CIVE 7397 – Optical Imaging Metrology

Lab #3 – Relative Orientation

Lab Description

The purpose of this lab is to determine relative orientation between a pair of overlapping photos with common point measurements.

The table below contains raw (uncorrected) image measurements of common object points for both images 27 and 28. This camera is the same as that used for Lab #1 and Lab #2 and you should use the routines developed in these labs to correct for errors and distortions including atmospheric refraction (using the affine transformation). The images were capture from an elevation of 1860 meters, with an average ground elevation of 1100 meters, the scale number of the imagery is 5000, and the images are standard 9 inch square analog photographs.

Assignment

Using an affine transformation, and the transformation parameters you determined in lab #1, transform the measure image coordinates for both images into the fiducial coordinate system. Then using your functions from lab #2, correct the image measurements for lens distortion and atmospheric refraction. To verify that your transformed coordinates are correct, compare them to the corrected values given in the table below.

	Observed (right-handed) coords				Corrected Image Coordinates			
	Image 27		Image 28		Image 27		Image 28	
ID	x (pix)	y (pix)	x (pix)	y (pix)	x (mm)	y (mm)	x (mm)	y (mm)
100	9460	-2292	1411	-2081	-9.444	96.236	-105.378	98.756
101	17400	-1661	9416	-1167	85.033	103.733	-10.125	109.691
102	10059	-10883	2275	-10787	-2.318	-6.007	-95.024	-4.848
103	19158	-10412	11129	-10048	105.95	-0.413	10.334	4.012
104	11844	-17253	4160	-17085	18.919	-81.819	-72.539	-79.786
105	17842	-18028	10137	-17690	90.289	-91.049	-1.405	-86.941

Tasks:

1. Using an assumed value of 92.000 mm for the x baseline component, use the dependent relative orientation procedure described in class to determine the 5 unknown parameters for relative orientation. Give the unknown values in units of mm and decimal degrees. How many iterations were required for convergence?
2. For the least squares procedure used in Task 1, what were the convergence criteria you used for both distance and angular unknowns? Briefly justify your selection of these convergence criteria.
3. Using space intersection, compute model space coordinates for all of the observed points.
4. From your model space coordinates, compute y-parallax values for all of the point observations. Given these y-parallax values, would any of the measurements be considered possible outliers? Why or why not?
5. Plot the scale factors (for both the left and right image) obtained from task #3 for each image point. What is the primary cause of the change in scale factor from point to point?
6. Compute the correlation coefficient matrix for the least-square adjustment. Identify any of the unknown parameters that appear to be highly correlated. How could this correlation be reduced?

Notes:

- Points will be deducted for sloppy programming style and/or results format, and failure to properly document your code, and tabular results.
- If your lab #1 and #2 programs do not give the results in the above table, then use the measurements in the above table (some points will be deducted from your overall score).

Due Date: March 22, 2023 at 10:00 am (hand in at start of class)