Analytical and Digital Photogrammetric Engineering
Geospatial Systems Engineering
Spring 2019

A. COURSE INFORMATION

Course number/section: GSEN-6385-001, GSEN-6385-W01
Class meeting time: W 02:00-05:00
Class location: CBI 104
Course Website: Accessed via Blackboard (Bb): https://bb9.tamucc.edu/

B. INSTRUCTOR INFORMATION

Instructor: Dr. Michael J. Starek
Associate Professor of Civil and Geospatial Systems Engineering
School of Engineering and Computing Sciences
Director of Measurement Analytics Lab (MANTIS)
Conrad Blucher Institute for Surveying and Science
Office location: NRC 3407
Office hours: M,W 11:00 AM to 12:30 PM, T 2:00 to 4:00 PM
Telephone: 361.825.3978
e-mail: michael.starek@tamucc.edu,
Blackboard messaging preferred
Appointments: Office hours and scheduled by email or phone.

C. COURSE DESCRIPTION

Catalog description. A study of the mathematical and geometric models of modern photogrammetry. Covers principles of stereoscopic vision, collinearity, coplanarity, epipolar geometry, ground control densification and extension by analytical aerotriangulation. Explores automation in photogrammetric procedures - digital aerotriangulation, automated data capture, direct geo-referencing via integrated inertial/GNSS-aided navigation.

My description. This course is intended to be exploratory and adaptive as we progress from the foundational material of airborne photogrammetry to the forefront of geodetic imaging techniques. The first half of the course will focus on the foundations of airborne digital imaging systems for 2D and 3D measurement of the natural and built environment. From there, we will move into emergent scanning and imaging techniques including structure-from-motion (SfM) photogrammetry with unmanned aircraft systems (UAS), LiDAR mapping and data processing, and technology on the rise such as SLAM mapping.

D. PREREQUISITES AND COREQUISITES

Permission of the Program Coordinator. Some knowledge of calculus, linear (matrix) algebra, and statistics will be required for certain topics. Math can be refreshed along the way, but if you have not taken coursework in these areas, please discuss with me first.

E. REQUIRED TEXTBOOK(S), READINGS AND SUPPLIES

"Elements of Photogrammetry," Fourth Edition, Wolf, Dewitt, and Wilkinson.

Journal papers and additional readings will be provided to complement the material.

Software

This class integrates different software and tools. Matlab may be used for some assignments, which has an associated cost for a student version if you do not have campus access. We may, on occasion, use open-source software and there are a set of distributable computer programs that come with the textbook for teaching certain concepts. ArcGIS and commercial lidar and photogrammetry software may be integrated for 3D data processing. Student or trial versions of these software are available at no cost. Basic programming knowledge in a language of your choice may be helpful on some assignments and is required for GSCS students as part of their final project.

F. STUDENT LEARNING OUTCOMES AND ASSESSMENT

Assessment is a process used by instructors to help improve learning. Assessment is essential for effective learning because it provides feedback to both students and instructors. A critical step in this process is making clear the course's student learning outcomes that describe what students are expected to learn to be successful in the course. The student learning outcomes for this course are listed below. By collecting data and sharing it with students on how well they are accomplishing these learning outcomes students can more efficiently and effectively focus their learning efforts. This information can also help instructors identify challenging areas for students and adjust their teaching approach to facilitate learning.

By the end of this course, students should be able to:

1. Define and characterize basic principles of digital photogrammetric systems
2. Demonstrate the principles of interior and exterior orientation including the different methods utilized to spatially reference airborne imagery.
3. Recognize limitations and potential sources of error and distortion that impact the photogrammetric process and be able to apply methods to correct this distortion.
4. Perform single and stereo-pair image analysis for spatial measurement in 2D and 3D.
5. Apply structure-from-motion photogrammetry and explain its differences to traditional photogrammetry for 3D measurement.
6. Integrate, process, and apply LiDAR data for topographic mapping.
7. Describe a range of 3D imaging modalities and recognize trade-offs in performance and capabilities for surveying and geospatial applicability.

G. INSTRUCTIONAL METHODS AND ACTIVITIES

The course will be taught in a lecture, discussion, and case-study format. Weekly reading will be assigned. There will be up to ten assignments requiring the management and analysis of geospatial data. ArcGIS will serve as the main software utilized in these assignments; however, specific assignments may utilize other software tools for data processing and analysis (e.g. open-source). A midterm with short answer and essay formats will be given. A comprehensive final project will be assigned (see grading below).

Online Students

My lectures will be recorded live (audio only) along with my screen shots (e.g. power points) using Webex. Students taking the course online must have continuous web access and are expected to keep pace with the course as if they were an in-class student. You must adhere to all assignment deadlines, exam deadlines, etc.

H. MAJOR COURSE REQUIREMENTS AND GRADING

Your final grade will be based on the following point distribution:

ACTIVITY	% of FINAL GRADE
Midterm Exam	27.5%
Final Project	27.5%
Assignments combined	45%

I. COURSE CONTENT/SCHEDULE

TOPICAL OUTLINE (adaptive and subject to change)
– Fundamentals of digital imaging systems, electromagnetic radiation, optical principles
– Airborne vertical photography,
– Image coordinate measurement and reduction
– Mathematical and geometric principles
– Theory and procedures of photogrammetric orientation/geo-referencing
– Digital image matching, orthophoto generation, digital surface model generation
– Structure from motion photogrammetry
– LiDAR mapping systems and data processing
– Emergent techniques for 3D imaging

SCHEDULE is tentative and subject to change. The official schedule and required weekly readings will be posted to Bb. Assignments will be provided on weekly to bi-weekly basis.

DATE (BY DAY OR WEEK)	TOPIC
1	Course introduction
2	Principles of Photography and Digital Imaging
3	Airborne Digital Cameras and Calibration

4	Image Measurements and Refinements
5	Vertical and Tilted Photographs
6	Analytical Photogrammetry and Collinearity
7	Topographic Mapping and Spatial Data Collection
8	Aerotriangulation and Bundle Adjustment
9	MIDTERM
10	Unmanned Aircraft Systems
11	Structure from Motion and Dense Matching
12	Structure from Motion and Dense Matching
13	Lidar
14	Lidar
15	3D data processing
16	3D data processing
17	Final Project

Note: Changes in this course schedule may be necessary and will be announced to the class by the Instructor. The assignments and exams shown are directly related to the Student Learning Outcomes described in Section F.

J. COURSE POLICIES

Attendance/Tardiness
Regular attendance is expected. In-person students are expected to attend face-to-face lectures and distance students are normally not permitted to attend in-person lectures without prior approval first. Recorded lectures may be restricted to distance students at discretion of the instructor (e.g. in-person attendance is poor due to students watching online as opposed to attending class).

Assignments and Late Work Policy
You are expected to work individually on all assignments/exams unless otherwise stated. Assignment due dates will be specified for each assignment.

Effective as of 12:00 AM on the day following the assignment due date:
- 1 to 3 days late - Minus 3 pts per day past due
- 4 to 7 days - Minus 4 pts per day past due
- > 1 week late - Minus 5 pts per day past due
- After assignment is graded and returned = 0 (*typically 1 week after due date!*)

If you are not able to meet a particular deadline, you must notify me before the due date to request an extension. Reduced penalty extensions will be granted on a case-by-case basis and will likely be refused for repeat offenders.

Cell Phone Use
Absolutely no cell phone use during class, except for emergency situations.

Missed Exam
You are expected to take the exam when scheduled. Make-up exams will only be permitted under department approved circumstances.

Exam Policy for Distance Students
Midterm Exam will be given in-class or provided as a take-home exam. If given in-class, distance students must take the same exam on that same day. Online students will be notified of the procedure at least one week in advance. Implementation will be through Blackboard.

In-person students must take the exam in-class and distance students cannot take the exam in-person during class without instructor approval. For exams provided as take home, the same rules apply to in-class and distance students.

Others
All work submitted for grading must be the student's own work. Plagiarism will result in a score of 0 (zero) for the work or dismissal from the course and the Dean of Students office will be notified. No copying from another student's work or past work of any type is allowed. It is the student's duty to allow no one to copy his or her work. Anyone found cheating and/or copying, in the exams or assignments, in the instructor's opinion, may receive an automatic F for the course.

If you are having a problem finishing an assignment or other concerns, please talk to me. My goal is to help you succeed in the course.

K. COLLEGE AND UNIVERSITY POLICIES

- **Academic Integrity (University)**
  University students are expected to conduct themselves in accordance with the highest standards of academic honesty. Academic misconduct for which a student is subject to penalty includes all forms of cheating, such as illicit possession of examinations or examination materials, falsification, forgery, complicity or plagiarism. (Plagiarism is the presentation of the work of another as one's own work.) In this class, academic misconduct or complicity in an act of academic misconduct on an assignment or test will result in a failing grade.

- **Classroom/Professional Behavior**
  Texas A&M University-Corpus Christi, as an academic community, requires that each individual respect the needs of others to study and learn in a peaceful atmosphere. Under Article III of the Student Code of Conduct, classroom behavior that interferes with either (a) the instructor's ability to conduct the class or (b) the ability of other students to profit from the instructional program may be considered a breach of the peace and is subject to

disciplinary sanction outlined in article VII of the Student Code of Conduct. Students engaging in unacceptable behavior may be instructed to leave the classroom. This prohibition applies to all instructional forums, including classrooms, electronic classrooms, labs, discussion groups, field trips, etc.

- **Statement of Civility**
  Texas A&M University-Corpus Christi has a diverse student population that represents the population of the state. Our goal is to provide you with a high quality educational experience that is free from repression. You are responsible for following the rules of the University, city, state and federal government. We expect that you will behave in a manner that is dignified, respectful and courteous to all people, regardless of sex, ethnic/racial origin, religious background, sexual orientation or disability. Behaviors that infringe on the rights of another individual will not be tolerated.

- **Deadline for Dropping a Course with a Grade of W (University)**
  The grade of W will be assigned to any student officially dropping a course. Please consult with the instructor before you decide to drop to be sure it is the best thing to do. Just stopping attendance and participation WILL NOT automatically result in your being dropped from the class. Should dropping the course be the best course of action, visit the Office of the University Registrar for the Course Drop Form that must submitted. No student is eligible to receive a W without completing the official drop process by this deadline. Please consult the Academic Calendar (http://www.tamucc.edu/academics/calendar/) for the last day to drop a course.

- **Grade Appeals (College of Science and Engineering)**
  As stated in University Procedure 13.02.99.C2.01, Student Grade Appeal Procedures, a student who believes that he or she has not been held to appropriate academic standards as outlined in the class syllabus, equitable evaluation procedures, or appropriate grading, may appeal the final grade given in the course. The burden of proof is upon the student to demonstrate the appropriateness of the appeal. A student with a complaint about a grade is encouraged to first discuss the matter with the instructor. For complete details, including the responsibilities of the parties involved in the process and the number of days allowed for completing the steps in the process, see University Procedure 13.02.99.C2.01, Student Grade Appeal Procedures. These documents are accessible through the University Rules website at http://www.tamucc.edu/provost/university_rules/index.html, and the College of Science and Engineering Grade Appeals webpage at http://sci.tamucc.edu/students/GradeAppeal.html. For assistance and/or guidance in the grade appeal process, students may contact the chair or director of the appropriate department or school, the Office of the College of Science and Engineering Dean, or the Office of the Provost.

- **Disability Services**
  The Americans with Disabilities Act (ADA) is a federal anti-discrimination statute that provides comprehensive civil rights protection for persons with disabilities. Among other things, this legislation requires that all students with disabilities be guaranteed a learning

environment that provides for reasonable accommodation of their disabilities. If you believe you have a disability requiring an accommodation, please call (361) 825-5816 or visit Disability Services in Corpus Christi Hall 116.

If you are a returning veteran and are experiencing cognitive and/or physical access issues in the classroom or on campus, please contact the Disability Services office for assistance at (361) 825-5816.

http://disabilityservices.tamucc.edu/

- **Statement of Academic Continuity**
  In the event of an unforeseen adverse event, such as a major hurricane and classes could not be held on the campus of Texas A&M University–Corpus Christi; this course would continue through the use of Blackboard and/or email. In addition, the syllabus and class activities may be modified to allow continuation of the course. Ideally, University facilities (i.e., emails, web sites, and Blackboard) will be operational within two days of the closing of the physical campus. However, students need to make certain that the course instructor has a primary and a secondary means of contacting each student.

L. OTHER INFORMATION

- **Academic Advising**
  The College of Science & Engineering requires that students meet with an Academic Advisor as soon as they are ready to declare a major. The Academic Advisor will set up a degree plan, which must be signed by the student, a faculty mentor, and the department chair. Meetings are by appointment only; advisors do not take walk-ins. Please call or stop by the Advising Center to check availability and schedule an appointment. The College's Academic Advising Center is located in Center for Instruction 350 or can be reached at (361) 825-3928.

GENERAL DISCLAIMER

I reserve the right to modify the information, schedule, assignments, deadlines, and course policies in this syllabus if and when necessary. I will announce such changes in a timely manner during regularly scheduled lecture periods.