GGS426-001, Fall 2025 (Hybrid)

Physical Fundamentals of Remote Sensing

Course Information

Title: GGS426-001 Physical Fundamentals of Remote Sensing (Hybrid)

Time: Tuesdays 4:30 - 5:45 PM

Classroom: Exploratory Hall 2312

Instructors: Dr. John Qu and Dr. Xianjun Hao

Telephone: (703) 993-3958

Office: Exploratory Hall, Room 2412

Office Hour: Stop by 3:00-4:00 PM on Tuesdays and Thursdays or make appointment.

Course Description

This course is designed to give undergraduate students with limited Earth science satellite remote sensing background a thorough introduction to gather the basic concepts and physical fundamentals of remote sensing. The main emphasis of this course is on the basic physical and mathematical principles underlying the satellite remote sensing techniques, including radiometric and geometric information, satellite orbit and geo-location simulation, designing, atmosphere corrections, raw data record (RDR), sensor data record (SDR), environment data record (EDR), climate data record (CDR) and in situ measurements in support of remote sensing. In addition, this class will provide a focus on the NASA, NOAA and USGS current and future satellite instruments. This course aims to provide students all-inclusive overview of the state of the art in physical fundamentals of remote sensing and applications for monitoring global, regional and local atmosphere, ocean and land surface.

- **Detailed Schedule**

Week one	Introduction to Earth science satellite remote sensing
Week two	Physical fundamentals of remote sensing
Week three	Satellite data processing and analysis +Google Earth Engine (GEE) Dr. Hao
Week four	Top atmospheric solar radiation
Week five	Radiation transfer in the atmosphere
Week six	Applications radiation transfer principles to remote sensing

Week seven	Platform for remote sensing and Raw Data Record (RDR) data products
Week eight	Satellite orbit and geo-location simulation
Week nine	Sensor Data Record (SDR) algorithms and data products
Week ten	SDR algorithms and instrument calibrations
Week eleven	Atmospheric correction and surface reflectance
Week twelve	Selected scientific Environmental Data Record (EDR) algorithms
Week thirteen	Physical Principals of Climate Data Record (CDR)
Week fourteen	Attend GGS626 student final project presentations
Week fifteen	Final term paper (due date)

Final projects and term papers: Each student will choose an Earth satellite remote sensing related topic and will focus on physical principles of satellite remote sensing.

Grading:

Grades will be based upon students' performance on the homework exercises, midterm, class attendance and final term paper and presentation. The weighted contribution of each of these items to your final grade is given below:

- Midterm 30 %
- Homework 20%
- Final Project 45%
- Class attendee 5%

(A=90-100, B=80-89, C=70-79, D=60-69, F=<60)

Prerequisites:
College Math (such as MATH 214) and physics (such as PHYS 262), or permission of instructor.

Required Textbook: None

Reference Books:

1. Kuo-Nan Liou, 2002, An Introduction to Atmospheric Radiation, Second Edition, Academic Press, ISBN 0-12-451451-0
2. Charles Elachi, 1987, Introduction to the Physics of Remote Sensing, Wiley Series in Remote Sensing, John Wiley & Sons Inc., ISBN-0-471-84810-7.
3. Qu, John, Powell, Alfred, Sivakumar, M.V.K. (Eds.), 2013. Satellite-based applications on climate change. Springer, 371. ISBN 978-94-007-5871-1.
4. Qu, J.J., Gao, W., Kafatos, M., Murphy, R.E., Salomonson, V.V. (Eds.) 2006). Earth science satellite remote sensing: vol. 1: Science and Instruments. Springer and Tsinghua University Press, ISBN 10 3-540-35606-1
5. Wiley J. Larson and James R. Wertz, 1997, Space Mission Analysis and Design, Space Technology Series. Kluwer Academic Publishers, ISBN 1-881883-01-9 (paperback), ISBN 0-7923-1998-2 (hardback).

Honor code:

Students must follow the GMU Scholastic Honor Code. Please show respects to everyone in the classroom. Copying homework (or quiz) is considered cheating.

Academic Standards

Academic Standards exist to promote authentic scholarship, support the institution's goal of maintaining high standards of academic excellence, and encourage continued ethical behavior of faculty and students to cultivate an educational community which values integrity and produces graduates who carry this commitment forward into professional practice.

As members of the George Mason University community, we are committed to fostering an environment of trust, respect, and scholarly excellence. Our academic standards are the foundation of this commitment, guiding our behavior and interactions within this academic community. The practices for implementing these standards adapt to modern practices, disciplinary contexts, and technological advancements. Our standards are embodied in our courses, policies, and scholarship, and are upheld in the following principles:

Honesty: Providing accurate information in all academic endeavors, including communications, assignments, and examinations.

Acknowledgement: Giving proper credit for all contributions to one's work. This involves the use of accurate citations and references for any ideas, words, or materials created by others in the style appropriate to the discipline. It also includes acknowledging shared authorship in group projects, co-authored pieces, and project reports.

Uniqueness of Work: Ensuring that all submitted work is the result of one's own effort and is original, including free from self-plagiarism. This principle extends to written assignments, code, presentations, exams, and all other forms of academic work.

Violations of these standards—including but not limited to plagiarism, fabrication, and cheating—are taken seriously and will be addressed in accordance with university policies. The process for reporting, investigating, and adjudicating violations is outlined in the university's procedures. Consequences of violations may include academic sanctions, disciplinary actions, and other measures necessary to uphold the integrity of our academic community.

The principles outlined in these academic standards reflect our collective commitment to upholding the highest standards of honesty, acknowledgement, and uniqueness of work. By adhering to these principles, we ensure the continued excellence and integrity of George Mason University's academic community.

Student responsibility: Students are responsible for understanding how these general expectations regarding academic standards apply to each course, assignment, or exam they participate in; students should ask their instructor for clarification on any aspect that is not clear to them.

Students with Disabilities

If you are a student with a disability and you need academic accommodations, please see me and contact the Office of Disability Resources at 703/993-2474. All academic accommodations must be arranged through that office.

Student use of electronic devices

The use of computers, either lab desktops or personal laptops, is required for the course. You will only be permitted to work on material related to the class, however. Engaging in activities not related to the course will result in a significant reduction in your participation grade. Please be respectful of your peers and instructor and avoid email, social media, and other distracting uses of computers.

Class Cancellation

If a class is cancelled due to inclement weather or other reasons, the syllabus will be updated as early as possible. Best efforts will be made to send each student an email with information on the cancellation of class. Make up classes will be scheduled during the next lecture. When an exam or quiz is cancelled, it will be given during the next lecture.

AI (Artificial Intelligence) Statement

Large language model generative artificial intelligence (generative AI) tools, such as ChatGPT and others, have recently emerged and become available for wide use. While generative AI tools can offer inspiration and new possibilities, they should not be seen as unacknowledged substitutes for the content created by students in their courses. More detailed information can be obtained from the following websites (https://stearnscenter.gmu.edu/knowledge-center/ai-text-generators/ and https://ctl.utexas.edu/chatgpt-and-generative-ai-tools-sample-syllabus-policy-statements)