Benha University

Shoubra Faculty of Engineering

Photogrammetry 2B
Lecture 1: Introduction

Dr. Eng. Hassan Mohamed Hassan

Hassan.hussein@feng.bu.edu.eg

Geomatics Department

What you learn from this course

1. Be familiar with various types of Photogrammetric Orientation.
2. To know the theory of photogrammetry, photographic methods and other field considerations.
3. The Relationships of Photogrammetry with Lidar and Terrestrial laser scanning systems.
4. Learn the types of Aerial triangulation.
5. Drone systems.
6. To demonstrate how to use various photogrammetry software.
7. How to plane and ortho rectification of imagery.

Course Contents :

Week	Topics
1	Revision + coplanarity condition
2	Linearization of coplanarity condition
3	Analytical relative orientation
4	Ground coordinates of aerial photogrammetry
5	Analytical absolute orientation
6	Aerial triangulation
7	Analytical aerial triangulation
8	Midterm Exam
9	Orthophoto Generation and Digital Elevation Models
10	Laser scanning systems
11	Introduction to Lidar
12	Introduction to Drone Systems

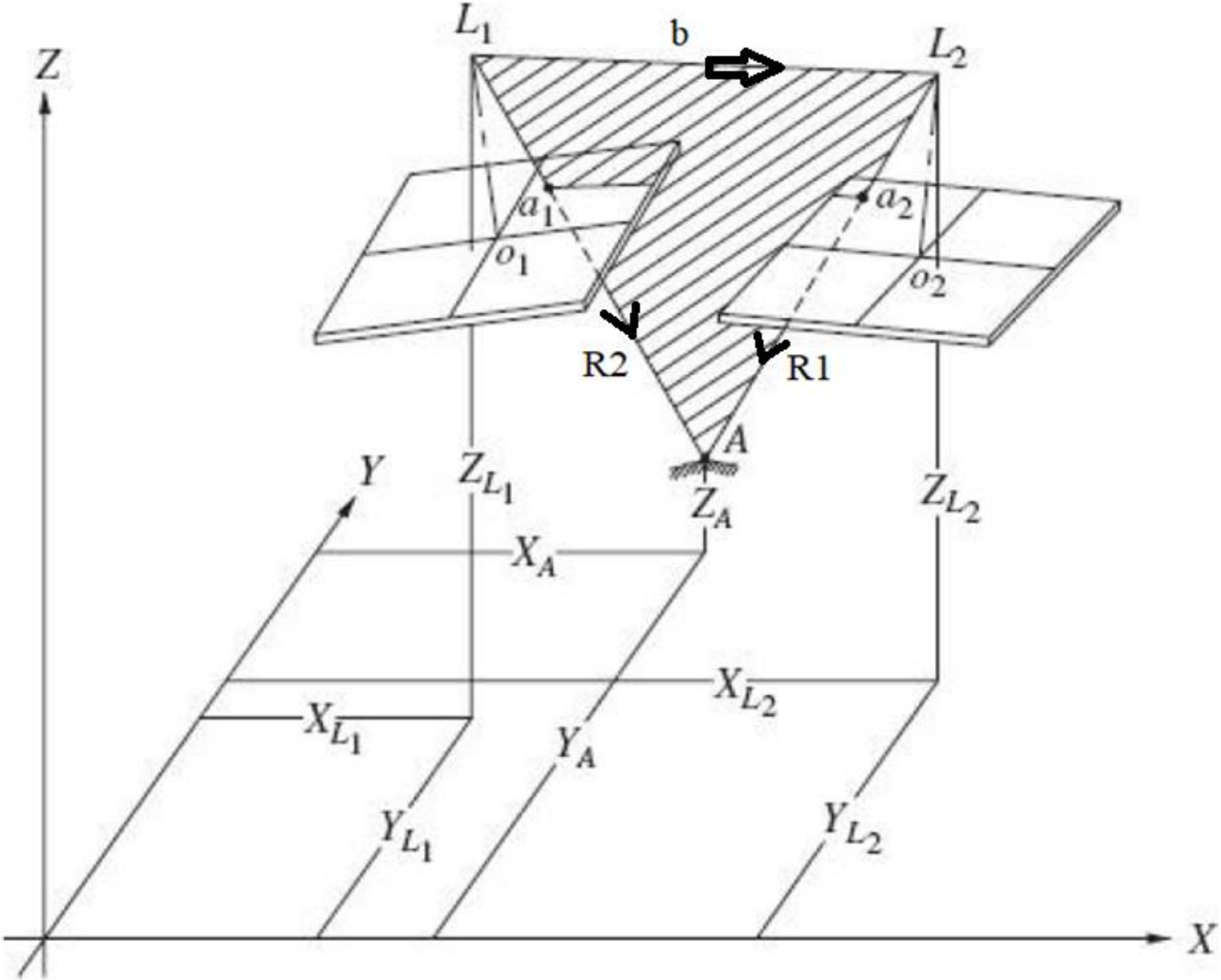
Weighting of Assessments:

Assessment	Weight
Mid-term Examination	10%
Semester work	10%
Oral Examination	20%
Final Examination	60%
Total	100%

COPLANARITY CONDITION

- Definition: is the condition that the two exposure stations of a stereopair, any object point, and its corresponding image points on the two photos all lie in a common plane.
- In the figure, for example, points L1, L2, a1, a2, and A all lie in the same plane.

COPLANARITY CONDITION



COPLANARITY CONDITION

- When relative orientation is achieved, the vector R1 from L1 to A and the vector R2 from L2 to A, these two vectors together with air base vector, b, will be coplanar.
- Hence, their scalar triple product is zero. That is:

$$F_1 = \vec{b} - \vec{R}_1 + \vec{R}_2 = 0$$

COPLANARITY CONDITION

- **Where:**

$$\vec{b} = \begin{bmatrix} b_X \\ b_Y \\ b_Z \end{bmatrix} = \begin{bmatrix} X_{O2} - X_{O1} \\ Y_{O2} - Y_{O1} \\ Z_{O2} - Z_{O1} \end{bmatrix}$$

$$\vec{R}_{1i} = \begin{bmatrix} X_{1i} \\ Y_{1i} \\ Z_{ii} \end{bmatrix} = K_1 M_1^T \begin{bmatrix} x_{a1} - x_o \\ y_{a1} - y_o \\ -f \end{bmatrix}$$

$$\vec{R}_{2i} = \begin{bmatrix} X_{2i} \\ Y_{2i} \\ Z_{2i} \end{bmatrix} = K_2 M_2^T \begin{bmatrix} x_{a2} - x_o \\ y_{a2} - y_o \\ -f \end{bmatrix}$$

COPLANARITY CONDITION

- Where K_1 and K_2 are scale factors for both left and right photos, respectively.
- b_x, b_y, b_z are Airbase components.
- M_1 Rotation matrix of the left photo.
- M_2 Rotation matrix of the right photo.
- X_{a1}, Y_{a1} coordinates of image point a_1 in left photo.
- X_{a2}, Y_{a2} coordinates of image point a_2 in right photo.
- Xo, Yo coordinates of principle point.
- *F* CFL of the used camera.

COPLANARITY CONDITION

- Equation (1) may be written in determinant form as,

$$F_1 = \begin{bmatrix} b_X & b_Y & b_Z \\ X_{1i} & Y_{1i} & Z_{1i} \\ X_{2i} & Y_{2i} & Z_{2i} \end{bmatrix} = 0$$

Supplementary files:

- https://www.youtube.com/watch?v=bMUN0ASDob4&t=329s
- https://www.youtube.com/watch?v=-y76vDBbl_8
- https://www.youtube.com/watch?v=Cl1Kne_WqPg&t=967s
- Elements of Photogrammetry With Applications in GIS by Paul R. Wolf, Bon A. Dewitt. Fourth Edition

Thanks

Dr.Eng. Hassan Mohamed