Asian Institute of Technology
School of Engineering and Technology

AT76.09 ***Digital Image Processing in Remote Sensing*** **3(2-3)** **Semester: January**

Course Objective: The objective of this course aims at providing students with knowledge and in-depth understanding of techniques in digital image processing for remote sensing data analysis. This course emphasizes on implementation of algorithms as computer programs. The techniques taught in this course have application in several fields dealing with image data.

Learning Outcomes:

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

1. Explain the image data handling in memory and file system
2. Interpret the C programming source code for image processing
3. Apply the principle of image processing as the automate data processing procedure for remote sensing data analysis, resampling and DEM processing
4. Apply the principle of image processing on huge image files by using High Performance Computing (HPC) and General-purpose computing on Graphics Processing Units (GPGPU) environment
5. Develop new algorithms for image processing and conduct scientific Remote Sensing research

Prerequisite: AT76.03

Course Outline:

I. Review of C Language
   1. Syntax
   2. Functions
   3. Control structures
   4. Pointer and array
   5. Dynamic memory allocation
   6. File I/O

II. Image Data Handling in Computer System
   1. Memory system
   2. Image model in computer memory
   3. Memory allocation
   4. Handling of various types & length of image
   5. File system
   6. File format: basic

7. Image file handling subroutines

III. Remote Sensing Image File Format and Handling
1. Tagged Image File Format (TIFF)
2. Joint Photographic Experts Group (JPEG)
3. Hierarchical Data Format (HDF)
4. Image file format used in commercial remote sensing software such as ENVI, ER-MAPPER, ARC/INFO, and etc.

IV. Image Processing Algorithm and Implementation-I (Basic Algorithm)
1. Image statistics
2. Image contrast enhancement
3. Color composite
4. Pseudo color composite
5. Image filtering
6. Image matching

V. Image Processing Algorithm and Implementation –II (Application)
1. Image geometric conversion - Resampling
2. River network extraction
3. Handling of huge image files on HPC and GPGPU environment
4. Image classification
5. Segmentation

VI. RS data and DEM for 3D Visualization and Mapping
1. DEM (Digital Elevation Model)
2. Coordinate system
3. Shading model
4. Z-Buffer model
5. Topographic feature extraction

Laboratory Session(s):

1. C development environment on Windows and LINUX
2. Exercise of basic C programming
3. Using image handling libraries
4. Reading / Writing image files
5. Implementation of image processing algorithm –I (Basic algorithm)
6. Implementation of image processing algorithm –II (Application)

Learning Resources:

Textbooks: No designated textbook, but class notes and handouts will be provided

Reference Books:

R.C. Gonzales, R. E. Woods:
Digital Image Processing (4th Edition), Prentice Hall, USA, 2017.

J. C. Russ:
The Image Processing Handbook, (6th Edition), CRC Press, USA, 2011.

Journals and Magazines: None

Others: None

Teaching and Learning Methods:

1. **Lectures and class discussion**: Students will received the lecture notes and the weekly lecture schedule at the beginning of the course, and requested them to read the lecture notes before coming to the class.
2. **Laboratory sessions**: The laboratory instruction will be provided to the students. Lab instruction will provide a basic guideline and source code for student to learn and be familiar with programing procedure and basic algorithm. Students are requested to understand the algorithm of each operation so that they are able to conduct new algorithm or automate image processing workflow. The home assignments for developing source code are requested to submit the report.

Time Distribution and Study Load:

Lecture: 30 Hrs
Laboratory: 45 Hrs
Self-study: 90 Hrs

Evaluation Scheme:

Laboratory report: 20%
Mid-semester examination (close book): 30%
Final-semester examination (close book): 50%

In the examination, an "A" would be awarded if a student can elaborate the knowledge learned in the class by developing new C programming application for digital image processing. A "B" would be awarded if a student shows an overall understanding of all give 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 course.

Instructor(s): Dr. Sarawut Ninsawat