National Exams May 2014

04-Geom-A5, Remote Sensing and Image Analysis

3 hours duration

NOTES:

1. If doubt exists as to the interpretation of any question, the candidate is urged to submit with the answer paper, a clear statement of any assumptions made.

2. This is a CLOSED BOOK EXAM.
   One of two calculators is permitted, any Casio or Sharp approved models.

3. The complete exam paper consists of 5 questions.

4. Each question is of equal value.

5. Most questions require an answer in essay format. Clarity and organization of the answer are important.

04-Geom-A5 Remote Sensing and Image Analysis

Candidate ID:_____Name_____Signature_____

Question 1: Answer the following questions related to remote sensors and their characteristics [Total 20 marks; 5 marks each]

1.1: What are the advantage(s) and disadvantage(s) of the pushbroom imager, compared with the optical-mechanical scanner?

1.2: Passive sensors working within thermal and microwave spectral regions usually have a low spatial resolution. Why?

1.3: A satellite sensor has many characteristics. For example, one of them is its spatial resolution. Please name three other characteristics and define them.

1.4: Compare and contrast active sensors and passive sensors.

Question 2 [20 Marks]

Describe 4 components of at-sensor radiance of a surface object (green circle in Figure 1), and illustrate the photon paths using diagrams. Please use one diagram for one component. Identify the component contains surface bi-directional reflectance information. Assume that the surface object is within the field of view of the sensor and the reflectance between the surface object (green circle) and its background are different.
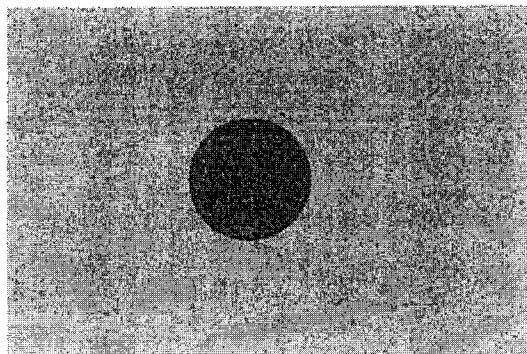

Figure 1: The diagram showing the surface object of interest within a background with different reflectance.

Question 3 [20 Marks]

Assume you are asked to perform contrast enhancement for band 4 (near-infrared) of an ETM+ image obtained on a clear-sky day during the summer of 2004.

3.1 [10 marks]: Assume that the brightness values range from 30 to 160, write the equation for a simple linear contrast stretch which makes use of the full range of brightness values of 8 bits.
3.2 [10 marks]: What type of contrast enhancement would you use to enhance the contrast within healthy vegetation region of the image more? Why?

Question 4 [20 Marks]

4.1 [10 marks]: If you are asked to perform spectral classification of TM imagery over an area, under what circumstances will you consider an unsupervised classification over a supervised classification?

4.2 [10 marks]: If you choose a supervised classification, under what circumstances will you choose a maximum-likelihood classifier over a minimum distance classifier?

Question 5 [20 Marks]

If the principal component analysis (PCA) is applied to the image with the following variance-covariance matrix among its four spectral bands, would you expect the PCA be effective? Justify your answer.

$$\Sigma = \begin{bmatrix} 34.89 & 55.62 & 52.87 & 22.71 \\ 55.62 & 105.95 & 99.58 & 43.33 \\ 52.87 & 99.58 & 104.02 & 45.80 \\ 22.71 & 43.33 & 45.80 & 21.35 \end{bmatrix}$$