Asian Institute of Technology
School of Engineering and Technology

AT76.03 *Remote Sensing* 3 (2-3) **Semester: August/ January**

Course Objective: This course provides students foundations of Remote Sensing (RS) theory, RS image processing techniques and applications. Specific objectives of this course are: i) to provide background knowledge and understanding of principles of RS and RS systems; ii) to enhance students' capacity to interpret images and extract information on the earth surface from multi-resolution imagery at multi-scale level; iii) to acquire skills on basic image processing and classification techniques; iv) to enable critical, spatial and temporal thinking on Remote Sensing for real-world applications.

Learning Outcomes:

The students on the completion of this course would be able to:

1. Critically compare different EO systems taking into account the essence of the observed phenomena.
2. Evaluate different EO data and select the more appropriate under limited observation condition.
3. Carry out effective and accurate geometric and atmospheric corrections to reduce observation distortions.
4. Apply basic procedures of digital image processing for RS image enhancement analysis.
5. Conduct accurate automatic or semi-automatic geo-information extraction from remotely sensed imagery.
6. Carry out independent scientific remote sensing research or professional RS assignments.

Prerequisite: None

Course Outline:

I. Introduction
   1. What is Remote Sensing
   2. Historical overview: from maps to digital earth

II. The Physics of Remote Sensing
   1. Electromagnetic energy, sources, EM spectrum and wavelength ranges
   2. Optical Remote Sensing
   3. Microwave Remote Sensing

III Remote Sensing Systems for Earth Observation
   1. Multispectral Remote Sensing

2. Fundamentals of hyperspectral remote sensing, SAR, stereoscopy and photogrammetry.

IV Earth Observation Space Programs
1. Satellite missions and constellations
2. Commercial and non-commercial RS: image availability and costs.

V Overview of RS Application
1. Disaster management; Volcano, Flood, Forest Fire
2. Agriculture applications
3. Land and use/land cover monitoring
4. Fishery and marine application
5. Coastal zone management
6. Urban monitoring

VI Image Data Visualization and Radiometric Enhancement
1. Digital image and display
2. Radiometric (contrast) enhancement

VII Image Correction and Registration
1. Radiometric correction
2. Geometric correction

VIII Image Data Enhancement
1. Image Arithmetic (Vegetation Indices and rescaling factors)
2. Principal Components Transformation
3. Pan Sharpening

IX Image Interpretation and Information Extraction
1. Introduction
2. Pixels based approaches
3. Object based image information extraction (concepts and terms)
4. Ground truthing and accuracy assessment

Laboratory Session(s):

1. Introduction of Basic Tool and Colour Composition Images
2. Earth Explorer and Map Composition
3. Low to High Resolution Remote Sensing
4. Field Radiometric Measurement – MultiSpectral Characteristics
5. Image Enhancement
6. Math Operation I (NDVI calculation)
7. Math Operation II: DN to Radiance Conversion
8. Geometric Correction
9. Field Trip preparation and assignment
10. Unsupervised Classification

11. Supervised Classification
12. Accuracy Assessment

Learning resources:

Textbooks: No designated textbook, but lecture notes, handouts and other ancillary learning resources will be provided.

Reference Books:

John A. Richards:

Remote Sensing Digital Image Analysis - An Introduction (Fifth Edition), Springer-Verlag Berlin Heidelberg, 2013.

R. A. Schowengerdt:

Remote Sensing - Models and Methods for Image Processing (3rd Edition), (Third ed.). San Diego, California: Academic Press, 2007.

Congalton, R.G., & Green, K.

Assessing the Accuracy of Remotely Sensed Data: Principles and Practices, Second Edition, Boca Raton, CRC Press, 2009.

Liu, J.-G., & Mason, P.J.

Image processing and GIS for remote sensing: techniques and applications, Chichester, Wiley-Blackwell, 2016.

Journals and Magazines:

Remote Sensing, MDPI
International Journal of Photogrammetry and Remote Sensing (ISPRS), Elsevier
Photogrammetric Engineering and Remote Sensing, ASPRS
Remote Sensing of Environment, Elsevier

Others: None

Teaching and Learning Methods:

1. **Lectures:** Students will receive lecture notes and the weekly lecture schedule at the beginning of the course. They will be requested to read the lecture notes before coming to the class**.**
2. **Laboratory sessions:** 12 laboratory exercises will expose students to different tools in Remote Sensing. Laboratory instruction will provide a basic guideline for student to learn and familiarize with remote sensing software and data**.** Students are requested to understand the algorithm of each operation so that they able to operate with other software**.** Students will be also requested to complete home assignments submit a report in due time.

3. **Discussion Sessions:** Every class and laboratory will have discussion sessions to engage all the students.
4. **Assignments:** Assignments are given to assess the understanding of concept, analysis methods and modeling to be applied Remote Sensing methods and applications development.
5. **Field Survey:** a field survey will be organized with the aim of training students on how to collect remote sensing training and test dataset necessary for classification process and image information extraction

Time Distribution and Study Load:
Lecture: 30 Hrs
Laboratory: 45 Hrs
Field Survey = 1 day
Self-study: 90 Hrs

Evaluation Scheme:
The final grade will be based on the following weight distribution: assignments (20), mid-semester examination (30%), final-semester examination (30%), Mini project (20%). An "A" would be awarded if a student can elaborate the knowledge learned in class by giving his/her own analysis on real case examples given in this course and from journal articles and including assigned readings. A "B" would be awarded if a student shows an overall understanding of all given topics, a "C" would be given if a student meets below average expectation on both knowledge acquired and analysis. A "D" would be given if a student does not meet basis expectations in understanding and analyzing the topics and issues presented in the course.

Instructor(s): Dr. Salvatore G.P. Virdis