國立東華大學

教學計劃表 Syllabus

課程名稱(中文) Course Name in Chinese	攝影測量在地表變遷調查應用			學年/學期 Academic Year/Semester	112/1
課程名稱(英文) Course Name in English	The application of digital photogrammetry on earth surface change				
科目代碼 Course Code	NRESM0510	系級 Department & Year	碩士	開課單位 Course-Offering Department	自然資源與環境學系
修別 Type	選修 Elective	學分數/時間 Credit(s)/Hour(s)	3.0/3.0		
授課教師 Instructor	/張有和				
先修課程 Prerequisite					

課程描述 Course Description

This course focuses on how to use drone/digital camera to take vertical or oblique aerial photos in order to create Digital Surface Model (DSM), ortho image and other NDVI image. In order to have the highest quality of image and derived DSM result, this course will discuss from image capture errors such as camera calibration, light polarization, image capture methods to image processing. (本課程著重於使用無人機拍攝航照進行正色影像製作,數值地形製作,相機校正與NDVI影像製作等實務練習。為了得到最高品質影像與數值地表模型，本課程會討論包括相機鏡頭扭曲校正，使用偏光鏡減少反光，影像拍攝方式與影像處理等面向)。

Apart from the Drone application in recent years, the traditional photogrammetry using aerial photos has also been introduced. Following is the details of the course. (配合傳統利用光學影像，例如航空照片或數位相機影像之立體對與野外測量資料重建地形，此課程包括學習利用即時動態全球衛星定位系統、全站儀、不同數位相機之相機校正與拍攝方式，再結合數位攝影測量軟體針對數十公分至數公里之目標物，依調查目的進行數公釐至數公尺3D重建)。

Textbook: Elements of Photogrammetry with Application in GIS, Fourth Edition 4th Edition (2014) by Paul Wolf (Author), Bon DeWitt (Author), Benjamin Wilkinson (Author)

一、Introduction to Remote Sensing (遙測學簡介)：Textbook: Remote sensing and image interpretation (2015) by Lillesand, T. M. and Kiefer, R. W., 7th edition. Willey.chaps.1-3, p. 1-189.
二、Aerial photos and Stereoscope (航空照片與立體鏡)：Introduction to relief displacement and image parallax。(簡介relief displacement與image parallax)
三、Introduction to Global Positioning System and Map Projection (全球位星定位系統與地圖投影介紹)。
四、Introduction of photogrammetric software such as Lisa and Foto, VirtualSFM, Agisoft Metashape, Pix4D Mapper, Photomodeler Scanner, SketchUp etc. 攝影測量軟體介紹。
五、The application of tradition analog aerial photos. Linder, W. (2006) Digital photogrammetry, 2nd edition, Springer. Chaps. 1-3,p.1-30.介紹如何掃瞄傳統航空照片。
六、Photogrammetry: From image to create DSM and ortho image. Exercise 1&2: Linder, W. (2006) Digital photogrammetry, 2nd edition, Springer.Chaps. 4-5, p.31-108，航空照片立體對與地形建立：
七、Pix4D Mapper: aerial photo scan and ground control points (攝影測量軟體簡介與花蓮航空照片立體對掃瞄、野外使用RTK-GPS建立控制點與地真點資料庫)。
八、Post-processing of (Digital Elevation Models. 數值高程模式(Digital Elevation Models)後處理。Digital elevation model technologies and application: The DEM users manual (2001) Maune, D. F. (Editor) ASPRS. Chap. 5, p. 121-141.
九、Close range photogrammetry：Linder, W. (2006) Digital photogrammetry, 2nd edition, Springer.Chap.6, p.109-132.(近景攝影測量)
十、Camera Calibrations: Self Camera calibration, Field Camera Calibration and Lab. Camera Calibration (相機校正： Photomodeler Scanner軟體介紹與相機校正，手標本3D重建)。

課程目標 Course Objectives

The earth changes could be detected by using remote sensing techniques. Among those techniques, digital photogrammetry has been mostly used due to the widely use of drone images captured in the air and ground images captured on the ground. This course focuses on building 3D model using image capturing on the ground and in the air to monitoring the earth surface change of different scales. The course divided in tot the following topics,

	系專業能力 Basic Learning Outcomes	課程目標與系專業能力相關性 Correlation between Course Objectives and Dept.'s Education Objectives
A	能覺知多元的自然科學與社會科學理論並具備研究能力To have knowledge of natural and social science theories.	●
B	具備自然資源與人類社會議題之調查分析、規劃與經營之能力To be able to investigate, analyze, plan, and manage both natural resource and human social issues.	●
C	具備將環境倫理與生態思想落實於永續性生活型態的能力To implement sustainable lifestyles based on environmental ethics and ecological principles.	●
D	能以整全式的觀點來解析環境問題，並具備發展系統性解決方案的能力To resolve environmental issues and develop systematic solutions with a global perspective	●
E	具備系統分析、未來思考、溝通協調與團隊合作的能力The ability to analyze, plan, communicate, and coordinate with others (teamwork).	●
F	具備終身學習、國際視野與外語溝通的能力To instill the values of lifelong learning, an international perspective, and the ability to communicate in a foreign language	

圖示說明Illustration ：● 高度相關 Highly correlated ○中度相關 Moderately correlated

授 課 進 度 表 Teaching Schedule & Content

週次Week	內容 Subject/Topics	備註Remarks
1	課程介紹(Introduction to Digital Photogrammetry);著重加入以無人機為載具之影像擷取系統操作與製作數值地形模型與正射投影影像 Elements of Photogrammetry with Application in GIS, Fourth Edition 4th Edition (2014) by Paul Wolf (Author), Bon DeWitt (Author), Benjamin Wilkinson (Author)	
2	History of Photogrammetry 攝影測量歷史	
3	第三章 航空測量法之基本原理(Chap. 3 Introduction to Aerial Photogrammetry) 航空照片與立體鏡(The measurements of relief displacement and parallax in aerial photos)	作業一:航空照片立體對影像中測量相對高程
4	全球位星定位系統與地圖投影(Global Positioning System and Map Projection) Principle_of_stereoscopic_measurement PDF document	
5	Linder, W. (2006) Digital photogrammetry, 2nd edition, Springer.Chaps. 1-3,p.1-30.介紹如何掃瞄航空照片。 Lab. exercise 1 reference (課堂作業一參考資料) 第五章航照中拍攝物體之座標轉換(Chapter 5 Object space coordinate systems) PDF document	作業一繳交 Assignment 1
6	UAV reviews PDF document Exercise 1&2: Linder, W. (2006) Digital photogrammetry, 2nd edition, Springer.Chaps. 4-5, p.31-108，航空照片立體對與地形建立：介紹Lisa and Foto軟體, PCI Geomatica, VirtualSFM, Agisoft PhotoScan, Acute3D Basic, Pix4D mapper等軟體介	
7	Lab. Exercise 2 (課堂練習作業二說明) 課堂作業二LISA-FOTO Assignment	
8	花蓮航空照片立體對掃瞄、野外使用RTK-GPS建立控制點與地真點資料庫。 Homework 3(作業三):Buiding 3D model using VisualSFM(利用Visual SFM與照片建立3D點雲)! Resource	
9	Chapter 9 Elementary methods of planimetric mapping for GIS Processing the UAV images of the campus (上週UAV影像處理)	野外測量 作業二 Assignment 2

10	Photogrammetry Ex. 2 : Asia Cement aerial photos download file Photogrammetry Ex2: Tutorial of aerial photos analysis using Pix4Dmapper. PDF document Agisoft Metashape User Manuals PDF document Lab. Exercise 2: Asia Cement Company Mine 3D reconstruction! Assignment	
11	Pox4Dmapper Lab Ex2_1 環境學院垂直空拍處理參考操作步驟	作業二繳交與作業三
12	Homework 4(作業四) 2D NERS ortho image and DSM creation using ground control points and 20200525 uav images.	作業三繳交 Assignment 3
13	Sequoia multi-spectrum Camera and NDVI 多光譜像機與NDVI指數介紹!	
14	近景攝影測量 (Close range photogrammetry):Linder, W. (2006) Digital photogrammetry, 2nd edition, Springer.Chap.6, p.109-132 Camera Calibration (相機校正): Photomodeler Scanner introduction and Camera Calibration-軟體介紹與相機校正，手標本3D重建 (一)	
15	Camera Calibration (相機校正): Photomodeler Scanner introduction and Camera Calibration-軟體介紹與相機校正，手標本3D重建 (二)	作業四 Assignment 4
16	Drone fly practice(無人飛行練習):DJI MINI 3 Pro	作業四繳交
17	The application of UAV photogrammetry (UAV攝影測量應用)	作業五 Assignment 5
18		作業五繳交

教 學 策 略 Teaching Strategies

☑ 課堂講授 Lecture ☑ 分組討論Group Discussion ☑ 參觀實習 Field Trip

☐ 其他Miscellaneous:

教 學 創 新 自 評 Teaching Self-Evaluation

創新教學(Innovative Teaching)

☐ 問題導向學習(PBL) ☐ 團體合作學習(TBL) ☐ 解決導向學習(SBL)

☐ 翻轉教室 Flipped Classroom ☐ 磨課師 Moocs

社會責任(Social Responsibility)

☐ 在地實踐Community Practice ☐ 產學合作 Industy-Academia Cooperation

跨域合作(Transdisciplinary Projects)

☐ 跨界教學Transdisciplinary Teaching ☐ 跨院系教學Inter-collegiate Teaching

☐ 業師合授 Courses Co-taught with Industry Practitioners

其它 other:

學期成績計算及多元評量方式 Grading & Assessments									
配分項目 Items	配分比例 Percentage	多元評量方式 Assessments							
		測驗會考	實作觀察	口頭發表	專題研究	創作展演	卷宗評量	證照檢定	其他
平時成績 General Performance	20%		✓						
期中考成績 Midterm Exam									
期末考成績 Final Exam									
作業成績 Homework and/or Assignments	80%			✓					
其他 Miscellaneous (_____)									

評量方式補充說明
Grading & Assessments Supplemental instructions

教科書與參考書目（書名、作者、書局、代理商、說明）
Textbook & Other References (Title, Author, Publisher, Agents, Remarks, etc.)

1. Wolf, P., DeWitt, B. and Wilkinson, B. (2014)Elements of Photogrammetry with Application in GIS, Fourth Edition 4th Edition.
2. Linder, W. (2006) Digital photogrammetry, 2nd edition, 209 pp.
3. Remote sensing and image interpretation (2015) by Lillesand, T. M. and Kiefer, R. W., 7th edition. Willey.chaps.1-3, p. 1-189
4. Digital elevation model technologies and application: The DEM users manual (2001) Maune, D. F. (Editor) ASPRS.Chap. 5, p. 121-141
5. http://www.photomodeler.com/products/pm-scanner.htm
6. https://www.pix4d.com/product/pix4dmapper-photogrammetry-software
7. DIGITAL PHOTOGRAMMETRIC CHANGE ANALYSIS AS APPLIED TO ACTIVE COASTAL DUNES IN MICHIGAN(1999) http://www-personal.umich.edu/~danbrown/papers/pers.pdf
8. Correcting the Data Mapping of IKONOS Images Using (2008) http://www.pcigeomatics.com/pdfs/Ikonos.pdf
9. Habib, A. F., Lee, Y. R., Morgan, M. (2001) Surface matching and change detection using a modified hough transformation for robust parameter estimation. Photogrammetric Record, 17(98): 303-315 (October 2001)

課程教材網址(含線上教學資訊,教師個人網址請列位於本校內之網址)
Teaching Aids & Teacher's Website(Including online teaching information. Personal website can be listed here.)

e learning website

First three weeks are online course, please use the link:

攝影測量在地表變遷調查應用(Special Topics on the application of Photogrammetry)
9月 23日（星期四）· 下午1:10 – 4:00
如何加入 Google Meet 會議
視訊通話連結：https://meet.google.com/nsi-hhty-isu
或撥打以下電話號碼：?(US) +1 941-800-3104? PIN 碼：?916 679 852?#

其他補充說明 (Supplemental instructions)