REMOTE SENSING

Image Interpretation and Analysis

OVERVIEW

Introductory Remarks
Visual Image Interpretation
Digital Image Processing
- Image Reconstruction/Correction
- Image Transformation/Conversion
- Image Classification

INTRODUCTORY REMARKS

The ***interpretation and analysis*** of remote sensing imagery involves the identification and/or measurement of various targets or objects in an image in order to extract useful information about them. More specifically, this seeks to extract qualitative (thematic) and quantitative (metric) information from remote sensing data. Qualitative information provides descriptive data about Earth's surface features like structure, characteristics, quality, condition, relationship of and between objects.

Metric information includes location, height, and their derivatives such as area, volume, shape, slope angle etc. Metric information is usually extracted through photogrammetry

Method	Merits	Demerits
Human image interpretation	• Interpreter's knowledge available	• Time consuming
	• Understanding of complex images is better	• Human knowledge is not easy to apply
Digital image processing	• Short processing time	• Human knowledge is difficult to apply
	• Standardized processing	
	• Extraction of physical quantities is possible	• Contextual information is poor

VISUAL IMAGE INTERPRETATION

photographic interpretation is the act of examining aerial photographs/ images for the purpose of identifying objects and judging their significance.

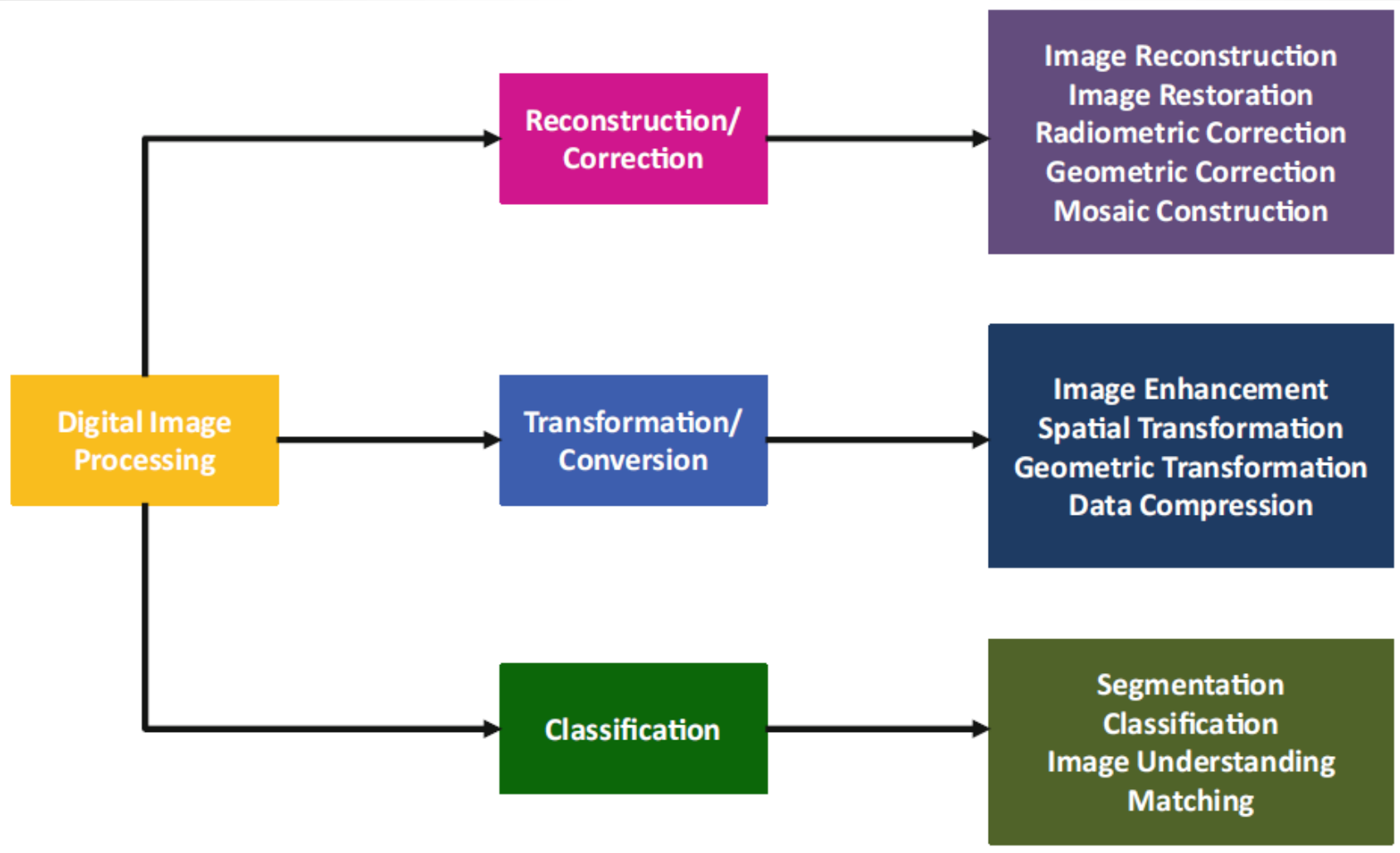
When interpreting or analyzing an image through visual methods two scenarios may arise: (i) direct and spontaneous recognition or (ii) logical inference.

Direct and spontaneous recognition refers to the ability of an interpreter to identify objects or phenomena at a first glance. In logical inference, several cues are used in a reasoning process to draw conclusions. The degree of success in the inference depends on the interpreter's professional knowledge and experience as well as the quality of the photographic imagery.

Several basic elements, commonly referred to as interpretation elements or cues, are used in photographic/image interpretation: (1) tone/color, (2) size, (3) shape, (4) texture, (5) pattern, (6) shadow, and (7) association.

DIGITAL IMAGE PROCESSING

As a matter of fact, digital image analysis is the only viable interpretation method that can be adopted in the case of multi-sensor, multi-temporal or multi-spectral remotely sensed image data.



DIGITAL IMAGE PROCESSING

Image Reconstruction/Correction

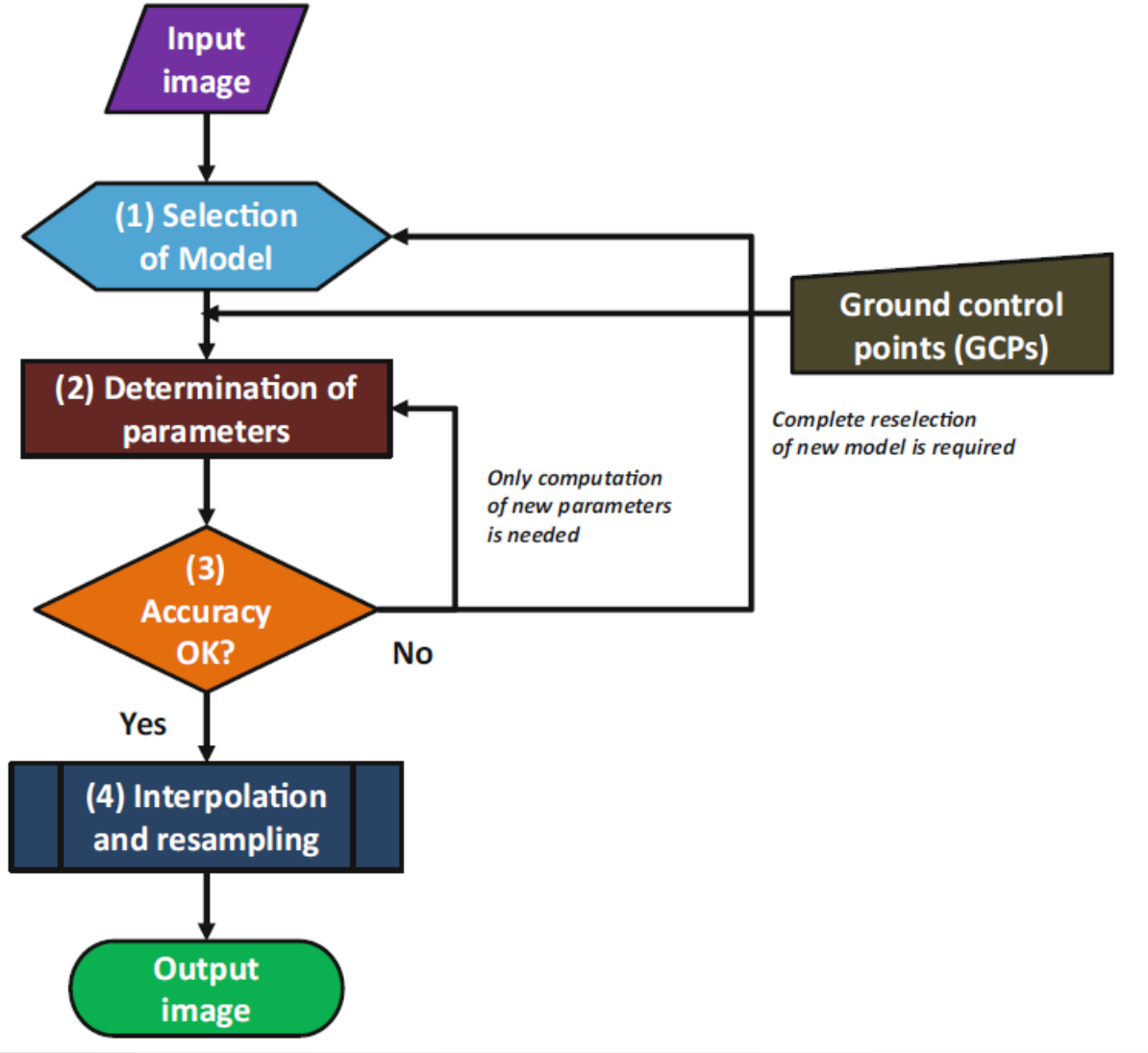
In principle, image pre-processing aims to correct for different types of errors, both systematic and accidental, that may have arisen out of the employment of the sensor platform combination (imaging system), absorption and scattering characteristics of the atmosphere and due to the earth's curvature and rotation and nature of topography. Image pre-processing, which constitutes a major phase of data processing in remote sensing, includes procedures for image reconstruction, image restoration, radiometric correction, geometric correction and mosaic construction.

Radiometric distortions will arise due to variations in scene illumination and viewing geometry, atmospheric conditions, and sensor noise and response and will vary depending on the specific sensor and platform used to acquire the data and the conditions present during data acquisition.

DIGITAL IMAGE PROCESSING

Image Reconstruction/Correction

Geometric distortions may result due to several factors, including: the perspective of the sensor optics; the motion of the scanning system; the motion of the platform; the platform altitude, attitude, and velocity; the terrain relief; and, the curvature and rotation of the earth. One can distinguish between two types of geometric distortions: (i) internal distortions which are geometric errors that result from the sensor's geometry and (ii) external distortions that are geometric errors emanating from platform and ground targets.



DIGITAL IMAGE PROCESSING

Image Transformation/Conversion

Image conversion or transformation includes procedures for image enhancement, spatial transformation, geometric transformation and data compression. Image enhancement methods can be broadly grouped into three categories: (a) contrast enhancement, (b) spatial enhancement, and (c) spectral transformation.

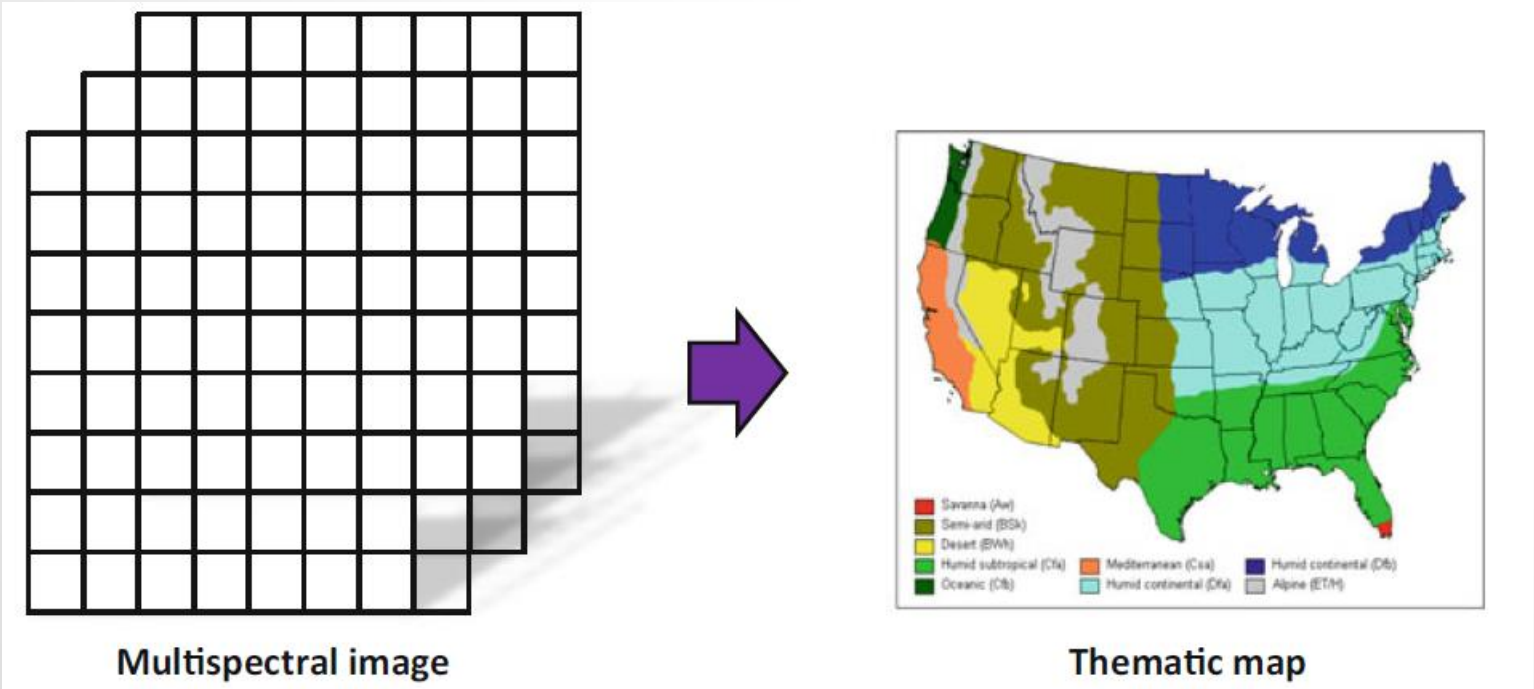
Contrast enhancement involves changing the original values so that more of the available range of digital values is used, and the contrast between targets and their backgrounds is increased. ***Histogram equalization*** is a typical contrast enhancement method. Major spatial filters with their effects in brackets include the following; Sobel (gradient- finite differences), Laplacian (differential), median (smoothing), high-pass (edge-enhancement), sharpening (clearer image) etc. Spectral transformation refers to the manipulation of multiple bands of data to generate more useful information and involves such methods as band rationing and differencing, Principal Components Analysis (PCA), vegetation indices such as the Normalized Difference Vegetation Index (NDVI) and its associated derivatives.

DIGITAL IMAGE PROCESSING

Image Classification

The objective of image classification is to match the spectral classes in the data to the respective information classes of interest.

Spectral classes represent groups of pixels that are uniform (or near-similar) with respect to their brightness values in the different spectral channels of the data. Hence, image classification involves assigning all pixels in the image to particular information classes.



DIGITAL IMAGE PROCESSING

Image Classification

Two basic types of image classifications can be distinguished namely: ***supervised*** and ***unsupervised*** classifications. In supervised classification the operator defines the clusters during the training process using data obtained from ground truth. Clean and homogeneous areas need to be identified for the training data. Unsupervised classification involves a clustering algorithm automatically determining and defining the number of clusters in the feature space using only image characteristics or features. This is often a processor intensive operation. To optimize on available computing resources, most clustering algorithms provide facility for defining the desired number of clusters a priori.