

## ASEN 6519. Lidar Remote Sensing HWK Report #1

Please write a HWK report on the Introduction Chapter and the Reading Materials including:

- 1) Introduction of Remote Sensing by W. G. Rees from book of "Physical Principles of Remote Sensing".
- 2) Chapter 1 "Lidar: Introduction" by Claus Weitkamp in textbook "Laser Remote Sensing".
- 3) Introduction of Lidar by Ulta Wandinger in book of "Lidar"
- 4) Chapter 5.1 and 5.2.1.1 by Xinzhao Chu in textbook "Laser Remote Sensing".
- 5) Searchlight lidar paper by L. Elterman in 1966

In the report, please address the following aspects:

### 1. On the Introduction of Remote Sensing

- (1) Describe the concept, picture, and content of remote sensing using your own words.
- (2) What applications and advantages does remote sensing have?
- (3) Describe the classifications of remote sensing. What is the major difference between passive and active remote sensing? What advantages and disadvantages does active remote sensing have in comparison to passive remote sensing?
- (4) Summarize the types of passive remote sensing and give an example for each type.
- (5) Describe the common principle of SODAR, RADAR, and LIDAR. What do these acronyms stand for?
- (6) What are the major differences among SODAR, RADAR, and LIDAR (e.g., frequency range, energy format, hardware, application range, etc)?

### 2. On the Introduction of Lidar and Lidar Remote Sensing Overview

- (1) Describe the history of lidar using your own words.
- (2) Searchlight lidar: 1) Derive the equation of altitude determination for searchlight lidar (referring to Slide #6 in lecture notes #3):

$$h = \frac{d \cdot \tan(\theta_T) \cdot \tan(\theta_R) + H_T \cdot \tan(\theta_R) + H_R \cdot \tan(\theta_T)}{\tan(\theta_T) + \tan(\theta_R)},$$

where  $d$  is the separation between transmitter and receiver,  $h$  is the altitude of the detected point,  $H_T$  and  $H_R$  are the base altitudes of transmitter and receiver,  $\theta_T$  and  $\theta_R$  are the elevation angles of transmitter and receiver.

- 2) Why must the separation between the transmitter and the receiver be large in such a lidar? Try to show this from mathematic way. 3) Explain why modulation of searchlight intensity with a shutter dramatically improves the detection sensitivity and range?
- (3) Explain the principles of how different lidars determine altitude or range: searchlight or CCD-imaging lidar, atmospheric lidar, and target lidar.
- (4) Describe the basic architecture, configuration, and arrangement of lidar using your own words. Point out the potential advantages and disadvantages of bistatic and monostatic configurations, and of biaxial and coaxial arrangements.
- (5) Describe the basic ideas of lidar equation from the picture of active remote sensing. Why do we have different formats of lidar equations – what do people care in each equation?