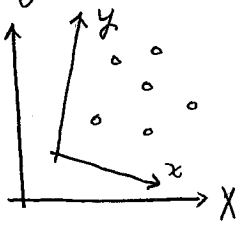
# Adj. Geospa. Obs. Homework 3

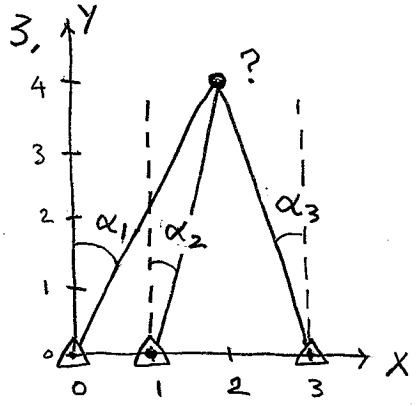
assigned Wed. 2 October, due Thur. 10 October

1. 


A set of 6 points is known in one system $(X,Y)$ and observed in another system $(x,y)$. Solve for the 2D conformal transformation parameters, using a linear model. Convert linear parameters to the physical parameters $\lambda, \theta, tx, ty$ (scale, rotation, shiftx, shifty). Observations have equal precision and are uncorrelated. Use indirect observations.

| | | | | | | |
|---|---|---|---|---|---|---|
| X | 1.00 | 2.00 | 2.00 | 3.00 | 4.00 | 5.00 |
| Y | 3.00 | 1.00 | 5.00 | 4.00 | 1.00 | 4.00 |
| x | 4.46 | 5.31 | 7.71 | 9.23 | 9.85 | 13.44 |
| y | 6.70 | 1.83 | 10.22 | 7.61 | 0.79 | 6.60 |

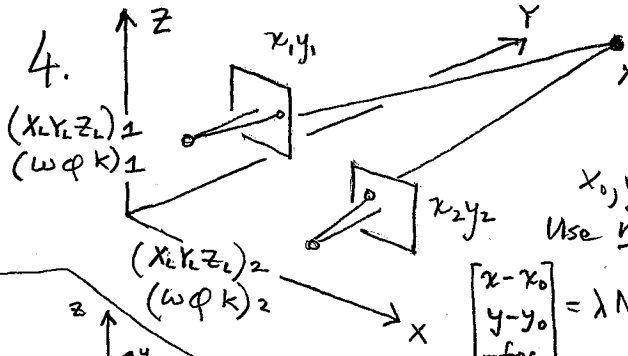
2. Take resulting parameters from problem (1) and perturb them "a little" to use as initial approximations. Then solve the nonlinear LS problem. Evaluate the convergence. Is the result the same as in problem (1) ?

3. 


Azimuth observations $\alpha_1, \alpha_2, \alpha_3$ are made from 3 control points (fixed X,Y) as shown in the sketch.

| | |
|---|---|
| $\alpha_1$ | 26.97 deg |
| $\alpha_2$ | 13.84 deg |
| $\alpha_3$ | −14.04 deg |

Use Indirect Observations to find LS estimate of the unknown point. (It is nonlinear) Weights are equal.

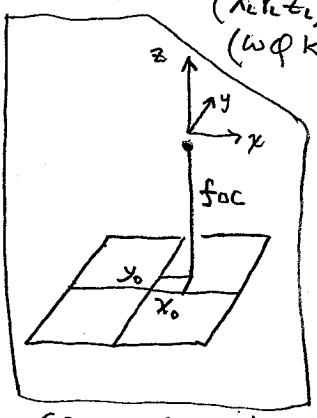
4. 


A point XYZ is observed on 2 photographs. We also observe the point directly, and we observe the exterior orientations $(\omega,\varphi,\kappa,X_L,Y_L,Z_L)$ of each photo. Interior orientation is fixed: $x_0, y_0 = 0,0$, foc = 15.0 mm. Make LS adj. by Obs. Only. Use numerical or symbolic partials.

$$\begin{bmatrix} x-x_0 \\ y-y_0 \\ -foc \end{bmatrix} = \lambda M \begin{bmatrix} x-X_L \\ Y-Y_L \\ Z-Z_L \end{bmatrix} = \lambda \begin{bmatrix} U \\ V \\ W \end{bmatrix}, \quad x = x_0 - foc \cdot U/W, \quad y = y_0 - foc \cdot V/W$$

[Eliminate nuisance parameter $\lambda$]

$M = M_\kappa M_\varphi M_\omega$




Sensor coord. system

| | $\omega$ | $\varphi$ | $\kappa$ | $X_L$ (m) | $Y_L$ (m) | $Z_L$ (m) | x (mm) | y (mm) |
|---|---|---|---|---|---|---|---|---|
| 1 | 89.05° | 2.00° | 2.94° | 10.01 | 20.02 | 44.97 | 3.345 | 0.768 |
| 2 | 90.03° | −0.98° | 2.00° | 60.03 | 9.95 | 45.04 | −4.020 | 0.783 |
| σ | 0.05° | 0.05° | 0.05° | 0.05 | 0.05 | 0.05 | 0.02 | 0.02 |

X, Y, Z: 29.0, 131.0, 52.0 ; $\sigma_x, \sigma_y, \sigma_z$ = 2.0 (m)