ASEN 6519. Lidar Remote Sensing

Syllabus, Fall 2012

Lecture: ECCS 1B28 @ 12:00-12:50 pm on Monday, Wednesday, and Friday

Web page: http://cires.colorado.edu/science/groups/chu/classes/lidar2012/

Instructor

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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.

Our objectives are to provide:

1. Comprehensive, yet easily understandable, up-to-date understandings of lidar principles, technologies, and applications;
2. Approaches for quantitative lidar simulation, lidar sensitivity and error analysis, lidar data retrieval, lidar system design and performance analysis;
3. Opportunities to see and operate the real state-of-the-art lidar systems and make connections to lidar experts in the nation and world.

This class is based on the 6000-level "Lidar Remote Sensing" class offered in Spring 2011. In light of the new development of lidar technologies and applications presented at the 25th International Laser Radar Conference (ILRC) that was held in St. Petersburg, Russia in July 2010, and the 26th ILRC held in Greece in June 2012, the course contents have been updated to include new developments and directions, more sophisticated lidar simulation and sensitivity analysis. Students will be offered field-trip opportunities to UCB Table Mountain lidar facility for real lidar operations. Guest speakers will be invited from different lidar groups.

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 will 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

20	HWK Reading Reports
60	HWK Projects
20	Final Projects
100	Total