INSTITUTE OF REMOTE SENSING

ANNA UNIVERSITY, CHENNAI - 600 025.

LAB MANUAL

PHOTOGRAMMETRY LABORATORY

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Expt No. 1	TESTING STEREOVISION WITH TEST CARD	Date of Expt:

Aim:

To perform a preliminary test in stereovision and to determine depth perception which is also useful in developing stereovision.

Materials required:

- Pocket stereoscope
- Test card

Procedure:

- Place the stereogram card/test card over the table
- Keep the pocket stereoscope vertically over the stereogram card and adjust the eye base slightly (if needed) with the screw provided till correct fusion is obtained.
- Tighten the screw and fix the eye base.
- View through the pocket stereoscope and observe the stereogram card. Try to obtain depth perception and become accustomed to it by viewing all the normal pictures (given eye becomes tired, we can stop for a while).
- Determine the order of depth of each object on the card and enter your result in the form (Always follow the same sequence of depth from near to far/descending order from top to bottom).
- Secondly, within each object, determine the order of depth of each item and enter your result in the form.

OBSERVATION:

ORDER OF CIRCLE:

RESULT:

Thus, the depth perception is achieved.

Expt No. 2	MIRROR STEREOSCOPE- BASE LINING AND ORIENTATION OF AERIAL PHOTOGRAPHS AND PHOTO INTERPRETATION.	Date of Expt:

AIM:

To determine the baseline and orientation of aerial photographs and perform photo interpretation using a mirror stereoscope.

MATERIALS REQUIRED:

- Aerial photographs (stereo pair)
- Mirror stereoscope
- 50 cm ruler
- Glass-Marking pencil

PROCEDURE:

DETERMINATION OF INSTRUMENT BASE:

1. Adjust the distance between the stereoscope's binoculars to match your eye base (interpupillary distance).
2. The eye base can be measured by another person using a ruler or by observing your reflection in a mirror and noting the distance between the inner edges of your pupils.
3. On the white cardboard or drawing sheet, draw a horizontal straight line approximately **40 cm long**, parallel to the edge of the table.
4. Position the line about **20 cm away** from the table's edge.
5. Place the stereoscope directly over the horizontal line.
6. Look through both binoculars. You will likely see **two separate images** of the same
7. Carefully shift the stereoscope horizontally until the two line images **coincide**, appearing as a single continuous line across the binoculars' field of view.
8. To verify alignment, alternately close one eye at a time.The line should appear **centrally positioned** within the field of view of each ocular lens.
9. Close your **right eye** and focus through the **left-hand binocular**.
10. Identify the center of the field of view and mark this point directly on the sheet.Draw a **vertical line (perpendicular)** to the horizontal line at this point. Label this as **Point A**.
11. Keep the stereoscope in position and now focus with **both eyes**.
12. Move your pencil slowly along the horizontal line while viewing through the stereoscope.
13. Stop precisely when the pencil aligns with the vertical line drawn at Point A in both binoculars. Mark this position as **Point B**.
14. Draw another vertical line at Point B, perpendicular to the horizontal line.
15. When observing through the stereoscope, the vertical lines at Points A and B should appear **fused**, forming a single line.
16. If they do not align, repeat the marking process to ensure accuracy.
17. Using a ruler, measure the **distance between Points A and B**.
18. This distance represents the **instrument base**, which should be approximately **24 cm**.

NOTE:

If the eye axes coverage during stereoscope the instrument base used may be slightly shorter than the true instrument base this will show up when stereoscopy cannot be obtained when the photographs are orientated to the separation distance AB.

ORIENTATION OF PHOTOGRAPHS:

- Take one stereoscope of the photographs and mark the principles point by joining the fiducial marks (principal points is the point of intersection of the lines joining the fiducial marks)on both photographs individually with red ink.
- Using the mirror stereoscope transfer the principle points mutually on the two photographs and draw perpendicular to the principle points and the transferred principal points with red ink or chinagraph pencil.
- In each photograph join the principal point and the transferred principal point and the line is the flight line.
- Place the left photographs in such a way that its principal point is on point A and the perpendicular to the principal point is on the perpendicular to A and at the same time, the flight line coincides with the base line AB.
- Now place the right photograph in such a way that the transferred principal point of the left photo is on point B and perpendicular to the transferred principal point coincide with the perpendicular to point B now fix the photographs securely with marketing tape fixed at the 4 corners.

NOTE:

The position of the two photographs is preferably such that the shadows visible in them fall towards the observer this facilitates stereovision.

- Summarizing one can say that the flight lines of the photos should always coincide when viewing with both eyes.
- Eye base instrument base and photo base must then be parallel so that the stereo model can now be observed by moving the stereoscope as desired while maintaining the parallelism of the instrument base and the line of flight.

NOTE:

When the stereo pair is properly oriented under the stereoscope the two fields of view must very nearly cover the same parts of the terrain with binocular observation we should see once circular common field of view. By viewing through the stereoscope, mark the overlapping areas and trace their limits then scan them thoroughly.

RESULT:

Thus the air base was determined from aerial photographs using mirror stereoscope airbase = __________.

EXPT NO. 3	SCALE OF VERTICAL PHOTOGRAPHS	DATE OF EXPT:

AIM:

To determine the scale of a vertical aerial photograph and analyze its applications in photogrammetry.

MATERIALS REQUIRED:

Vertical aerial photograph

PROCEDURE:

1. **Image Identification:**
   - Obtain a vertical aerial photograph of the area of interest.
   - Identify known features visible in both the photograph and the reference map.
2. **Measurement on Photograph:**
   - Measure the distance between two identifiable points on the photograph using a ruler.
3. **Measurement on Map:**
   - Determine the corresponding ground distance between the same points on the map.
   - Ensure the map scale is known and consistent.
4. **Scale Calculation:**
   - Use the formula:
   - Express the scale as a representative fraction (e.g., 1:10,000).
5. **Verification:**
   - Compare the calculated scale with known reference scales, if available.
6. **Application:**
   - Use the scale to estimate distances or areas directly from the photograph.

CALCULATION:

Feature	Distance on Photograph (cm)	Ground Distance (km)	Scale (1:x)
Feature 1			
Feature 2			

RESULT:

The scale of the vertical photograph was successfully calculated as 1:x, and its applications in photogrammetric analysis were demonstrated**.**

Expt No. 4	TO FIND THE HEIGHT OF THE POINT USING THE PARALLAX CONCEPT	Date of Expt:

AIM:

To find the height of the point using the Parallax concept**.**

MATERIALS REQUIRED:

- Parallax bar
- Aerial photograph
- Mirror stereoscope
- Pencil

In the stereo model of the control photographs five circles A, B, C, D, and E are marked on the objects, the height of which is to be measured.

PROCEDURE:

- Prepare orient and fix the photograph correctly.
- Identify the object for which height measurement is required and if necessary put a note draw a mark around it with a wax pencil a circle of 2cm in diameter for future reference.
- Measure with a long rule the distance between the foot of the object in the left-hand photograph and the foot of the object in the right-hand photograph also the distance between the two principal points (h_1 and h_2) of the photograph the distance between these two points is the stereoscope parallax pa of point a in the photograph in float terrain this value is practically the same for all conjugate image points and approximately equal to the distance b or the differential parallax h_1h_2
- Measure the differential parallax between the top and foot of the object as the difference between the parallax bar readings with the floating mark landed on the top and at the foot of the object, making sure that accurate readings are being obtained.
- Determine the flying height ZA over point a by the appropriate method in accordance with the data available.
- Complete the height difference between the top and foot of the object in meters from the formula.

FORMULA:

- If it is small in comparison with *pa*, the formula may be simplified with little appreciable loss in accuracy.
  Formula:
- In fact, since *pa* is probably only accurate to 0.2mm in the best of circumstances H is clear that the sample formula may be used whenever p is less than this.

NOTE:

Many parallax bars have reversed measuring scales in relation to the motion of the measuring mark. This results in higher readings for objects of higher elevation, however for the formula to remain valid p must be entered as a positive value as point (a) is selected as topographically lower (b).

CALCULATION:

RESULT:

Thus the calculated height difference for the given points using the parallax bar is as follows,

H1=

H2=

H3=

H4=

H5=

Expt No. 5A	AERIAL TRIANGULATION USING DIGITAL PHOTOGRAMMETRY	Date of Expt:

AIM:

To perform interior orientation for the given image.

SOFTWARE USED:

PHOTOMOD 3.7

THEORY:

The interior orientation is the process whereby one can recover the digital images coordinate system reference back to photogrammetric cameras metric coordinate system. The parameters that describe this are the principal distance and the image coordinates of the principal point. This is possible by measuring the image fiducial mark generally available in those taken with film cameras.

The fiducial mark measurement allows the correlation of the pixel position (column and row) in a digitized image with the corresponding millimetre values in the camera calibration system, where the optical axis intersects the object axis projection on the image plane (principal point).

PRINCIPAL POINT:

It is the point on the image where a ray of light travelling perpendicular to the image plane passes through the focal point of the lens and intersects the film.

FIDUCIAL POINT:

Marks located in the corners or edge centres of an aerial photographic image are exposed within the camera onto the original film and are used to define the frame of reference for spatial measurements of an aerial photograph.

PROCEDURE:

- Open the PHOTOMOD 3.7 software then go to the new project and save the new project as 201710756.
- Select the project type as ‘block’ and then click the coordinate system the dialogue box is open select the coordinate system as Cartesian right which is the rectangular coordinates system.
- After this the project manager dialogue box opens and it guides us for interior orientation.
- Go to the menu, click the add strip icon and name it strip I. Then move on to the add images icon to the C drive the images are named as GUD3438, GUD3437, GUD3440, and GUD3437 select and add all four images.

- Then go to modules – camera editor – select a new camera and feed the information camera name – new cam 56 focal length – 304.897, principal point – (0,0) feed the fiducial coordinates the distortion is zero.
- Click aero triangulation select the first image, give the camera parameter to zoom the image and enter the fiducial coordinates of that image by using fiducial marks.
- After entering the fiducial coordinates press the measure button it measures all four points of that image set the transformation type as affine then click ok it shows the error in the image the error should be less than 3um click save results this procedure is followed for all the other three images.

FOR IMAGE I

FOR IMAGE II

FOR IMAGE III

FOR IMAGE IV

RESULT:

Thus process of interior orientation has been performed using PHOTOMOD 3.7.

Expt No. 5B	AERIAL TRIANGULATION USING DIGITAL PHOTOGRAMMETRY	Date of Expt:

AIM:

To measure and transfer the control points and the points for the given images (i.e.,) to perform absolute and relative orientation.

REQUIREMENT:

Images to perform interior orientations

PHOTOMOD 3.7

DESCRIPTION:

- Exterior orientation represents a transformation from the ground coordinate system to the image coordinate system the exterior orientation is the position and orientation of the camera when the image is taken.
- In other words, it is the relationship between the ground and the image.

PROCEDURE:

1. **Start PHOTOMOD and Open the Project,** Launch the **PHOTOMOD** software.
2. Open the project with the name **2017107056**., Go to the **Project Manager**.
3. Under **Aero Triangulation (AT)**, start the AT process. Navigate to **Tab 2**. Import all GCPs:
4. Click on **Import**. Select the folder **Nilgiris**. Choose **All File Types**.Import all points.
5. From the imported GCPs, select **5 points** as **Check Points**.Exit the import window after completing this step.
6. In **Tab 2**, select **Measure Points**. Since there are **12 control points**, measure them as follows:
7. Measure the **first 6 points** in the **Image**. Measure the **remaining 6 points** in **Image 3**.
8. To measure a point: Place the cursor at the respective position on the image. Click **Measure Point**. Click **Done** after measuring all points Go to **Tab 4**. Perform **Measuring and Transferring of Points**:
9. Transfer the control points to the next image in the overlap region.Ensure the points are accurately transferred.
10. Add **Tie Points** in each image: Avoid placing tie points on trees, shadows, or moving objects. Select appropriate locations for tie points. Use the **Add with Correlation** option to add tie points.
11. To adjust the parallax value: Go to **Show/Add Image**. Move the point to the marked position. Save the changes.

12. After completing all the above steps, compute the **Relative Orientation**: Ensure all points (GCPs, checkpoints, and tie points) are correctly measured and transferred. Run the computation to calculate the relative orientation.

STEREO PAIRS				
N	**LEFT**	**RIGHT**	**+/-**	

RESULT:

Finally, all the images were done with absolute and relative orientation with appropriate values using PHOTOMOD 3.7.

Expt No. 6	BUNDLE BLOCK ADJUSTMENT	Date of Expt:

AIM:

To do block adjustment after aerial triangulation and to reduce.

SOFTWARE USED:

PHOTOMOD 3.7

DESCRIPTION:

- It is used to detect blunders and it reduces ground control point (GCP) measurements
- It is defined as adjusting all the overlapping images (or) photographs within the block.

PROCEDURE:

- Open your project in PHOTOMOD 3.7.
- Click start solver in block adjustment.
- Select the parameters menu.
- In the first tab, select independent stereo pairs to increase overall accuracy. Then check whether the model we use has ground control points (GCPS). If it has then no need for a free model.
- In the report tab, check all the options. Check exterior orientation
- Parameter – omega, phi, kappa. Select degrees in the unit and check the same in acceptable residuals.
- Enter 0.100 in X, Y and Z residual limits here enter the scale as 1:8000 check between models under residuals.
- Check fixed point under residual point format.
- Click on check complete – report.
- If the rms of each point is more than the specified limits it appears with an asteril (*) sign.
- To eliminate the error (*) go to the point list, checkpoint attribute – open – adjust the point – save
- Save once the RMS is free from error.

RESULT:

Thus the block adjustment is done for the images and the residuals are found and eliminated/minimized at that limit.

EXPT NO. 7	GENERATION AND EDITING OF DTM AND CONTOUR	DATE OF EXPT:

AIM:

To Generate and edit DTM and Contour

SOFTWARE USED:

PHOTOMOD 3.7

PROCEDURE:

Open project 2017107056

PICKETS:

- Go to pickets – create a layer
- Go to pickets – add from layer – triangulation points – ok
- Go to pickets – create from pickets – click the convex hull – ok
- In the main window before saving the pickets add points to improve the TIN
- Then go to vector – create layer – select a break line. A break line is the vector line which separates relief areas the break line may be the steep portion of a mountain or a valley then add the layer with the help of insert and save the pickets.

TO DRAW GRID:

- Go to TIN – create/modify grid
- TIN – grid parameters set x=30, y=30
- Click ok.

ADAPTIVE MODEL:

- Go to TIN – check – adaptive – click the convex null – create
- The adaptive model is created and then goes to TIN – accuracy control.
- Minimum value of RMS=2m
- In order to reduce the distance, select the particular point with high error and edit the nodes surrounding the points as we can't change the ground control and the points.
- With the help of stereoscope view – first place the cursor over the node + control + scrolling the mouse will change its position.
- Then compute to get the result.
- When the output to be desired is obtained save the TIN.

REGIONS:

- Go to vector – local regions – create layer
- Now digitize a region from the map and click the insert and end (enter) key.
- Select the region and vector – local region – region properties
  Use for TIN creation
  Regular
  Nodes x: 10
  y: 10
- Go to TIN – create – from the region – click convex null
- Save to region.

DEM:

To create contours, there are 2 options

- Build from TIN
- Buil from DEM
- DEM – build – ok – save the DEM
- DEM model is created.

CONTOURS:

Go to contours – build from DEM

Interval = 15m

Thick contours interval – 5m

If there are intersections then use scroll + ctrl + t by clicking the contour line twice and moving in the desired direction.

Then save the column.

ALGORITHMS FOR THE TIN MODELS:

There are several algorithms for creating TIN

- Regular
- Adaptive
- Smooth
- From vector
- From pickets
- From region

REGULAR:

It is for the image with heterogeneous properties all points are kept even though they are not correct.

ADAPTIVE:

Image with homogeneous properties widely used, reliable and pickets won't create TIN on slope areas where there is so much variation.

SMOOTH:

There is no relief displacement in the photograph used for the flat.

FROM VECTORS:

It is used where the image has many vector images like building roads etc..,

REGION:

It is used to creak TIN for your interested area.

FROM PICKETS:

They are the triangulated points – which include the manual adding of points and break lines for a smooth contour surface.

RESULT:

Thus, digital terrain modelling is prepared for the project 2010107056.

EXPT NO. 8	PREPARATION OF PLANIMETRIC MAP AND ORTHOPHOTO GENERATION	DATE OF EXPT:

AIM:

To preparea planimetric map and generate an orthophoto using photogrammetric techniques and tools.

MATERIALS REQUIRED:

- Aerial photographs or drone imagery.
- Ground control points (GCPs) with known coordinates.
- Photogrammetry software (e.g., Agisoft Metashape, Pix4D, or ERDAS Imagine).

PROCEDURE:

- Obtain high-resolution aerial or drone images of the study area.
- Ensure the images have sufficient overlap (60-80%) to enable stereo analysis.
- Identify and record the coordinates of Ground Control Points (GCPs) visible in the images.
- Use a GPS device or existing map data for precise coordinates.
- Load the images into photogrammetry software.
- Align the images to create a sparse point cloud.
- Generate a dense point cloud from the aligned images.
- Create a Digital Surface Model (DSM) to represent the topography.
- Use the DSM and GCPs to correct image distortions and create an orthophoto.
- Export the orthophoto in a suitable format (e.g., GeoTIFF).
- Digitize features like roads, buildings, and vegetation from the orthophoto.
- Add map elements such as scale bars, north arrows, and legends.
- Validate the map and orthophoto using additional ground truth data or reference maps.

RESULT:

A planimetric map and an orthophoto of the study area were successfully prepared. The outputs accurately represent spatial features and can be used for various applications such as urban planning and environmental monitoring.

EXPT NO. 9	PREPARATION OF PLANIMETRIC MAP USING DRONE IMAGES	DATE OF EXPT:

AIM:

To prepare a planimetric map using high-resolution drone images.

MATERIALS REQUIRED:

- High-resolution drone images of the study area.
- Drone with GPS-enabled camera.
- Ground control points (GCPs) with known coordinates.

PROCEDURE:

- Plan the drone flight path to cover the study area with sufficient image overlap (70% forward, 60% side).
- Set appropriate flight altitude and camera settings to ensure high-resolution imagery.
- Conduct the drone flight over the study area.
- Capture high-quality images and ensure proper geotagging.
- Place GCPs within the study area and record their precise coordinates using a GPS device.
- Ensure GCPs are visible in the captured images.
- Import drone images into photogrammetry software.
- Align the images to create a sparse point cloud.
- Generate a dense point cloud.
- Create a Digital Surface Model (DSM) using the dense point cloud.
- Use the DSM and images to extract planimetric features such as roads, buildings, and vegetation.
- Digitize these features in the software.
- Add map elements like scale bars, legends, and north arrows.
- Export the map in a printable format.

RESULT:

Thus, the planimetric map using drone images was prepared.