ASEN 6519. Lidar Remote Sensing

HW #1 -- Lidar Fundamentals

Please address the following aspects in your reading report:

1. On the Introduction to 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 over *in situ*?
   (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.
   (6) Please find out the frequency range for SODAR, RADAR, and LIDAR, respectively, and answer the question: could we hear it when a SODAR is in operation?
   (7) What physical interactions are used in SODAR, RADAR and LIDAR? In other words, how can sound waves, EM waves and light be scattered back?
2. On the Fundamentals of Lidar Remote Sensing
   (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 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, θ_T and θ_R are the elevation angles of transmitter and receiver.
   2) 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: 1) searchlight or CCD-imaging lidar, 2) atmospheric lidar, and 3) target lidar. Why can laser altimeters have better resolution than normal atmospheric lidars?
   (4) Describe the basic ideas of lidar equation from the picture of active remote sensing. You may want to derive a lidar equation by yourself.
   (5) In the example of airborne Na lidar profile (lecture 3), why do we see a sharp edge near 80 km? How many aspects do you need to consider in order to explaining it?
   (6) Please summarize the different forms of lidar equations and point out what people care in each format of the equation. How would you solve each lidar equation and what parameters do you need to do so?

Reading materials that you may consider include IntroRemoteSensing.pdf, IntroLidar.pdf, Searchlight.pdf, Chapter 1 and Chapter 5 of our textbook. You may also try to search literatures for answers to some of the questions. It is encouraged to give references for numbers or things you quoted but you do not get them by yourself. Please write things in your own words. Do NOT copy from websites.

HW #1 is due in class on Monday, September 8, 2014.