

Unit 9 - Week 7:Photogrammetry

Course outline

How does an NPTEL online course work?

Week 0: Prerequisite

Week 1: Introduction to Higher Surveying and Coordinate System & Reference Frame

Week 2: Coordinate System and Reference Frame & Time and Astronomy

Week 3: Time and Astronomy & Error, Accuracy, and Adjustments Computations

Week 4: Error, Accuracy, and Adjustments Computations

Week 5: Error, Accuracy, and Adjustments Computations, GPS & Photogrammetry

Week 6: Photogrammetry

Week 7: Photogrammetry

- Quiz : Assignment 7
- Lec 1:Analytical photogrammetry-II
- Lec 2:Photogrammetric products
- Lec 3: Image matching
- Weekly feedback form for week 7

Week 8:Photogrammetry & LIDAR (LIDARgrammetry)

Week 9: RADAR (RADARgrammetry)

Week 10: RADAR (RADARgrammetry)

Week 11: RADAR (RADARgrammetry) & Hydrographic Survey

Week 12: Hydrographic Survey & Navigation

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Assignment 7

The due date for submitting this assignment has passed. **Due on 2020-03-16, 23:59 IST.**
As per our records you have not submitted this assignment.

1) In the absolute orientation process, $Y = \mu MX + T$ 1 point

Given, $X = \begin{bmatrix} 20 \\ 30 \\ 140 \end{bmatrix}$, $M = \begin{bmatrix} \omega = 30^\circ, \phi = 50^\circ, K = 60^\circ \end{bmatrix}$, $T = \begin{bmatrix} 5 \\ 6 \\ 7 \end{bmatrix}$, $\mu = 1.2$, find Y

- a. $\begin{bmatrix} -4 \\ 6.3 \\ 35 \end{bmatrix}$
- b. $\begin{bmatrix} -4 \\ 35 \\ 6.3 \end{bmatrix}$
- c. $\begin{bmatrix} 4 \\ -35 \\ -6.3 \end{bmatrix}$
- d. $\begin{bmatrix} 4 \\ 35 \\ -6.3 \end{bmatrix}$

No, the answer is incorrect. Score: 0
Accepted Answers: $\begin{bmatrix} -4 \\ 35 \\ 6.3 \end{bmatrix}$

2) In collinearity equation, $M = R^{-1}$ or $M = M_x M_\phi M_\omega$ 1 point

$\frac{\partial M}{\partial \omega} = M'_\omega = MK$

What is the value of matrix K?

- a. $\begin{bmatrix} 0 & 0 & 0 \\ 0 & 0 & -1 \\ 0 & -1 & 0 \end{bmatrix}$
- b. $\begin{bmatrix} 0 & 0 & 0 \\ 0 & -1 & 1 \\ 0 & -1 & 0 \end{bmatrix}$
- c. $\begin{bmatrix} 0 & 0 & 0 \\ 0 & 0 & 1 \\ 0 & -1 & 0 \end{bmatrix}$
- d. $\begin{bmatrix} 1 & 0 & 0 \\ 0 & -1 & 0 \\ 0 & -1 & 0 \end{bmatrix}$

No, the answer is incorrect. Score: 0
Accepted Answers: $\begin{bmatrix} 0 & 0 & 0 \\ 0 & 0 & 1 \\ 0 & -1 & 0 \end{bmatrix}$

3) Consider the following and choose the correct option: Statement 1: In collinearity equation, only translating the image reference frame to origin of object reference frame can bring both reference frames parallel to each other. Statement 2: In collinearity equation, if image reference frame is rotated at different origins from perspective center) still it can become parallel to object reference frame but only difference will be created by translation and scale. 1 point

- a. Statement 1 is true and statement 2 is false
- b. Both statement 1 and statement 2 are true
- c. Statement 1 is false and statement 2 is true
- d. Both statement 1 and statement 2 are false

No, the answer is incorrect. Score: 0
Accepted Answers: c. Statement 1 is false and statement 2 is true

4) Consider the following and choose the correct option: Statement 1: In collinearity equation, we express the image coordinates of an image point as a function of object coordinates of a terrain point, and exterior orientation parameters. Statement 2: While deriving collinearity equation, we express object coordinate system as a function of image coordinates but we call collinearity equation by inverting such that the image coordinates are expressed as function of object coordinates. 1 point

- a. Statement 1 is true and statement 2 is false
- b. Both statement 1 and statement 2 are true
- c. Statement 1 is false and statement 2 is true
- d. Both statement 1 and statement 2 are false

No, the answer is incorrect. Score: 0
Accepted Answers: b. Both statement 1 and statement 2 are true

5) Consider the following and choose the correct option: Statement 1: One can find the focal length by collinearity equation if exterior orientation parameters and object coordinates of a point on ground surface are known. Statement 2: Focal length appears to be providing a sense of scale in collinearity equation because it replaces the scale factor and connects the image coordinates to object coordinates. 1 point

- a. Statement 1 is true and statement 2 is false
- b. Both statement 1 and statement 2 are true
- c. Statement 1 is false and statement 2 is true
- d. Both statement 1 and statement 2 are false

No, the answer is incorrect. Score: 0
Accepted Answers: b. Both statement 1 and statement 2 are true

6) Consider the following and choose the correct option: Statement 1: Collinearity equations are derived by dividing first and second equation by third equation and thus eliminating the scale factor (s). Elimination of scale factor removes the scale of image and so an image becomes free of scale. Statement 2: If all image reference frames and object reference frames are parallel to each other, collinearity equation will not show any thing and may lead to indeterminate form. 1 point

- a. Statement 1 is true and statement 2 is false
- b. Both statement 1 and statement 2 are true
- c. Statement 1 is false and statement 2 is true
- d. Both statement 1 and statement 2 are false

No, the answer is incorrect. Score: 0
Accepted Answers: d. Both statement 1 and statement 2 are false

7) Coplanarity equation is derived by equating the volume of a triangle formed by a surface triangle between perspective centers and ground point on terrain. Statement 2: If volume of triangle formed by airbase and vectors, connecting perspective centers to ground point is not equal to zero, it means that two triangles of coplanarity equations are formed from opposite sides from two different origins. 1 point

- a. Statement 1 is true and statement 2 is false
- b. Both statement 1 and statement 2 are true
- c. Statement 1 is false and statement 2 is true
- d. Both statement 1 and statement 2 are false

No, the answer is incorrect. Score: 0
Accepted Answers: a. Statement 1 is true and statement 2 is false

8) Consider the following and choose the correct option: Statement 1: Coplanarity equation can be used for relative orientation where we orient one image to another by taking image reference frame of one image as reference. Statement 2: Coplanarity equations can be used for orienting individual images after using collinearity equation first for orienting individual image in object reference frame. 1 point

- a. Statement 1 is true and statement 2 is false
- b. Both statement 1 and statement 2 are true
- c. Statement 1 is false and statement 2 is true
- d. Both statement 1 and statement 2 are false

No, the answer is incorrect. Score: 0
Accepted Answers: b. Both statement 1 and statement 2 are true

9) Consider the following and choose the correct option: Statement 1: Changing the camera across an air base will acquire the overlapping images though, the different resolution will not allow coplanarity equation to be established. Statement 2: Changing cameras for data acquisition of overlapping images having perspective centers distant by air base will affect the rotation between the image reference frame mutually for relative orientation. 1 point

- a. Statement 1 is true and statement 2 is false
- b. Both statement 1 and statement 2 are true
- c. Statement 1 is false and statement 2 is true
- d. Both statement 1 and statement 2 are false

No, the answer is incorrect. Score: 0
Accepted Answers: d. Both statement 1 and statement 2 are false

10) Consider the following and choose the correct option: Statement 1: If a camera is changed, interior orientation parameters will also change because interior orientation parameters define the geometry between image and image reference frame. Statement 2: Exterior orientation parameters are not changed even if the camera is replaced by another camera. However, exterior orientation parameters change if position of camera is changed. 1 point

- a. Statement 1 is true and statement 2 is false
- b. Both statement 1 and statement 2 are true
- c. Statement 1 is false and statement 2 is true
- d. Both statement 1 and statement 2 are false

No, the answer is incorrect. Score: 0
Accepted Answers: b. Both statement 1 and statement 2 are true

11) A digital image has the following values: 1 point

| Row number | Column number | Intensity |
|------------|---------------|-----------|
| 10 | 12 | 138 |
| 10 | 13 | 132 |
| 11 | 12 | 134 |
| 11 | 13 | 130 |

Calculate the intensity for a point at row number 10.4, column number 12.8 by bilinear interpolation.

- a. 134.24
- b. 136.24
- c. 132.24
- d. 130.24

No, the answer is incorrect. Score: 0
Accepted Answers: c. 132.24

12) Read the following and choose the correct option: Statement 1: Orthophoto is an orthogonal projection of image which is a perspective projection of a scene. Statement 2: Orthophoto is prepared by removing sensor tilt and relief effects using DEM and image. 1 point

- a. Statement 1 is true and statement 2 is false
- b. Both statement 1 and statement 2 are true
- c. Statement 1 is false and statement 2 is true
- d. Both statement 1 and statement 2 are false

No, the answer is incorrect. Score: 0
Accepted Answers: b. Both statement 1 and statement 2 are true

13) A vertical stereopair is acquired from an altitude of 10 km using a camera of 152.4 mm focal length. The air base (distance between two exposure stations) is 1280 ft. If the error in the measurement of parallax, flying height and air base are respectively ± 0.04 mm, ± 6 ft and ± 6 ft. The parallax for a point is measured as 93.22 mm. Calculate the error in the measurement of the point. 1 point

- a. ± 14.419 m
- b. ± 14.415 m
- c. ± 14.410 m
- d. ± 14.418 m

No, the answer is incorrect. Score: 0
Accepted Answers: b. ± 14.415 m

14) The coordinates of a point in image is row 3824, column 800 and on digital map (GSD=0.5 m), the same point has coordinates 588,800 m E, 4,479,000 m N. Find the coordinates of the point in the orthophoto, produced using backward. 1 point

- a. 589250, 4477088
- b. 589251, 4477089
- c. 589252, 4477086
- d. 589253, 4477087

No, the answer is incorrect. Score: 0
Accepted Answers: a. 589250, 4477088

15) If a point is located on ground at (3,4.5) and exposure station is located at (8.6,7), find the orthophoto error due to DSM, if the error in the DSM is 2m? 1 point

- a. 5.385
- b. 5.395
- c. 5.375
- d. 5.365

No, the answer is incorrect. Score: 0
Accepted Answers: a. 5.385

16) How do you compare the planimetric accuracy (σ_{xy}) of two images acquired from two different cameras (say P and Q) at the same height. (assume same GSD, k_x, k_y are the constants of image measurement accuracy for the camera) 1 point

- a. $\frac{(\sigma_{xy})_P}{(\sigma_{xy})_Q} = \frac{GSD_P}{GSD_Q} \times \frac{k_y}{k_x}$
- b. $\frac{(\sigma_{xy})_P}{(\sigma_{xy})_Q} \times \frac{k_y}{k_x} = 1$
- c. $(\sigma_{xy})_a \times k_x - (\sigma_{xy})_b \times k_y = 0$
- d. Comparison not possible

No, the answer is incorrect. Score: 0
Accepted Answers: c. $(\sigma_{xy})_a \times k_x - (\sigma_{xy})_b \times k_y = 0$

17) Consider the following and choose the correct option: Statement 1: We prefer to use 50% of collected points on ground as GCPs because remaining 1 point 50% points can be used for validation of accuracy for the tie points. Statement 2: Accuracy validation by comparing the calculated values of 3D coordinates of point and 3D coordinates of ground points by DGPS or map is essential because this gives the criterion for accuracy estimate of other points, which may be used to generate 3D coordinates independently. 1 point

- a. Statement 1 is true and statement 2 is false
- b. Both statement 1 and statement 2 are true
- c. Statement 1 is false and statement 2 is true
- d. Both statement 1 and statement 2 are false

No, the answer is incorrect. Score: 0
Accepted Answers: c. Statement 1 is false and statement 2 is true

18) Consider the following and choose the correct option: Statement 1: Digital elevation model (DEM) is a term that is used for photogrammetry shows the terrain in well edged boxes which is the errorless representation of terrain surface 1 point

- a. Statement 1 is true and statement 2 is false
- b. Both statement 1 and statement 2 are true
- c. Statement 1 is false and statement 2 is true
- d. Both statement 1 and statement 2 are false

No, the answer is incorrect. Score: 0
Accepted Answers: d. Both statement 1 and statement 2 are false

19) Consider the following and choose the correct option: Statement 1: The vertical focus of high rise buildings, are shown by square grids of a DEM. So 1 point that one can find the fitness of vertical walls of a building. Statement 2: DEM can be considered as collection of cubes, which are stacked vertically to show the terrain. 1 point

- a. Statement 1 is true and statement 2 is false
- b. Both statement 1 and statement 2 are true
- c. Statement 1 is false and statement 2 is true
- d. Both statement 1 and statement 2 are false

No, the answer is incorrect. Score: 0
Accepted Answers: a. Statement 1 is true and statement 2 is false

20) For a DEM, following are observations for (z) coordinates of different points with observations measured on ground by DGPS. 1 point

| Z_{DEM} | Z_{DGPS} |
|-----------|------------|
| 10 m | 11.9 m |
| 12 m | 13.2 m |
| 14 m | 15.9 m |
| 08 m | 08.9 m |
| 10 m | 11.2 m |

Calculate the RMSE of DEM from given data and decide that what should be minimum contour interval of contour map generated from this DEM.

- a. 6 m
- b. 8 m
- c. 9 m
- d. 10 m

No, the answer is incorrect. Score: 0
Accepted Answers: d. 10 m

21) Consider the following and choose the correct option: Statement 1: Increasing B/H ratio (airbase to flying height) will increase the accuracy of DEM. Statement 2: Increasing the B/H ratio is equivalent of increasing (b/f) ratio because case numerators of two terms increases. 1 point

- a. Statement 1 is true and statement 2 is false
- b. Both statement 1 and statement 2 are true
- c. Statement 1 is false and statement 2 is true
- d. Both statement 1 and statement 2 are false

No, the answer is incorrect. Score: 0
Accepted Answers: b. Both statement 1 and statement 2 are true

22) GCPs, each of accuracy 20 cm is to be collected. If GCPs are collected on a DEM, what should be minimum accuracy of DEM. 1 point

- a. 5 cm
- b. 6 cm
- c. 3 cm
- d. 2 cm

No, the answer is incorrect. Score: 0
Accepted Answers: c. 3 cm

23) Consider the following and choose the correct option: Statement 1: Orthomap is prepared by rectifying an image using the elevation values of DEM for pixels' locations of image. Therefore, there is no roll of DEM cell size. Statement 2: DEM is only useful for collecting the Z values for an image point because point is first identified in image and corresponding z value to that pixel is observed from DEM for purpose of rectification. 1 point

- a. Statement 1 is true and statement 2 is false
- b. Both statement 1 and statement 2 are true
- c. Statement 1 is false and statement 2 is true
- d. Both statement 1 and statement 2 are false

No, the answer is incorrect. Score: 0
Accepted Answers: c. Statement 1 is false and statement 2 is true

24) Consider the following and choose the correct option: Statement 1: In forward projection, we use image coordinates exterior orientation and interior orientation parameters to find 3D coordinates of an image point, for which we already know the 3D ground coordinates from DEM. Using two sets of 3D coordinates of a ground point, we calculate the accuracy of orthomap. Statement 2: In backward projection, we calculate image coordinates (x',y') of a point on image using 3D coordinates of corresponding point on DEM and interior orientation and exterior orientation parameters. Later, we calculate the accuracy by differencing calculated (x',y') and actual coordinates (x,y) of an image point and report the accuracy of orthophoto in terms of pixels. 1 point

- a. Statement 1 is true and statement 2 is false
- b. Both statement 1 and statement 2 are true
- c. Statement 1 is false and statement 2 is true
- d. Both statement 1 and statement 2 are false

No, the answer is incorrect. Score: 0
Accepted Answers: b. Both statement 1 and statement 2 are true

25) Consider the following and choose the correct option: Statement 1: Error of orthophoto for image point which is located towards image corners are more than the image points which are closer to principle point. Statement 2: Orthomap error at a point is directly proportional to error of DEM and cell size of DEM. 1 point

- a. Statement 1 is true and statement 2 is false
- b. Both statement 1 and statement 2 are true
- c. Statement 1 is false and statement 2 is true
- d. Both statement 1 and statement 2 are false

No, the answer is incorrect. Score: 0
Accepted Answers: a. Statement 1 is true and statement 2 is false

26) In Forstner Operator, the uncertainty in determining the position of a point does not depend on_____ 1 point

- a. Size of the Sobel operator used for detecting the point
- b. Covariance of the noise of the point
- c. Magnitude of the gradients around that point
- d. Resolution of the image

No, the answer is incorrect. Score: 0
Accepted Answers: d. Resolution of the image

27) In the generalized least squares matching, we have not considered any translation in the position of points in the two images. How many parameters are needed to be defined for matching two images? 1 point

- a. 6
- b. 8
- c. 2
- d. 4

No, the answer is incorrect. Score: 0
Accepted Answers: d. 4

28) What do we assume in the least squares image matching of two images which are acquired at the same time, and at the same altitude under the same ambient conditions (illumination) but at different locations with different views (stereo normal case)? 1 point

- a. Radiometric change, geometric change
- b. No change in geometry, radiometric change
- c. No change in radiometry, geometry of two image
- d. No change in radiometry of two images, only change is the geometry

No, the answer is incorrect. Score: 0
Accepted Answers: c. No change in radiometric, geometry of two image

29) Given a 3x3 array of DN from an image: 1 point

| | | |
|----|----|----|
| 15 | 22 | 26 |
| 18 | 46 | 13 |
| 25 | 16 | 14 |

Find the gradient magnitude and direction of pixel having DN value 46, given Sobel operator as:

$$S_x = \begin{bmatrix} 1 & 2 & 1 \\ 0 & 0 & 0 \\ -1 & -2 & -1 \end{bmatrix}$$

- a. 54.46°
- b. 18,44,57°
- c. 19,34,46°
- d. 20,64,46°

No, the answer is incorrect. Score: 0
Accepted Answers: a. 54.46°

30) Consider the following and choose the correct option: Statement 1: Image matching is not possible if scene is of homogenous intensity (e.g. desert, glacier surface or white building) because image matching is based on similar contrast of illumination around a pixel. Statement 2: In image matching, though we know that image is a discrete set of pixels, each is located by discrete coordinates (x,y), the intensity values are continuous functions over 2D space and so we use derivative based methods. 1 point

- a. Statement 1 is true and statement 2 is false
- b. Both statement 1 and statement 2 are true
- c. Statement 1 is false and statement 2 is true
- d. Both statement 1 and statement 2 are false

No, the answer is incorrect. Score: 0
Accepted Answers: b. Both statement 1 and statement 2 are true

31) Consider the following and choose the correct option: Statement 1: Image matching between two images compares two images over each other and 1 point so by minimizing the errors of variations in illumination, overall pixels image matching is achieved. Statement 2: Point identification in two images are independent of each other, because point is identified by calculating the contrast in illumination of surrounding pixels around a candidate pixel.

- a. Statement 1 is true and statement 2 is false
- b. Both statement 1 and statement 2 are true
- c. Statement 1 is false and statement 2 is true
- d. Both statement 1 and statement 2 are false

No, the answer is incorrect. Score: 0
Accepted Answers: c. Statement 1 is false and statement 2 is true

32) Consider the following and choose the correct option: Statement 1: In feature identification, a point which is to be identified, is characterized by contrast in illumination with respect to surrounding pixels. So, a Sobel operator of smaller size is also applicable even for low illumination scenes. (say 3x3) Statement 2: For identification of image points by Forstner operator, we use sobel operator having some fixed kernel values, which has zero mean value. It works, because for uniform illumination areas (homogeneous areas) will have derivative value equal to zero while areas having distinct features will have positive values of derivatives around a pixel. 1 point

- a. Statement 1 is true and statement 2 is false
- b. Both statement 1 and statement 2 are true
- c. Statement 1 is false and statement 2 is false
- d. Both statement 1 and statement 2 are false

No, the answer is incorrect. Score: 0
Accepted Answers: b. Both statement 1 and statement 2 are true