GIST 58: REMOTE SENSING & DIGITAL IMAGE PROCESSING

Foothill College Course Outline of Record

Heading	Value
Effective Term:	Summer 2022
Units:	3
Hours:	2 lecture, 3 laboratory per week (60 total per quarter)
Advisory:	This is an intermediate level course in GIST, and assumes the ability to use industry standard software; successful completion of GEOG 11 or GIST 11, and GEOG 12 or GIST 12 strongly recommended; not open to students with credit in GEOG 58.
Degree & Credit Status:	Degree-Applicable Credit Course
Foothill GE:	Non-GE
Transferable:	CSU
Grade Type:	Letter Grade (Request for Pass/No Pass)
Repeatability:	Not Repeatable

Student Learning Outcomes

- Apply electromagnetic radiation principles for earth observation and analysis.
- Define remote sensing and explain its basic concepts.
- Integrate imagery within a GIS environment.

Description

Physical basis of remote sensing. Aerial photography and high resolution multi-band imaging. Satellite multi-band optical remote sensing. Other forms of remote sensing (RADAR, SAR, LIDAR). Applications of remote sensing.

Course Objectives

The student will be able to:

1. define remote sensing.
2. discuss the applications of remotes sensing with Geographic Information Systems (GIS).
3. discuss the physical basis for remote sensing in terms of the electromagnetic spectrum.
4. evaluate three remote sensing platforms and discuss their applications.

Course Content

1. Remote sensing overview
    a. Definition of remote sensing
    b. Remote sensing assumptions
    c. Advantages of using remote sensing
    d. Correlating remotely sensed data with ground data
2. Physical basis for remote sensing
    a. The electromagnetic spectrum
        i. Overview
        ii. Visible (short) wavelengths
        iii. Near-infrared wavelenghs
        iv. Mid-infrared wavelengths
        v. Thermal wavelengths
        vi. Microwave (long) wavelengths
        vii. Spectral bands
    b. Atmospheric effects
        i. Overview of interaction between radiation and targets
        ii. Reflected, emitted and absorbed radiation
        iii. Description of energy path
        iv. Atmospheric scattering and absorption
    c. Reflectance of terrain materials, transmission of water (optical)
        i. Spectral signatures across wavelengths
        ii. Comparison of spectral patterns
        iii. Changes of signatures over time and space
    d. Microwave remote sensing (SAR, RADAR and thermal)
        i. RADAR geometry
        ii. Backscatter
        iii. Interpreting surface cover
        iv. Advantages and disadvantages
3. Multi-band image interpretation
    a. How multi-band image display works
        i. Image bands vs. software/computer color guns
        ii. Additive color
        iii. Image pixel values and color
    b. False color imagery
    c. Histogram interpretation
        i. Overview of histograms
        ii. Relationship between image bands and histograms
        iii. Relationship between image objects and histogram
    d. Image classification
        i. Land use vs. land cover
        ii. Classification systems
        iii. Classification criteria
        iv. Informational vs. spectral classes
        v. Unsupervised classification
            1. Clustering
            2. Interpreting and editing clusters
            3. Field verification
        vi. Supervised classification
            1. Training areas
            2. Training signatures
        vii. Accuracy assessment
4. Aerial photography and high-resolution multi-band imaging
    a. Methods of interpretation
        i. Manual vs. digital
    b. Aircraft scanner equipment
        i. CCDs and digital cameras
        ii. Spectral and spatial resolution
    c. Orthorectification and georeferencing
        i. Types of correction
        ii. Effects of topographic relief displacement

iii. Digital image rectification process overview
iv. Ground control points
v. Transformation matrix and root mean square error
vi. Resampling

d. Interpretation techniques
i. Air photo manual interpretation and delineation
ii. Satellite imagery

5. Satellite remote sensing
a. Overview of remote sensing equipment
b. Remote sensing platforms and data acquisition
i. Satellite orbits (geostationary, near-polar)
ii. Passive vs. active systems
iii. Whisk broom vs. push broom systems
iv. Sensors from NOAA, NASA, SPOT, commercial satellites and aircraft
v. Data acquisition from NASA DAACs, USGS MRLC, websites with free data

c. Data applications
i. Weather
ii. Disaster assessment
iii. Vegetation monitoring
iv. Urban growth
v. Ocean health
vi. Public health

d. Integration with GIS systems
i. Digital filters for imagery
ii. Converting raster layers to vector

6. Lab content
a. Introduction to Idrisi
i. Display imagery
ii. Pan, zoom

b. Histograms
i. Manual exercise
ii. Exercise using Idrisi

c. Exploring reflectance values and creating color composites
i. Spectral response of land cover types
ii. Creating spectral graphs
iii. Natural color and false color composites

d. Geometric correction
i. Image re-projection
ii. Acquire GPS points
iii. Assess transformation error
iv. Resample image

e. Image classification
i. Manual image interpretation
ii. Manual unsupervised classification
iii. Digital unsupervised classification
iv. Image interpretation

Lab Content

1. Introduction to remote sensing software
a. Display imagery
b. Pan, zoom
2. Histograms
a. Manual exercise
b. Exercise using remote sensing software
3. Exploring reflectance values and creating color composites
a. Spectral response of land cover types
b. Creating spectral graphs
c. Natural color and false color composites
4. Geometric correction
a. Image re-projection
b. Acquire GPS points
c. Assess transformation error
d. Resample image
5. Image classification
a. Manual image interpretation
b. Manual unsupervised classification
c. Digital unsupervised classification
d. Image interpretation

Special Facilities and/or Equipment

1. For practical exercises: PC computer facilities and industry standard remote sensing software. Computer laboratory will also need internet access.
2. When taught via Foothill Global Access, ongoing access to computer with email software and hardware; email address.

Method(s) of Evaluation

Methods of Evaluation may include but are not limited to the following:

Laboratory projects
Final exam or final project and oral presentation

Method(s) of Instruction

Methods of Instruction may include but are not limited to the following:

Lecture presentations
Classroom discussion
Demonstrations and hands-on exercises
Reading assignments

Representative Text(s) and Other Materials

Lillesand, Thomas M., Ralph Kiefer, and Jonathan Chipman. Remote Sensing and Image Interpretation, 7th ed.. 2015.

Although this text is older than the suggested "5 years or newer" standard, it remains a seminal text in this area of study.

Types and/or Examples of Required Reading, Writing, and Outside of Class Assignments

1. Weekly reading assignments from text and outside sources ranging from 30-60 pages per week.
2. Weekly lecture covering subject matter from text assignment with extended topic information. Class discussion is encouraged.

3. Hands-on exercises and demonstrations: Weekly computer exercises. Each exercise covers assigned reading and lecture topics.

Discipline(s)

Geography or Drafting/CADD or Environmental Technologies or Forestry/ Natural Resources