HW6 Photogrammetry & Error Propagation
assigned 6 Nov, due 18 Nov 2015

Make 4 matlab functions:

$F_x = FX(A)$

$F_y = FY(B)$

$P_x = FX\_PART(A)$

$P_y = FY\_PART(B)$

$$A = \begin{bmatrix} x \\ X \\ Y \\ Z \\ X_L \\ Y_L \\ Z_L \\ \omega \\ \varphi \\ \kappa \end{bmatrix} \quad B = \begin{bmatrix} y \\ X \\ Y \\ Z \\ X_L \\ Y_L \\ Z_L \\ \omega \\ \varphi \\ \kappa \end{bmatrix} \quad P_x = \begin{bmatrix} \partial F_x/\partial x \\ \partial F_x/\partial X \\ \partial F_x/\partial Y \\ \partial F_x/\partial Z \\ \partial F_x/\partial X_L \\ \partial F_x/\partial Y_L \\ \partial F_x/\partial Z_L \\ \partial F_x/\partial \omega \\ \partial F_x/\partial \varphi \\ \partial F_x/\partial \kappa \end{bmatrix} \quad P_y = \begin{bmatrix} \partial F_y/\partial y \\ \partial F_y/\partial X \\ \partial F_y/\partial Y \\ \partial F_y/\partial Z \\ \vdots \\ \partial F_y/\partial \kappa \end{bmatrix}$$

FX, FY evaluate collinearity equations at given values.
FX_PART, FY_PART evaluate partials numerically

$$\begin{pmatrix} x \\ y \\ -f \end{pmatrix} = \lambda \underbrace{M\left[\begin{pmatrix} X \\ Y \\ Z \end{pmatrix} - \begin{pmatrix} X_L \\ Y_L \\ Z_L \end{pmatrix}\right]}_{\begin{bmatrix} u \\ v \\ w \end{bmatrix}}$$

$$\frac{x}{-f} = \frac{u}{w} \qquad x = -f \cdot \frac{u}{w} \qquad F_x = x + f \cdot \frac{u}{w} = 0$$

$$\frac{y}{-f} = \frac{v}{w} \qquad y = -f \cdot \frac{v}{w} \qquad F_y = y + f \cdot \frac{v}{w} = 0$$

f: focal length, careful about variable names.

---

1. for (a) and (b), compute Resection by LS indirect observations, using functions above. Make global test. If pass, proceed. If not pass find and remove bad observation. Then redo. (Global Test $\alpha = .05$, 2-sided)

#	X (m)	Y (m)	Z (m) (constant)	(a) obs. x (mm)	(a) obs. y (mm)	(b) obs. x (mm)	(b) obs. y (mm)
1	2482.150	5022.495	200.000	−8.515	6.866	−8.526	6.861
2	2517.850	5022.495	205.000	12.556	6.714	12.567	6.707
3	2517.850	4997.505	198.000	10.366	−7.881	10.365	−7.883
4	2482.150	4997.505	201.000	−9.527	−7.096	−9.596	−7.080
5	2491.075	5010.000	203.000	−4.330	−0.260	−4.119	−0.262
6	2500.000	5016.248	210.000	1.177	3.831	1.182	3.827
7	2508.925	5010.000	212.000	7.575	−0.894	7.586	−0.898
8	2500.000	5003.753	206.000	0.760	−4.521	0.746	−4.521

focal length 28.000 mm

$X_L \approx 2500 \quad \omega \approx 0$
$Y_L \approx 5010 \quad \Phi \approx 0$
$Z_L \approx 250 \quad \kappa \approx 0$

$\sigma_x, \sigma_y = 0.009$

for (a) make 50% conf. intv. for μ_{X_L}

for (b) make 75% conf. intv. for μ_{Y_L}

---

2. make intersection using LS and indirect observations with 3 image observations. Do global test $\alpha = .05$, and requested E.P. *

$f = 28.000$

$(x_1, y_1) = 12.556,\ 6.714$

$(x_2, y_2) = 10.002,\ 1.041$

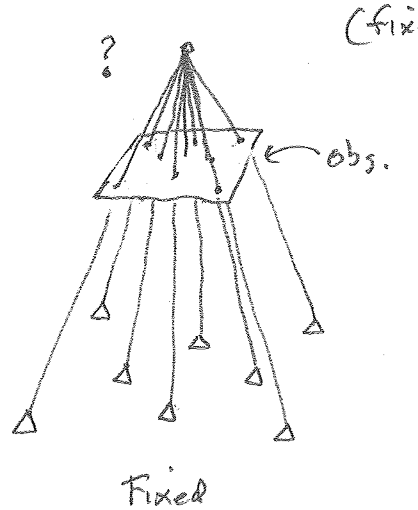
$(x_3, y_3) = 9.062,\ 2.082$

$\begin{bmatrix} X_L \\ Y_L \\ Z_L \\ \omega \\ \varphi \\ k \end{bmatrix}_1$ from 1(a), consider fixed

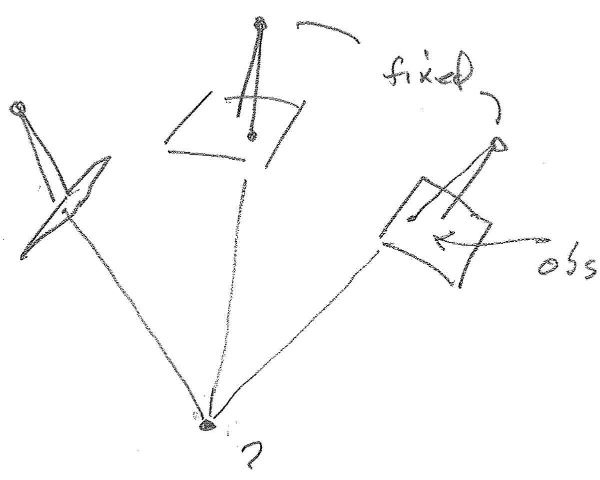
$$\begin{bmatrix} X_L \\ Y_L \\ Z_L \\ \omega \\ \varphi \\ k \end{bmatrix}_2 = \begin{matrix} 2525.000 \\ 5020.000 \\ 243.301 \\ 0 \\ 30/57.29\ R \\ 5/57.29\ R \end{matrix} \qquad \begin{bmatrix} X_L \\ Y_L \\ Z_L \\ \omega \\ \varphi \\ k \end{bmatrix}_3 = \begin{matrix} 2475.000 \\ 5020.000 \\ 243.301 \\ 0 \\ -30/57.29\ R \\ -5/57.29\ R \end{matrix}$$

(fixed) (fixed)

[* make 80% confidence ellipse and 80% confidence circle for XY]



Resection



Intersection

Notes: for Problem 2, use the coordinates of point #2 from problem 1 as initial approximations

$(X^{\circ}, Y^{\circ}, Z^{\circ}) = (2517.850, 5022.495, 205.000)$

Extra Credit: If you want some extra credit (not required) do an experiment with the numerical derivatives in the FX-PART and FZ-PART, to evaluate the stability of the derivative approximations across differing magnitudes of the Δ perturbation. Maybe compare them to the analytically derived derivatives.

use rotation order $M = M_{\kappa} \cdot M_{\varphi} \cdot M_{\omega}$