

**CENTER FOR PHOTOGRAMMETRIC TRAINING  
FERRIS STATE UNIVERSITY**

**SURE 340 - Photogrammetry**

**Spring 2008/09**

**Lab #4**

**PURPOSE:** The purpose of this lab is to compute the flying height of the camera taking a vertical photograph.

- PROCEDURE:**
1. Accurately mark the x and y coordinate axes on photos 8486-2-7 and 8486-2-8 by drawing lines from opposite mid-side fiducial mark.
  2. On photo 8486-2-7, measure the x and y photographic coordinates for points 2609, 2610, 2701, 2702, 2703, and 2801.
  3. On photo 8486-2-8, measure the x and y photographic coordinates of points 2703, 2726, 2801, 2802, 2803, and 2809.
  4. Compute the flying height of the camera for both photographs. On photo 8486-2-7, use point combinations 2609-2701, 2609-2703, 2610-2702, 2610-2801, and 2703-2801. For photo 8486-2-8, use point combinations 2703-2801, 2703-2802, 2726-2801, 2726-2802, and 2802-2809, .
  5. The scale relationship is used to determine the flying height. A simple approach is to use the iterative approach. Using the measured photo coordinates, compute the photo distance  $ab = \sqrt{(x_b - x_a)^2 + (y_b - y_a)^2}$ . Similarly, compute the ground distance based on the ground coordinates by  $AB = \sqrt{(X_B - X_A)^2 + (Y_B - Y_A)^2}$ .
  6. Compute the initial flying height using the scale relationship:

$$S = \frac{ab}{AB} = \frac{f}{H - h} \quad \Rightarrow \quad H' = \left( \frac{AB}{ab} \right) f + h_{AVG}$$

where  $h_{AVG}$  is the average elevation of the ends of the line and  $f$  is the focal length that is 152.997 mm. We know that this scale relationship is not correct unless the ground is flat.

7. Check the results by computing the X and Y coordinates of the points based on the scale relationship:

$$X = \frac{H' - h}{f} x \quad Y = \frac{H' - h}{f} y$$

Compute the ground distance between the two ends of the line using  $AB' = \sqrt{(X_B - X_A)^2 + (Y_B - Y_A)^2}$  where  $AB'$  is the ground distance calculated from the scale relationship.

8. Since the actual ground distance is known, and treated as “true”, any discrepancy can be primarily based on the error in the estimate of the flying height. Compare  $AB$  to  $AB'$  and if they agree to within 0.20 m then the estimated flying height is correct.
9. If the difference between the true and calculated ground distances is too large, then adjust the estimate of the flying height. This is based on the relationship:

$$H = \frac{AB}{AB'} (H' - h_{Avg}) + h_{Avg}$$

10.  $H$  becomes  $H'$  and return to step 7. This process is continued until the differences in the known “true” ground distance to the calculated coordinates based on the photo measurements.
11. Discuss your results and explain why the flying height may be different between the two photographs and even between points on the same photo. If blunders occur, re-observe the photo measurements.