7 parameter transformation, points observed in both systems

$$\begin{bmatrix} x \\ y \\ z \end{bmatrix} = \lambda M \begin{bmatrix} X - T_x \\ Y - T_y \\ Z - T_z \end{bmatrix}, \qquad \boxed{F = \begin{bmatrix} x \\ y \\ z \end{bmatrix} - \lambda M \begin{bmatrix} X - T_x \\ Y - T_y \\ Z - T_z \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}}$$

1 matrix equation = 3 scalar equations

shifts defined in the UpperCase system.

$$\begin{bmatrix} x \\ y \\ z \end{bmatrix} = \lambda M \begin{bmatrix} X \\ Y \\ Z \end{bmatrix} + \begin{bmatrix} t_x \\ t_y \\ t_z \end{bmatrix}, \qquad \boxed{F = \begin{bmatrix} x \\ y \\ z \end{bmatrix} - \lambda M \begin{bmatrix} X \\ Y \\ Z \end{bmatrix} - \begin{bmatrix} t_x \\ t_y \\ t_z \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}}$$

shifts defined in the lower case system. Let's choose this one !

Define the partials for 3 equations at once:

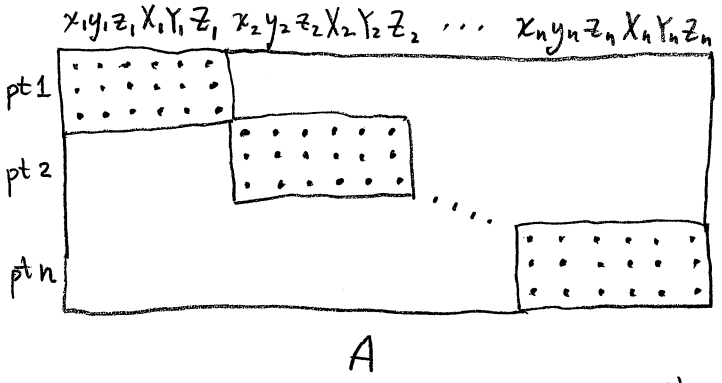
$$\frac{\partial F}{\partial x} = \begin{bmatrix} 1 \\ 0 \\ 0 \end{bmatrix}, \quad \frac{\partial F}{\partial y} = \begin{bmatrix} 0 \\ 1 \\ 0 \end{bmatrix}, \quad \frac{\partial F}{\partial z} = \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix}$$

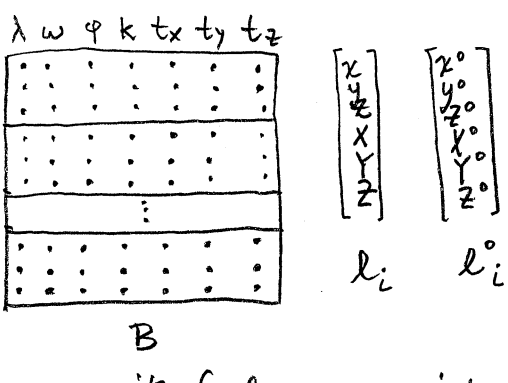
$$\frac{\partial F}{\partial X} = -\lambda M_{col1}, \quad \frac{\partial F}{\partial Y} = -\lambda M_{col2}, \quad \frac{\partial F}{\partial Z} = -\lambda M_{col3}$$

$$\frac{\partial F}{\partial \lambda} = -M \begin{bmatrix} X \\ Y \\ Z \end{bmatrix}, \quad \frac{\partial F}{\partial \omega} = -\lambda \frac{\partial M}{\partial \omega} \begin{bmatrix} X \\ Y \\ Z \end{bmatrix}, \quad \frac{\partial F}{\partial \varphi} = -\lambda \frac{\partial M}{\partial \varphi} \begin{bmatrix} X \\ Y \\ Z \end{bmatrix}, \quad \frac{\partial F}{\partial k} = -\lambda \frac{\partial M}{\partial k} \begin{bmatrix} X \\ Y \\ Z \end{bmatrix}$$

$$M = M_k M_\varphi M_\omega, \quad \frac{\partial M}{\partial \omega} = M_k M_\varphi \frac{\partial M_\omega}{\partial \omega}, \quad \frac{\partial M}{\partial \varphi} = M_k \frac{\partial M_\varphi}{\partial \varphi} M_\omega, \quad \frac{\partial M}{\partial k} = \frac{\partial M_k}{\partial k} M_\varphi M_\omega$$

$$\frac{\partial F}{\partial t_x} = \begin{bmatrix} -1 \\ 0 \\ 0 \end{bmatrix}, \quad \frac{\partial F}{\partial t_y} = \begin{bmatrix} 0 \\ -1 \\ 0 \end{bmatrix}, \quad \frac{\partial F}{\partial t_z} = \begin{bmatrix} 0 \\ 0 \\ -1 \end{bmatrix}$$





$f_{i\text{th point}} = -F_i - A_i (l_i - l_i^\circ)$

structure program with for loop per point, build A, B, f either by function or in-line code

row index: $(i-1)*3+1$, col index: $(i-1)*6+1$