ASEN 6519. Lidar Remote Sensing

Syllabus, Spring 2007

Lecture: MUEN D439 @ 2:00-2:50 pm on Monday, Wednesday, and Friday

Web page: http://cires.colorado.edu/science/groups/chu/classes/lidar2007/

Instructor

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Office Hours: TBD

Prerequisites

The pre-requisition is the ASEN-5519 "Fundamentals of Spectroscopy for Optical Remote Sensing" offered in Fall 2006. Equivalent spectroscopy or quantum / laser physics or optical engineering classes will be considered. Students lacking of above desired background can contact the instructor for further information about exception.

Course Objective

LIDAR stands for Light Detection and Ranging, commonly known as Laser Radar. It is not only replacing conventional sensors, but also creating new methods with unique properties that could not be achieved before. Lidar is extremely useful in atmospheric and environmental research as well as space exploration. It also has wide applications in industry, defense, and military.

This 6000 level class is based on the previous 5000 level "Laser Remote Sensing" class offered in Spring 2006. But it has been significantly upgraded to include more lidar examples, lidar data processing projects, and lidar design components. Students will be offered field-trip opportunities to CSU Fort Collins lidar facility. Guest speakers will be invited from different lidar groups.

Our objectives are to provide:

1. A comprehensive, yet easily understandable, up-to-date overview of lidar principles, technologies, and applications;
2. Practice of lidar data retrieval, lidar system design, and quantitative analysis of lidar performance and measurement errors;
3. Opportunities to see and possibly operate the real state-of-the-art lidar systems and make connections to lidar experts in the nation and world.

Course Content

1. INTRODUCTION

A. Concept and classification of remote sensing

B. Overview of lidar remote sensing

2. FUNDAMENTALS OF LIDAR REMOTE SENSING

A. General picture of lidar remote sensing

B. General lidar equation

C. Physical processes involved in different lidars

D. General lidar architecture

E. General solutions of lidar equation

F. Classification of lidars

3. LIDAR EQUATION, DATA INVERSION AND ERROR ANALYSIS

A. From photon counts to physical parameters using lidar equation

B. General data inversion procedure

C. General error analysis procedure

4. TOPICAL LIDARS AND THEIR APPLICATIONS

A. Lidars for Aerosol/Cloud Measurements

B. Lidars for Constituent Measurements

C. Lidars for Temperature Measurements

D. Lidars for Wind Measurements

E. Lidars for Solid Target Detection

5. LIDAR DESIGN AND PERFORMANCE ANALYSIS

A. Overall Considerations

B. Transmitter Considerations

C. Receiver and Data Acquisition Considerations

D. Lidar Performance Analysis and Simulation

6. LIDAR FUTURE OUTLOOK

Where do we go from here? Open discussions with students and experts will provide an overview for possible future development and application of laser remote sensing technologies.

Texts

Required Textbook: Laser Remote Sensing, Edited by Takshi Fujii and Tetsuo Fukuchi, Published by CRC Press, Taylor & Francis Group, ISBN: 0-8247-4256-7, 2005.

This text was chosen for its newest and frontier descriptions of modern lidars and applications. During the course of the semester chapters will be assigned for reading requirements. Supplementary material will also be provided during the course to provide more clarity or depth to a topic. There are some books on lidars that you can access through the Engineering Library to provide a different point of view on the material we will cover in class. Two recommended books are

- Lidar: Range-resolved optical remote sensing of the atmosphere, edited by Claus Weitkamp, published by Springer, ISBN: 0-387-40075-3, 2005.
- Laser Remote Sensing: Fundamentals and Applications, by Raymond M. Measures, Wiley-Interscience, New York, ISBN: 0-89464-619-2, 1984.

Course Grading

10	Reports
80	Projects
10	Presentations
100	Total