Authoring Organization: Del Mar College
Written by: Nate Jennings

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GST 105 – Mid Term

This midterm exam covers the material for Units 1-3 and will require written responses.

1. What is remote sensing?

   Remote sensing is the science and study of imaging systems that collect information about the environment without being in physical contact with the phenomena. Many common types of remote sensing systems are aerial and satellite-based imaging systems.

2. What are 4 common wavelengths that have been discussed? Name them and provide the wavelength ranges in nanometers.

   Blue – 400-500 nm
   Green – 500-600 nm
   Red – 600-700 nm
   Infrared – 700-900 nm*
   ***There are also other IR wavelengths that can be mentioned here based on specific sensors such as Landsat. (mid-IR: 1550-1750 nm and another near IR: 2080-2350 nm)**

3. Name and describe 4 kinds of remote imaging sensors. Name general categories not specific imaging systems or platforms.

   Aerial imaging
   RADAR
   Multispectral satellite systems
   LiDAR
   Hyperspectral

4. Name and describe 2 current or up-and-coming remote sensing technologies.

   Unmanned Aerial Vehicles (UAVs)
   Kite or Balloon-based systems

5. What are 5 common uses of remotely sensed imagery?

   Flood mapping (pre and post event)
   Agricultural change
   Forest mapping and change
   Ice break up

Urban change
Plant health
Wetland mapping and change
***Many others are possible.**

6. What is digital image processing and how is it used with remotely sensed imagery?

   Digital image processing is the ability to use computer systems and software to analyze and process digital images that come directly from remote sensing systems or have been converted from hard copy into digital formation (such as image scanning). A variety of algorithms and processes exist that can be used to analyze imagery, and derive new information and data products. Some of these are digital land cover maps, merged data sets, image mosaics, unique band ratios, among others.

7. What range of wavelengths is very beneficial to vegetation analysis using remotely sensed imagery? Why is this the case?

   The infrared portion of the electromagnetic spectrum is very important to vegetation analysis because the infrared wavelengths reflect much higher in the infrared portion of the spectrum than that of the true color portion because the true color wavelengths Blue, Green, and Red do not reflect as high as does the infrared portion. Minor differences in vegetation reflectance can be detected more so in the infrared than in the true color wavelengths.

8. What is the difference between an active and passive remote sensor?

   An active sensor provides its own energy source to produce a wave (usually radio or light) that hits the Earth and then records the reflected energy from the Earth back on the sensor. RADAR and LiDAR are two active remote sensor systems. A passive remote sensor records the energy reflected by objects on the Earth that are illuminated by the sun.

9. What is the benefit of hyperspectral sensors over other multispectral sensors?

   Hyperspectral sensor record reflected energy from the Earth in dozens or hundreds of narrow wavelengths. These systems have the capability to identify unique materials based on their chemical or structural characteristics. Multispectral sensors usually only collect imagery using a small number of wavelengths (usually 3 to 4 to 10 or less). Multispectral sensors can only image objects in broader wavelength sections of the electromagnetic spectrum.

10. What are the primary components of an image?

A typical image from a remote sensing system is composed of pixels organized by rows and columns and bands, where the bands represent the different wavelengths a remote sensor is capable of capturing.

11. Explain why different wavelengths are assigned to different color planes on a color display? What is the benefit of being able to do this with respect to remotely sensed image data?

    To see any combination of sensor bands (i.e wavelengths collected on the sensor), individual bands (or wavelengths) must be assigned to one of the Blue, Green, or Red color display planes. This provides the capability to see sensor data in "color" as well as "false color" displays for those sensor bands that are recorded in the infrared (or microwave) portions of the electromagnetic spectrum. Only up to 3 sensor bands can be viewed at a single time. In the case of hyperspectral data, this can be challenging since there are hundreds of possible band combinations that can possibly be displayed.

12. What are some important characteristics to keep in mind when ordering or tasking to have remotely sensed imagery collected?

    a. **Aerial – project area, ortho or true ortho collection, time of day, leaf on/off, specific seasonal capture, types of delivered products, type of sensor used in the collection, image resolution**

    b. **Satellite – repeat period, image resolution, time duration to collect imagery for a given project area, percent cloud cover, haze reduction, types of basic processing, georeference**

13. What is the benefit of using band ratios with remotely sensed imagery?

    Band ratios can help normalize areas that have different illumination characteristics as well as provide some derivative image data sets that can be used to help analyze plant condition and stress, soil condition, soil moisture, and wetland characteristics among others

14. What is the benefit of applying the NDVI band ratio? What kind of imagery is required?

    Using the Normalized Difference Vegetation Index can help identify areas of healthy green vegetation as well as those areas that are experiencing plant stress. This can be beneficial to

land cover mapping and plant mapping projects. Remotely sensed imagery must have at least one infrared wavelength captured in addition to the true color bands.

15. Describe the Tasseled Cap transformation and why it would be beneficial to use in land cover projects. What kind of imagery can the tasseled cap transformation be used?

    The tasseled cap transformation can be applied to Landsat MSS, TM, and IKONOS imagery, since the tasseled cap coefficients have been derived for these sensors. The tasseled cap transformation provides a means to derive three biophysical components of brightness, greenness, and wetness. These components can be used with other sensor data to help map land cover, biomass, wetlands, agricultural areas and changes in these environments over time.