HACETTEPE UNIVERSITY
DEPARTMENT OF
GEOMATICS ENGINEERING

GMT345

REMOTE SENSING AND IMAGE PROCESSING

HOMEWORK -1

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Regardless of the assignment, taking more GCP than necessary can be time consuming and costly. In this assignment, I chose 9 control points and 3 checkpoints from among 30 points, and when choosing, I made sure that they were distributed homogeneously in the image.

The GCP numbers in the " inputgcps.gcc and referencegcps.gcc " files refer to the following GCP numbers in the assignment.

" Input_gcps → gcps in assignment "

GCP#1 → GCP 1	GCP#2 → GCP 17	GCP#3 → GCP 19	GCP#4 → GCP 21
GCP#5 → GCP 25	GCP#6 → GCP 3	GCP#7 → GCP 29	GCP#8 → GCP 23
GCP#9 → GCP 13	GCP#10 → GCP 28	GCP#11 → GCP 9	GCP#12 → GCP 24

1) The degree of the polynomial that you have used. Why?

I chose a " 2nd degree " polynomial because the higher the degree of the polynomial, the more flexible the model and the better it can fit the data, whereas polynomials with many degrees (usually more than 2 and 3) indicate that the model is complex, so geometric distortions in the image are simple and I decided that since there was enough data, it could be corrected with a 2nd-order polynomial quite successfully.

2) For the GCPs ; "The table with the GCPs and their errors is in Figure 1"

- a. Average RMS error value ; 0.281

- b. The point with the largest RMS error and its value ; GCP#1 → GCP 1 : 0.452

  "I can explain the reasons for the RMS errors as being errors in marking GCPs on the image, measurement errors in the accurate coordinates of the GCPs, incorrect setting of parameters in the process, or errors resulting from the quality of the image. However, I think the amount of error is low. The point with the highest RMS error is the point where geometric correction is most difficult and unsuccessful. In this image, I can explain the highest RMS error as being due to my inability to accurately place the control points on the image (shift them) when marking them on the image, or due to small errors in the coordinates of the GCPs used in the accurate coordinates."

- c. The point with the lowest RMS error and its value ; GCP#6 → GCP 3 : 0.088

  "Geometric correction is more successful at this point. A low RSM error means that the objects in the image are closest to their true shapes. I can explain the reason for the small error as being due to the GCP points on the visual being marked in a more precise location when marking their coordinates."

Point #	Point ID	Color	X Input	Y Input	X Ref.	Y Ref.	Type	X Residual	Y Residual	RMS Error	Contrib.	Match
1	GCP #1		819.875	-424.375	477091.520	4415444.120	Control	-0.295	0.342	0.452	1.488	
2	GCP #2		518.875	-1010.375	476909.790	4415091.790	Control	0.285	-0.242	0.374	1.231	
3	GCP #3		491.625	-2121.875	476890.220	4414424.940	Control	-0.155	0.142	0.210	0.692	
4	GCP #4		1523.375	-2253.375	477510.950	4414343.750	Control	0.113	-0.177	0.210	0.692	
5	GCP #5		1734.375	-1872.375	477638.780	4414572.700	Control	-0.206	0.202	0.288	0.950	
6	GCP #6		1641.125	-475.375	477585.330	4415413.480	Control	0.048	0.074	0.088	0.290	
7	GCP #7		939.375	-1622.375	477160.560	4414724.550	Control	0.018	0.255	0.255	0.841	
8	GCP #8		1470.625	-1383.625	477480.880	4414867.160	Control	0.144	-0.154	0.211	0.696	
9	GCP #9		992.625	-941.875	477194.190	4415132.930	Control	0.048	-0.440	0.443	1.460	

Figure 1:GCPs control points and errors

3) For the check points; "The table with the checkpoints and errors of the GCPs is in Figure 2"

- a. Average RMS error value ; 0.269

- b. The point with the largest RMS error and its value ; GCP#10 → GCP 28 : 0.358

  "Checkpoints are points used to check the accuracy of the geometric correction process. The reason for the error may be that the image is dirty or blurry, which can make it difficult to properly identify the checkpoints. The coordinates of the checkpoints may be incorrect, or there may be very few checkpoints used in the image. However, in my opinion, the reason for the error appearing more at this point is that the GCP markings are not marked with precision when compared to other points."

- c. The point with the lowest RMS error and its value ; GCP#12 → GCP 24 : 0.217

  "There can be many reasons for the error to be less at this point. These can be the correct placement of the check points, the correct measurement of the coordinate system of the images to be corrected, or the correct selection of the check points. In my opinion, the reason for the RMS error to be lower at this point is due to more accurate marking of the GCP point in the image."

Point #	Point ID	Color	X Input	Y Input	X Ref.	Y Ref.	Type	X Residual	Y Residual	RMS Error	Contrib.	Match
1	GCP #1		819.875	-424.375	477091.520	4415444.120	Control					
2	GCP #2		518.875	-1010.375	476909.790	4415091.790	Control					
3	GCP #3		491.625	-2121.875	476890.220	4414424.940	Control					
4	GCP #4		1523.375	-2253.375	477510.950	4414343.750	Control					
5	GCP #5		1734.375	-1872.375	477638.780	4414572.700	Control					
6	GCP #6		1641.125	-475.375	477585.330	4415413.480	Control					
7	GCP #7		939.375	-1622.375	477160.560	4414724.550	Control					
8	GCP #8		1470.625	-1383.625	477480.880	4414867.160	Control					
9	GCP #9		992.625	-941.875	477194.190	4415132.930	Control					
10	GCP #10		1224.875	-1391.375	477332.970	4414862.790	Check	0.282	-0.221	0.358	1.297	
11	GCP #11		1509.625	-685.625	477505.720	4415287.180	Check	0.045	0.227	0.231	0.838	
12	GCP #12		1152.125	-1969.375	477287.640	4414515.630	Check	-0.179	0.122	0.217	0.784	
13	GCP #13						Control					

Figure 2: GCPs check points and errors

4) The resampling method that you have used. Why?

I used the Bicubic method because the Bicubic resampling method is generally considered the best option for producing high-quality results (produces smoother tonal gradations). Other methods are quick and simple, but may produce jagged or blocky results. I used the bicubic method as it will produce smooth results since I don't have much data in the image.

5) Evaluate your results by comparing them with a Basemap of your choice.

Geometric correction has been successfully completed and a model has been generated. This model was compared to Open Street Map and the image was analyzed. As a result of the analysis, it was determined that the RMS errors were acceptable or low, so the model has relatively been correct. When looking at the map (OSM), similarities and compatibility were found between the images. I noticed that the sizes of the objects in the image were close to the sizes of the objects in OSM, and I saw that the locations were correct.