Principles of Photogrammetry

October – December 2016

COURSE DETAILS	
Credits	2
Contact hours	5
Class	Wednesday 9.50 am to 12.15 pm Room 2-328 Friday 14:05 – 16:30 Room 2-328 Additional tutorial sessions will be programmed for further instructions on the exercises
Course Coordinator and Lecturer	Emeritus Professor John Trinder j.trinder@unsw.edu.au:

OBJECTIVES

To present the principles of processing aerial and satellite frame and push-broom based digital images as well as close range frame images for determining accurate metric details of extracted objects for input into digital mapping and GIS databases and in close range applications.

To present the basic principles of acquisition and processing of lidar data for the determination of DEMs and information extraction

TEACHING STRATEGIES

A variety of teaching strategies will be included to achieve the optimal teaching and learning outcomes. Major teaching activities in this course are:

1) Weekly lectures
2) Weekly tests on Wednesdays at 9.50 am
3) Tutorials to review the content of lectures and tasks on the digital photogrammetric workstations and software for lidar processing
4) Laboratory/personal computer activities on software
5) Assignment on digital photogrammetric processing
6) Final examination

The lectures will provide the foundation for the course. Laboratory/personal computer work will reinforce the basic principles and provide relevance to the lecture materials.

Private Study	• Review lecture slides and notes • Do set problems and assignments • Reflect on class problems and assignments • Download software from internet • Consult reference books
Lectures	• Find out what you must learn • See methods that are not in the notes • Follow worked examples • Hear announcements on course content

Laboratory/personal computer activities	• Be guided by lecturer and assistants • Practice solving set problems • Ask questions
Quiz each week and final examination and assignments	• Demonstrate your knowledge and skills learnt • Demonstrate higher understanding and problem solving
Laboratory/personal computer work	• The basic tools will be: • Photomodeler Close Range Photogrammetry software • LPS digital photogrammetry software

EXPECTED LEARNING OUTCOMES

By the end of this course you should be able to:

(a) Explain the principles of determining geometry of terrain features and close range objects form digital data based on frame and push-broom imaging
(b) Understand processing of analytical photogrammetry for multiple overlapping frame and pushbroom images by photogrammetric bundle adjustment
(c) Understand the acquisition and processing of airborne lidar data and its potentials for extraction of DEMs and other terrain information
(d) Understand the processes and products of mapping from aerial, unmanned aerial systems (UAS) and satellite images
(e) Understand the principles and applications of close range photogrammetry

The student will gain an appreciation of the advantages and disadvantages of the imaging systems for extraction of information for digital mapping and GIS databases. The student should learn how the imaging and lidar systems can provide accurate metric descriptions of terrain details, as well as the manual and automatic extraction processes used for aerial, satellite and close range imaging systems.

ASSESSMENT

Overall rationale for assessment components and their association with course objectives.

The final grade for this course will be based on the sum of the scores from each of the assessment tasks.

Weekly tests	50%
Successful completion of practical exercises and assignment	25%
Individual presentations	25%
Total	**100%**

The final grades will be assigned according to the LIESMARS grading system .

The instructor reserves the right to alter the assessment schedule following a review of their successful execution.

ASSIGNMENTS

1.:Close range Photomodeler software review

2. Use of LPS software for production of DEM and orthophoto

3. Computation of object coordinates by intersection:

PROGRAM OF LECTURES FOR COURSE

A table of lecture topics and assignments for each week.

Week	Topic	Topic
1 26/10 & 28/10	**Introduction to subject**. Definitions of photogrammetry and remote sensing, applications. Short history. **Chapter 1: Sensors and Platforms for Acquisition of Aerial and Satellite Image Data** Design of digital aerial cameras, overlaps of aerial photography. Characteristics of aerial and satellite images, Whiskbroom sensors.	**Chapter 1 (cont)** Radar image sensors, airborne lidar. **Chapter 2: Fundamental Geometry of Single and Overlapping Images.** Central projection and orthographic projection. Photograph scale, tilt and relief displacement. Geometry of whiskbroom imaging systems. Direct and indirect stereovision, instrumentation, epipolar geometry. Assignment 1 Close Range software instructions distributed
2 2/11 & 4/11	**Short test (15 minutes)** **Chapter 2 (cont**) **Chapter 3: Principles of analytical photogrammetry** Collinearity equations, Principles of analytical photogrammetry Collinearity equations for computation of block adjustment	**Chapter 3 (cont)** Block adjustment of multiple aerial photographs Assignment 2: Instructions for operations of LPS software
3 9/11 & 11/11	**Short test (15 minutes)** **Chapter 3 (cont)** Block adjustment; orientation of pushbroom scanner images. Whiskbroom image geometry, perspective projections. Examples Submit Assignment 1	**Chapter 4 Digital Image Processing for Elevation Determination and Orthophotos -** image matching: geometric correction of digital images for orthophoto production; resampling; digital photogrammetric workstations, software capabilities. Assignment 3: Intersection computation instructions distributed
4 16/11 & 18/11	**Short test (15 minutes)** **Chapter 5. Processing of Airborne Laser Scanning (ALS) – Lidar Data** Characteristics of lidar data, filtering, errors, extraction of DEMs and other features	**Chapter 5 (cont)** Processing of Airborne Laser Scanning (ALS) – Lidar Data Information extraction from digital images and lidar data
5 23/11 & 25/11	**Short test (15 minutes)** **Chapter 6: Procedures for photogrammetric mapping from aerial, UAS and satellite images** Submit assignment 2	**Chapter 6**: (Cont) **Chapter 7**: **Measurement and Analysis of Close Range Images** Measurement of objects from close range
6 30/11 & 1/12	**Short test (15 minutes)** Individual presentations Submit Assignment 3	Individual presentations :

RELEVANT RESOURCES

- Notes and slides will be provided for all chapters
- The following texts are suggested as references.
- Introduction to Modern Photogrammetry, E.M. Mikhail J.S Bethel and J C McGlone John Wiley & Sons Inc 2001 (somewhat out-of-date and hence have not been recommended for purchase)

- Photogrammetry Geometry from Images & Laser Scans Karl Kraus (translated from German by Ian A. Harley and Stephen Kyle) de Gruyter Textbook 2007 (a good text but uses different symbology than in the lectures)
- Geoinformation 2nd edition by G. Konecny CRC Press 2014 (This is the most up-to-date text covering photogrammetry and an excellent text. It also covers Remote Sensing and GIS)
- Manual of Photogrammetry, Ed C. McGlone, published by American Society for photogrammetry and Remote Sensing 6th edition (latest) but 5th edition is also acceptable
- Additional notes and slides provided.
- Recommended Internet sites: **www.asprs.org**; **http://www.isprs.org/education/tutorials.aspx**