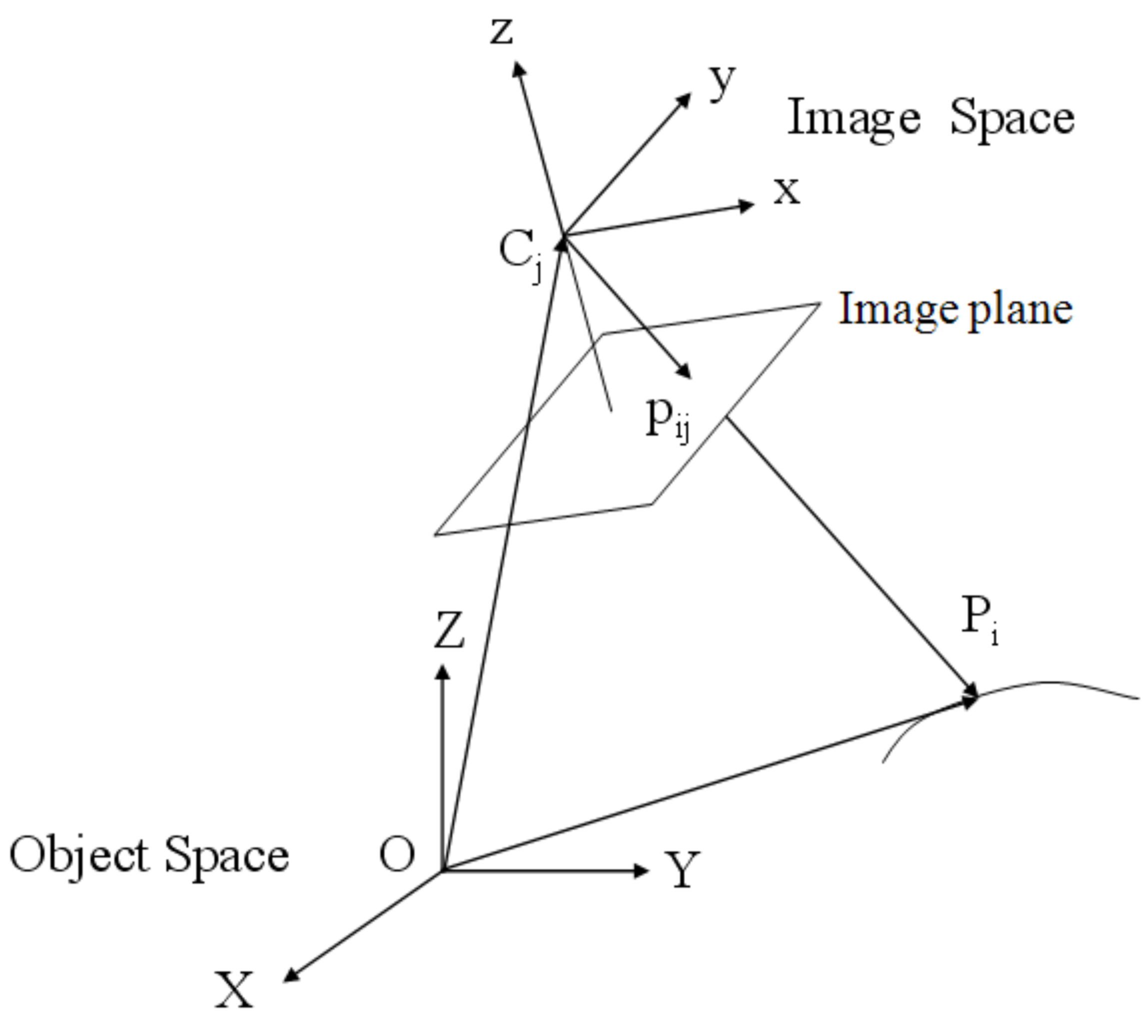
The Collinearity Condition



Collinearity Equations

- Table of specific uses of the collinearity equations

Exterior orientation parameters (EOPs)	**Interior orientation parameters (IOPs)**	**Object points**	**Adjustment case**
Unknown	Known	Known and fixed control points	Resection
Known	Known	Unknown tie points	Intersection
Unknown	Known	Known control points (fixed or weighted) Unknown tie points	Bundle adjustment (aerotriangulation)
Unknown	Unknown	Known control points (usually fixed)	Calibration (test field)
Unknown	Unknown	Unknown (minimally constrained datum definition)	Self-calibration

Collinearity Conditions and Partial Derivatives

$$x_{ij} = x_{p_j} - c_j \frac{m_{11}\left(X_i - X_j^c\right) + m_{12}\left(Y_i - Y_j^c\right) + m_{13}\left(Z_i - Z_j^c\right)}{m_{31}\left(X_i - X_j^c\right) + m_{32}\left(Y_i - Y_j^c\right) + m_{33}\left(Z_i - Z_j^c\right)} = x_{p_j} - c_j \frac{U_{ij}}{W_{ij}}$$

$$y_{ij} = y_{p_j} - c_j \frac{m_{21}\left(X_i - X_j^c\right) + m_{22}\left(Y_i - Y_j^c\right) + m_{23}\left(Z_i - Z_j^c\right)}{m_{31}\left(X_i - X_j^c\right) + m_{32}\left(Y_i - Y_j^c\right) + m_{33}\left(Z_i - Z_j^c\right)} = y_{p_j} - c_j \frac{V_{ij}}{W_{ij}}$$

$$\frac{\partial x}{\partial X^c} = -\frac{c}{W^2}\left(m_{31}U - m_{11}W\right) = -\frac{\partial x}{\partial X}$$

$$\frac{\partial x}{\partial Y^c} = -\frac{c}{W^2}\left(m_{32}U - m_{12}W\right) = -\frac{\partial x}{\partial Y}$$

$$\frac{\partial x}{\partial Z^c} = -\frac{c}{W^2}\left(m_{33}U - m_{13}W\right) = -\frac{\partial x}{\partial Z}$$

$$\frac{\partial y}{\partial X^c} = -\frac{c}{W^2}\left(m_{31}V - m_{21}W\right) = -\frac{\partial y}{\partial X}$$

$$\frac{\partial y}{\partial Y^c} = -\frac{c}{W^2}\left(m_{32}V - m_{22}W\right) = -\frac{\partial y}{\partial Y}$$

$$\frac{\partial y}{\partial Z^c} = -\frac{c}{W^2}\left(m_{33}V - m_{23}W\right) = -\frac{\partial y}{\partial Z}$$

$$\frac{\partial x}{\partial \omega} = -\frac{c}{W^2}\left\{\left(Y - Y^c\right)\left(Um_{33} - Wm_{13}\right) - \left(Z - Z^c\right)\left(Um_{32} - Wm_{12}\right)\right\}$$

$$\begin{aligned}\frac{\partial x}{\partial \phi} = -\frac{c}{W^2}\Big\{&\left(X - X^c\right)\left(-W\sin\phi\cos\kappa - U\cos\phi\right)\\ &+\left(Y - Y^c\right)\left(W\sin\omega\cos\phi\cos\kappa - U\sin\omega\sin\phi\right)\\ &+\left(Z - Z^c\right)\left(-W\cos\omega\cos\phi\cos\kappa + U\cos\omega\sin\phi\right)\Big\}\end{aligned}$$

$$\frac{\partial x}{\partial \kappa} = -\frac{cV}{W}$$

$$\frac{\partial y}{\partial \omega} = -\frac{c}{W^2}\left\{\left(Y - Y^c\right)\left(Vm_{33} - Wm_{23}\right) - \left(Z - Z^c\right)\left(Vm_{32} - Wm_{22}\right)\right\}$$

$$\begin{aligned}\frac{\partial y}{\partial \phi} = -\frac{c}{W^2}\Big\{&\left(X - X^c\right)\left(W\sin\phi\sin\kappa - V\cos\phi\right)\\ &+\left(Y - Y^c\right)\left(-W\sin\omega\cos\phi\sin\kappa - V\sin\omega\sin\phi\right)\\ &+\left(Z - Z^c\right)\left(W\cos\omega\cos\phi\sin\kappa + V\cos\omega\sin\phi\right)\Big\}\end{aligned}$$

$$\frac{\partial y}{\partial \kappa} = \frac{cU}{W}$$