CIVE 6374 – Optical Imaging Metrology

Lab #4 – Absolute Orientation

Lab Description

The purpose of this lab is to determine absolute orientation of the model that was relatively oriented in Lab #3.

The table below contains corrected (i.e. lens distortion and atmospheric effects already removed) image measurements of common object points for both images 27 and 28. This camera is the same as that used for Lab #1, #2 and #3. 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 the relative orientation results from lab #3, and the coordinates of known object space points given in the table, determine the absolute orientation parameters to transform the relative model into object space.

	Corrected Image Coordinates				Independently-Surveyed Ground Control Point Coordinates		
	Image 27		Image 28				
ID	x (mm)	y (mm)	x (mm)	y (mm)	X(m)	Y(m)	Z(m)
100	-9.444	96.236	-105.378	98.756	-399.28	-679.72	1090.96
101	85.033	103.733	-10.125	109.691			
102	-2.318	-6.007	-95.024	-4.848			
103	105.95	-0.413	10.334	4.012			
104	18.919	-81.819	-72.539	-79.786	475.55	-538.18	1090.5
105	90.289	-91.049	-1.405	-86.941	517.62	-194.43	1090.65
200	18.174	109.538	-77.840	113.375	-466.39	-542.31	1091.55
201	44.681	7.483	-48.786	10.165	42.73	-412.19	1090.82
202	-7.578	-49.077	-98.814	-48.039	321.09	-667.45	1083.49
203	52.736	-93.140	-38.924	-90.035	527.78	-375.72	1092

Tasks:

1. Using the above observations, and the relative orientation determined in lab #3, compute the absolute orientation parameters (all seven) for the model **USING ONLY POINTS 100, 104 and 105**.
2. For the least squares procedure used in Task 1, what were the convergence criteria you used for distance, scale and angular unknowns? Briefly justify your selection of these convergence criteria.
3. Using your absolute orientation solution, compute the residuals in object space for points 100, 104 and 105. Compute the RMSE of the residuals in all three coordinate directions.
4. Compute object space coordinates for the perspective centers of images 27 and 28.
5. Determine object space coordinates for points 200, 201, 202 and 203, and compare them to the known coordinates for these points given in the table above. Compute the RMSE of the residuals in all three coordinate directions.
6. Compare the RMSE of the residuals from tasks 3 and 5. Are they of similar size? How do they compare with the expected errors for this stereo pair (use flight height and scale above to estimate expected errors).
7. 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?
8. Compute final transformation angles (Cardan sequence) for the transformation from object space to image space for both images 27 and 28.

Notes:

- Points will be deducted for sloppy programming style and/or results format, and failure to properly document your code, and tabular results.

Due Date: April 5, 2023 at 10:00 am (hand in at start of class)