PRINCIPLES OF PHOTOGRAMMETRY

ENGE 252

Lecture : 3 **Year : II**
Tutorial : 0 **Part : II**
Practical : 3

Course Objectives:
The objective of the photogrammetry course is to gain familiarity with the basic principles of photogrammetric operations. The course emphasizes on mathematical concepts in photogrammetry, the possibility of object space reconstruction from imagery and incorporation of additional sensory data from GPS/INS units in photogrammetric triangulation.

1 Introduction (2 hours)

1.1 Definitions
1.2 Sources of photogrammetric information
1.3 Types and uses of photogrammetry: Aerial and terrestrial, metric and non-metric
1.4 Platform for photogrammetric sensing systems
1.5 History and developments in the field of photogrammetry
1.6 Differences between traditional and digital photogrammetry

2 Principles of Photography and Imaging Devices (5 hours)

2.1 Fundamental of optics (Lens formula, lens corrections)
2.2 Relationship of aperture and shutter speed
2.3 Characteristic of photographic emulsions
2.4 Processing and printing black-and-white photo
2.5 Spectral sensitivity of emulsions
2.6 Types of cameras for aerial mapping (Analog and digital)
2.7 Methods of camera calibration

3 Elementary Photogrammetry (5 hours)

3.1 Perspective projection
3.2 Scale and coverage
3.3 Vanishing points
3.4 Relief displacement
3.5 Parallax: X-parallax, Y-parallax and differential parallax
3.6 Stereo and stereo vision
3.7 Vertical exaggeration
3.8 Stereo image separation techniques

3.9 Image overlap
3.10 Epipolar planes and lines

4 Mathematical Concepts in Analog Photogrammetry (8 hours)

4.1 Photogrammetric transformation
4.2 Coordinate reference systems
  4.2.1 Image space coordinate system
  4.2.2 Object space coordinate systems
  4.2.3 Camera coordinate systems
4.3 Mathematical relationship between image and ground coordinates
  4.3.1 Theory of orientation
  4.3.2 Interior orientation (IO)
  4.3.3 Exterior orientation (EO)
  4.3.4 Relative orientation (RO)
  4.3.5 Absolute orientation (AO)
  4.3.6 Classification of points used in orientation
  4.3.7 Photogrammetric conditions: Collinearity and coplanarity equations

5 Intersection, Resection and Photogrammetric Triangulation (8 hours)

5.1 Intersection
5.2 Resection
5.3 Single flight lines (Strip triangulation)
5.4 Image blocks
  5.4.1 Block adjustment of independent models (BAIM)
  5.4.2 Bundle block adjustment
  5.4.3 Block adjustment with added parameters (Self-Calibration)
5.5 Advantages and disadvantages
5.6 Statistical evaluation: Precision, accuracy, and reliability

6 Direct Versus Indirect Orientation (5 hours)

6.1 Advantages
6.2 Prerequisites
6.3 Mathematical model
6.4 Direct versus indirect orientation
6.5 Flight planning

7 Digital Photogrammetry (5 hours)

7.1 Understanding images in photogrammetry
  7.1.1 Types of images
  7.1.2 Digital images
7.2 Principles of digital image processing
7.3 Image resampling and compression techniques

7.4 Measurement and analysis using digital images
7.5 Feature extraction from images

8 Photogrammetric Products (7 hours)

8.1 Concept of DEM, DSM, nDSM, and DTM
8.2 DEM representation and generation
  8.2.1 Raster versus TIN representation
  8.2.2 Automatic DEM generation
  8.2.3 Normalized image generation
8.3 Orthophoto production
  8.3.1 Polynomial rectification
  8.3.2 Differential rectification
  8.3.3 Image resampling techniques
  8.3.4 True orthophoto production
8.4 Application of aerial photographs
  8.4.1 Use of aerial photographs in highways, transmission lines and canals
  8.4.2 Use of aerial photographs in cadastral survey
  8.4.3 Use of aerial photographs in land and natural resource survey

Practical (45 hours)

1. Parallax and relief displacement
2. Interior and exterior orientations
3. Measurement of object coordinates
4. Aerial triangulation
5. Block adjustment
6. DTM via image matching
7. Orthophoto production
8. Computer programming in first five exercises using C or C++

Final Exam

The questions will cover all the chapters in the syllabus. The evaluation scheme will be as indicated in the table below:

Chapters	Hours	Marks distribution*
1 and 2	7	8
3	5	6
4	8	12
5	8	12
6 and 7	10	14
8	7	8
Total	**45**	**60**

* There may be minor deviation in marks distribution.

References

1. Wolf, P. R. (1983). Elements of photogrammetry: with air photo interpretation and remote sensing. Japan: McGraw-Hill.
2. Sharma, J. L., Joshi, M. D. (1985). A Text Book of Advanced Surveying. India: C.B.S. Publ.
3. Manual of remote sensing Volume I and II, American Society of Photogrammetry, Fall Church Virginia USA.
4. Mikhail, E. M., Bethel, J. S., McGlone, J. C. (2001). Introduction to modern photogrammetry. India: Wiley.
5. Mullen, R. (2004). Manual of Photogrammetry. United States: American Society for Photogrammetry and Remote Sensing.
6. Linder, W. (2016). Digital Photogrammetry: A Practical Course. Belgium: Springer Berlin Heidelberg.