

# **Image Processing for Remote Sensing Course 2023-2024**

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## **Principles and Practice of Digital Image Processing (DIP)**

- 1- Introduction**
- 2- Areas of DIP**

# Overview – Course Description

- This course extends remote sensing concepts and data analysis towards digital image processing topics with natural resources applications.
- **Topics such as:**
  - Radiometric and atmospheric corrections,
  - Image formation,
  - Image enhancement, and
  - Classification are presented.
- Special emphasis is given to hyperspectral and LiDAR data collection/analysis and machine learning algorithms for image classification.

# Overview – Course Resources

## TEXT BOOKS:

### 1- Required:

- John Jensen (2016). “Introductory Digital Image processing: A Remote Sensing Perspective” (4th edition.). Prentice-Hall - ISBN: 0-13-145361-0

### 2- Recommended:

- Robert Schowengerdt (2007). “Remote Sensing: Models and Methods for Image processing” (3rd edition). Elsevier. ISBN: 0-12-369407-8

### 3- ADDITIONAL MATERIALS:

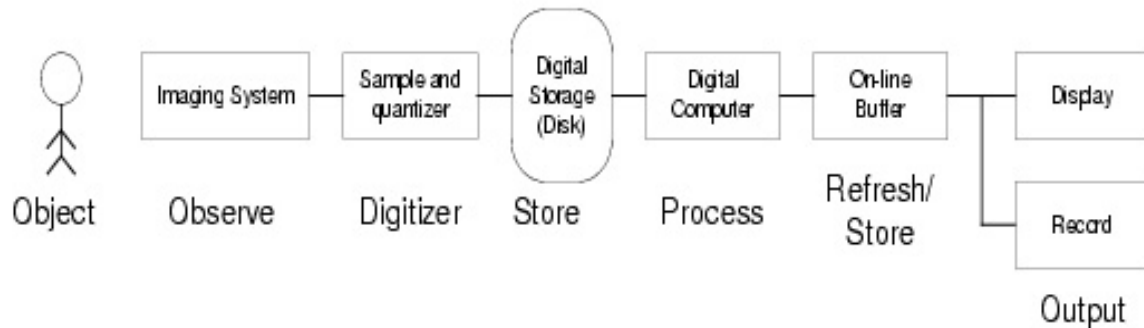
- Research article handouts.
- Links to websites covering different topics.

# DIP – Introduction

- The primary interest in transmitting and handling images in digital forms goes back to 1920's. However, due to lack of adequate computer systems and vast storage requirements the interest in this area was not fully explored until mid 1960's .
- The serious work in the area of digital image processing (DIP) originally established to analyse and improve satellite images is rapidly growing into a wealth of new applications, due to the enormous progress made in both algorithm development and computer engineering.
- The most important fields of growth appear to emerge in the areas of:
  - 1- medical image processing (e.g. surgical simulators)
  - 2- data communication and compression
  - 3- remote sensing (e.g., meteorological, environmental and UAVs)
  - 4- computer vision (e.g., robotics, autonomous systems )

# What is DIP ?

- Digital Image: A sampled and quantized version of a 2-D function that has been acquired by optical or other means, sampled at equally spaced rectangular grid pattern, and quantized in equal intervals of amplitudes.
- A typical image processing system is:



- DIP involves handling, transmitting, enhancing and analyzing digital images with the aid of digital computers. This calls for manipulation of 2-D signals. There are generally three types of processing applied to an image, namely:
  - 1- low-level,
  - 2- intermediate-level, and
  - 3- high-level processing,:

# What is DIP Idea ?

- The central idea behind digital image processing is quite simple. One or more images are loaded into a computer. The computer is programmed to perform calculations using an equation, or series of equations, that take pixel values from the raw image as input.
- In most cases, the output will be a new digital image whose pixel values are the result of those calculations.
- This output image may be displayed or recorded in pictorial format or may itself be further manipulated by additional software.
- The possible forms of digital image manipulation are categorized into one (or more) of the following seven broad types of computer-assisted operations:

# DIP Ideas

## 1- Image pre-processing.

- These operations aim to correct distorted or degraded image data to create a more faithful representation of the original scene and to improve an image's utility for further manipulation later on.
- This typically involves the initial processing of raw image data to:
  - 1- eliminate noise present in the data,
  - 2- to calibrate the data radiometrically,
  - 3- to correct for geometric distortions, and
  - 4- to expand or contract the extent of an image via mosaicking or sub-setting.

These procedures are often termed pre-processing operations

# DIP Ideas

## 2- Image enhancement.

- These procedures are applied to image data in order to more effectively render the data for subsequent interpretation.
- In many cases, image enhancement involves techniques for :
  - 1- heightening the visual distinctions among features in a scene,
  - 2- increasing the amount of information that can be interpreted from the data.



# DIP Ideas

## 3- Image classification.

The objective of image classification is to replace visual interpretation of image data with quantitative techniques for automating the identification of features in a scene.

- This normally involves the:

- 1- analysis of multiple bands of image data (typically multispectral, multi temporal, and Polarimetric)

- 2- and the application of statistically based decision rules for determining the land cover identity of each pixel in an image

# DIP Ideas

## 4- Analysis of change over time.

- Many remote sensing projects involve the analysis of two or more images from different points in time,
- to determine the extent and nature of changes over time.

## 5- Data fusion and GIS integration.

These procedures are used to combine image data for a given geographic area with other geographically referenced data sets for the same area.