GIS-E3010 Least-Squares Methods in Geoscience

Lecture 5, activation 2

<u>Exterior orientation</u>

The error equation (linearized model) is

$$\begin{bmatrix} v_x \\ \\ v_y \end{bmatrix} = \begin{bmatrix} \frac{\partial f_x}{\partial \omega} & \frac{\partial f_x}{\partial \varphi} & \frac{\partial f_x}{\partial \kappa} & \frac{\partial f_x}{\partial X_0} & \frac{\partial f_x}{\partial Y_0} & \frac{\partial f_x}{\partial Z_0} \\ \\ \frac{\partial f_y}{\partial \omega} & \frac{\partial f_y}{\partial \varphi} & \frac{\partial f_y}{\partial \kappa} & \frac{\partial f_y}{\partial X_0} & \frac{\partial f_y}{\partial Y_0} & \frac{\partial f_y}{\partial Z_0} \end{bmatrix} \begin{bmatrix} \\ \\ \\ \\ \\ \\ \end{bmatrix} - \begin{bmatrix} x - f_x^0 \\ \\ y - f_y^0 \end{bmatrix} \qquad v = Ax - y$$

What is the content of the vector *x* (the empty vector above)? How should you interpret these parameters?

Let's assume that we have two known points which have been identified from images (this is not enough to make solution). However, write (symbolically) the contents of a matrix *A* and a vector *y* in such case. Add a sub-index to x and y indicating the number of corresponding observation), e.g. for the first corresponding point, *y* is

$$y = \begin{bmatrix} x_1 - f_{x1}^0 \\ y_1 - f_{y1}^0 \end{bmatrix}$$

Solution:

$$x = \begin{bmatrix} d\omega \\ d\varphi \\ d\kappa \\ dX_0 \\ dY_0 \\ dZ_0 \end{bmatrix}$$

Interpretation is that this is a solution vector i.e. we'll get corrections to initial values of unknown parameters

$$A = \begin{bmatrix} \frac{\partial f_{x1}}{\partial \omega} & \frac{\partial f_{x1}}{\partial \varphi} & \frac{\partial f_{x1}}{\partial \kappa} & \frac{\partial f_{x1}}{\partial X_0} & \frac{\partial f_{x1}}{\partial Y_0} & \frac{\partial f_{x1}}{\partial Z_0} \\ \frac{\partial f_{y1}}{\partial \omega} & \frac{\partial f_{y1}}{\partial \varphi} & \frac{\partial f_{y1}}{\partial \kappa} & \frac{\partial f_{y1}}{\partial X_0} & \frac{\partial f_{y1}}{\partial Y_0} & \frac{\partial f_{y1}}{\partial Z_0} \\ \frac{\partial f_{x2}}{\partial \omega} & \frac{\partial f_{x2}}{\partial \varphi} & \frac{\partial f_{x2}}{\partial \kappa} & \frac{\partial f_{x2}}{\partial X_0} & \frac{\partial f_{x2}}{\partial Y_0} & \frac{\partial f_{x2}}{\partial Z_0} \\ \frac{\partial f_{y2}}{\partial \omega} & \frac{\partial f_{y2}}{\partial \varphi} & \frac{\partial f_{y2}}{\partial \kappa} & \frac{\partial f_{y2}}{\partial X_0} & \frac{\partial f_{y2}}{\partial Y_0} & \frac{\partial f_{y2}}{\partial Z_0} \end{bmatrix}$$

$$y = \begin{bmatrix} x_1 - f_{x1}^0 \\ y_1 - f_{y1}^0 \\ x_2 - f_{x2}^0 \\ y_2 - f_{y2}^0 \end{bmatrix}$$