Exam GEO4-4408 Remote Sensing
17 April 2009

Question 1:
Assume you have a multispectral scanning system with two narrow (10nm wide) spectral bands centered at 550 nm and 1000 nm. The imaged area is composed entirely of soil, water and vegetation.

a) Are these two bands enough to spectrally distinguish between these three land cover types? Explain why.

b) Assume you may design your own sensor consisting of two narrow spectral bands of which you can determine the position in the 400 to 2500 nm wavelength region. If the sensor should allow to separate limestone (carbonate) rock from the other land cover (vegetation, urban, water), where would you position the two bands? Explain why (!).

Question 2:
Wien's displacement law *wavelength = 2898 / temperature* provides the relation between wavelength of maximum transmittance of energy and absolute temperature of an (black body) object. If an iron stick is placed in a fire and its temperature increases slowly. If the stick emits red light with a wavelength of 650 nm, what is its temperature? Show your computation (!).

Question 3:
The spectral angle mapper is a commonly used algorithm for surface compositional mapping using hyperspectral remote sensing data and endmember spectra.

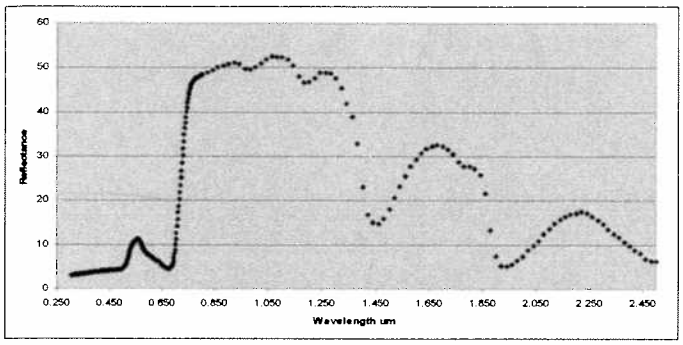
a) Explain the working principle of the spectral angle mapper (SAM). Use a sketch to clarify your answer.

b) If a mountain that consists of one and the same type of rock is imaged with a hyperspectral sensor on a sunlit slope and on a shadow slope, would the spectral angle mapper be able to discriminate between the two slopes (given their spectra are identical in terms of absorption features but differ only in terms of overall brightness)?

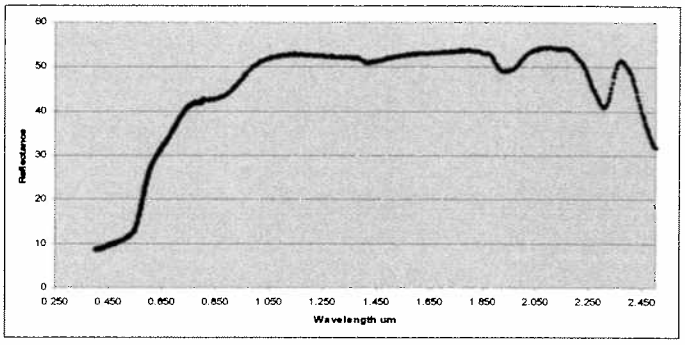
c) As input to a spectral classifier, one could use endmember spectra picked from a laboratory spectral library and endmember spectra picked from the image. List an advantage and a disadvantage for using image spectra, and list an advantage and disadvantage for using laboratory spectra.

Question 4:

The following graphs 6 graphs show spectral signatures of a selection of the following 10 objects: water, cloud, deciduous vegetation, senescent vegetation, snow, asphalt, peat soil, dolomite, goethite, quartz, red building brick. Please assign the appropriate object to the corresponding spectrum. Motivate your answer!! Note the difference ranges of the y-axes.



1.



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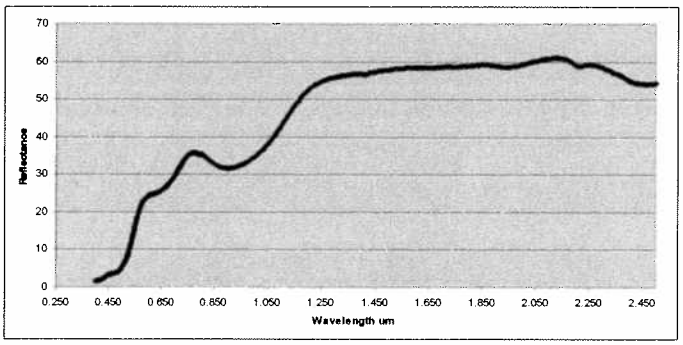

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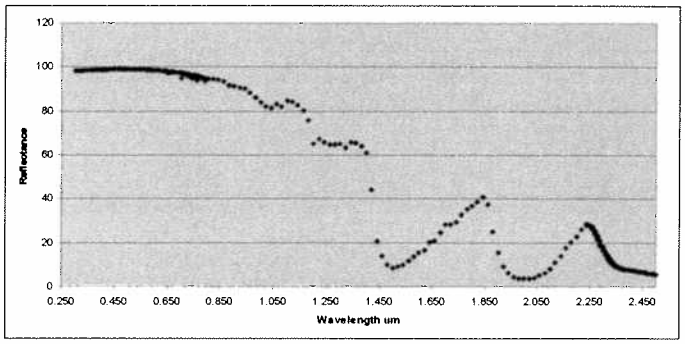

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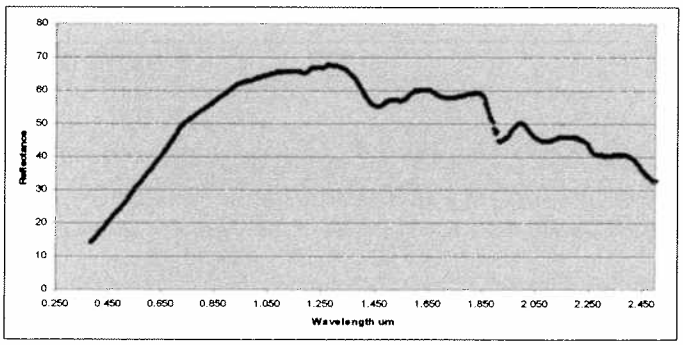
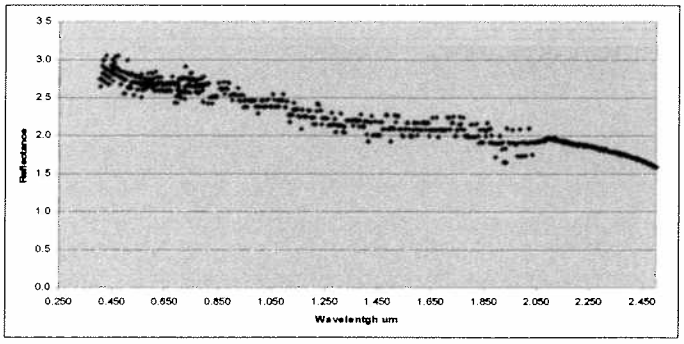


5.



6.

Question 5:
In lecture 6 we discussed the scientific paper of Woodcock and Strahler "On the Nature of Models in Remote Sensing". The paper aims at improving our understanding of image information in relation to objects at the earth surface. The paper introduces the scene model and the image model.

a) What is a scene model? What is an image model?
b) Explain the difference between H and L resolution images.
c) Indicate for the following classes whether one should use an IKONOS or a Landsat TM image to get an H resolution:
   - Tree
   - Forest
   - House
   - City

Motivate your answer.

Question 6:
Visual image interpretation is important in remote sensing. Color, color display and color printing plays an important role in this.

a) In physics colors are described using three variables: intensity, hue and saturation. Describe in your own words the meaning of these three variables.

b) Draw 4 figures with along the x-axis the electromagnetic spectrum ranging from 400 to 700 nm and along the y-axis the light intensity. Illustrate in these 4 graphs the effects of intensity, hue, saturation and an example of a mixture of these 3 variables. Clarify in a few written lines your drawings.

c) Colors and the composition of colors can be visualized by the 'color cone'. Draw such a color cone and indicate in this graph the location of the primary and secondary colors and indicate, by drawing arrows, how intensity, hue and saturation are represented in the color cone. Clarify in a few written lines your drawings.

d) Colors on a display are generated by additive color mixing and colors printed on paper are generated by subtractive color mixing. Explain in detail the differences between these two color mixing techniques.

e) can explain
interpret colors of Landsat image (red urban, green swamp, blue clouds)