GGS626-001, Fall 2023, Hybrid

Title: GGS626-001 Physical Fundamentals of Remote Sensing (Hybrid)

Time: 4:30 - 5:45 PM, Tuesdays (in-person)

4:30 - 5:45 PM, Thursdays (online)

Classroom: Exploratory Hall 2312

Instructors: Prof. John Qu and Dr. Qian Liu

Telephone: (703) 993-3958

Office: Exploratory Hall, Room 2412

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

Course Description

This course is designed to give students with limited Earth science satellite remote sensing background a thorough introduction to gather the basic concepts and fundamentals of physical principles 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, science algorithm designing, atmosphere corrections, 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. These students will understand not only what satellite remote sensing systems do, but also how they work. This course aims to provide students all-inclusive overview of the state of the art in physical principles of remote sensing and applications not only for monitoring global and regional atmosphere, ocean, and land surface, but also for detecting local targets, such as, urban, and suburban areas. The satellite-based applications of climate change are another focusing area too.

- **Detailed Schedule**

Week one	Introduction to Earth science satellite remote sensing
Week two	Physical fundamentals of remote sensing
Week three	Top atmospheric solar radiation
Week four	Atmospheric absorption and scattering
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 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	Student final project presentations
Week fifteen	Final term paper due

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 50%

(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).
6. Some EOS, JPSS, NPP and Landsat, Algorithm Theoretical Basis Documents (ATBDs) will be used during this class.

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.