Species	Crown shape	Edge of crown	Tone	Pattern	Texture
Cedar	Conical with sharp spear	Circular and sharp	Dark	spotted grain	Hard and Coarse
cypress	Conical with round crown	Circular but not sharp	Dark but lighter than cedar	spotted	Hard and Fine
Pine	Cylindrical with shape-less crown	Circular but unclear	Light and unclear	Irregularly spotted	soft but coarse
Larch	Conical with unclear crown	Circular with unclear edge	Lighter than cypress	spotted	soft and Fine
Fir / Spruce	Conical with wide crown	Circular with zig zag edge	Dark and clear	Irregular	coarse
Deciduous	Irregular shapes	Unclear	Lighter	Irregular	Coarse

Digital Interpretation:

Digital interpretation facilitates quantitative analysis of digital data with the help of computers to extract information about the earth surface.

Digital interpretation is popularly known as Image Processing.

Image processing deals with image correction, image enhancement, and information extraction.

Image correction means to correct the errors in digital image.

Errors are resulted due to two reasons

When errors are resulted due to defect in sensor is called radiometric error.

When errors are resulted due to earth rotation, space craft velocity, atmospheric attenuation is called geometric error.

Both radiometric and geometric errors in images are reduced through different techniques with the help of computer.

Image enhancement deals with manipulation of data for improving its quality for interpretation.

Through different image enhancement technique contrast is improved in digital image.

After image correction and enhancement information's are extracted from the digital image which is the ultimate goal of the interpreter.

In information extraction, spectral values of pixels are analyzed through computer to identify objects on the earth surface.

In this way, different features of earth are recognised and classified.

The field knowledge and other sources of information also helps in recognition and classification process.

⇒ Concept of Image Rectification / correction:

Image rectification is a transformation process used to project images onto a common image plane.

Image rectification is used in computer stereo vision to simplify the problem of finding matching points between images.

It is also used in geographic information systems to merge images taken from multiple perspective into a common map co-ordinate system.

In GIS this is done by matching ground control points (GCP) in the mapping system to points in the image.

Primary difficulties in the process are,

When the accuracy of the map points are not well known.

When the images lack clearly identifiable points to correspond to the maps

The maps that are used with rectified images are non-topographical.

However the images may contain distortion from terrain.

Image orthorectification additionally removes these effects.

There are two types of correction are available to remove the distortion in the images.

Radiometric correction

Geometric correction

> Radiometric Correction:

Radiometric correction is to avoid radiometric errors or distortions.

When the emitted or reflected electromagnetic energy is observed by a sensor does not coincide with energy emitted or reflected from the same object observed from a short distance.

This is due to sun's azimuth and elevation, atomspheric conditions etc.

Therefore inorder to obtain the real reflectance those radiometric distortions must be corrected.

Radiometric correction is classified in to following three types

Radiometric correction of effects due to sensor sensitivity

Radiometric correction for sun angle and topography.

Atmospheric correction.

> Geometric Correction:

Geometric correction is undertaken to avoid geometric distortions from an image.

It is achieved by establishing the relationship between the image co-ordinate system and the geographic co-ordinate system.

The relationship is established by using calibration data of the sensor, measured data of position and attitude, ground control points, atmospheric condition etc.

The steps to follow for geometric correction are

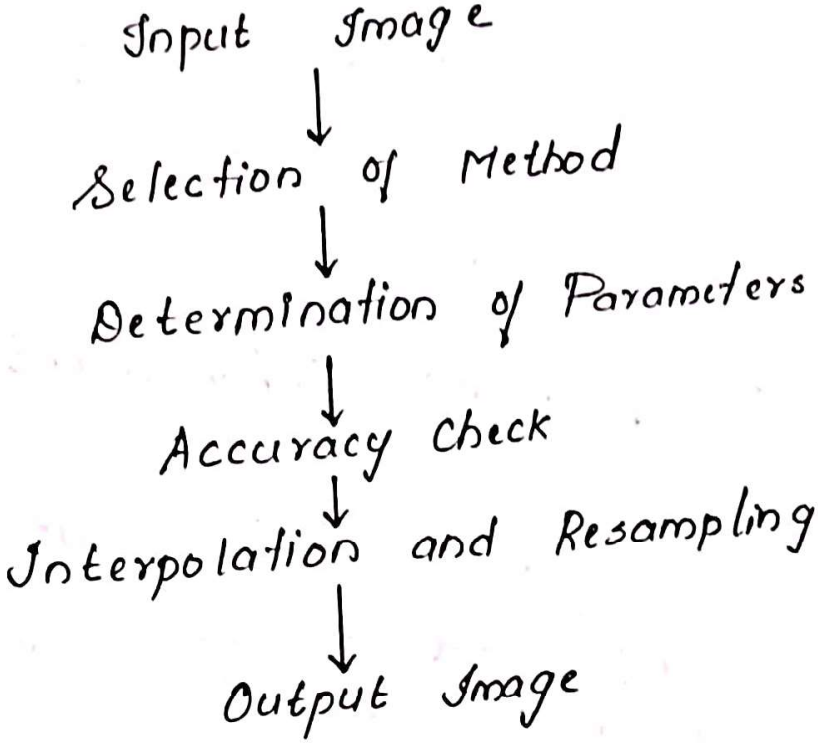

Fig: Flow of Geometric correction

There are three types of geometric correction namely,

systematic correction
Non-systematic correction
Combined Method.

Systematic correction ⇒ When the geometric reference data are measured, the geometric distortion can be systematically or theoretically avoided.

Non-systematic correction ⇒ Polynomials to transform from a geographic coordinate system to an image co-ordinate system or vice versa will be determined using the least square method.

Combined Method ⇒ Firstly the systematic correction is applied then the residual errors will be reduced using low order polynomials.

Usually the goal of geometric correction is to obtain an error within plus or minus one pixel of its true position.

Concept of Image Enhancement:

Image enhancement is a method which improve the contrast and edge information of the input image

Widely used remote sensing applications such as mapping, classification, soil moisture detection etc requiu high quality images.

To meet the increasing need for higher quality images, image enhancement method is used.

Images provided by remote sensing devices have to be enhanced by special methods instead of standard enhancement methods.

Remote sensing image enhancement techniques should improve the visibility, contrast and edge informations of the image while preserving the original reflectance values.

Most of the enhancement methods are based on histogram modification and transform based methods

Histogram modification based methods aim to modify the histogram of the input image to obtain a more uniform distribution.

Transform based methods apply a certain transform to the input image and enhance the image in transform domain followed by the inverse transform.

Visual comparisons as well as quantitative comparisons have been carried out for different enhancement methods.

Image enhancement methods can be divided into two main groups as direct and indirect methods.

Direct methods aim to enhance the images by using a defined contrast measure, while the indirect methods try to improve the dynamic range of the images without a contrast measure.

In direct methods, contrast measurements can be global or local.

The indirect methods can be divided into two sub categories as histogram modification based methods and transform domain methods.

The simplest histogram modification method is Histogram Equalization.

In this method, the histogram distribution of the input image is aimed to have uniform distribution.

The HE based enhanced images generally suffer from undersaturation which results in poor quality images.

To fix this problem, more efficient histogram modification methods have been proposed.

Transform domain based image enhancement methods use certain transformations to decompose the image into subbands and improve the contrast by

modifying specific components.

The quality of remote sensing images depends upon numerous factors such as noise, illumination or equipment conditions during acquisition procedure.

The data obtained by optic sensors are degraded by atmospheric effects and instrumental noises, namely thermal noise, quantization noise and shot noise which cause corruption in spectral bands by varying degrees.

These degradations reduce the contrast in the resulting images and can highly affect human perception or the accuracy of computer assisted applications.

Thus contrast enhancement besides noise removal, constitute a primary step for various applications of remote sensing image processing for better information representation and visual perception.

Concept of Image Classification:

Image classification is the process of assigning land cover classes to pixels. For eg: classes include water, forest, agriculture etc.

The three main types of image classification techniques in remote sensing are

Unsupervised image classification
Supervised image classification
Object based image analysis.

⇒ Unsupervised Classification:

In this method, it first groups pixels into clusters based on their properties.

Then it is classified each cluster with a land cover class.

There are two basic steps are involved for unsupervised classification. They are,

Generate clusters
Assign classes

The first step is to create clusters by using image clustering algorithms namely,

K-Means
Iso Data

After picking a clustering algorithm, the number of groups that wants to be genelated was identified

The next step is to manually assign land cover classes to each cluster.

⇒ Supervised Classification:

In supervised classification, representative samples has to be selected for each land cover classes

The software then uses these training sites and applies them to the entire image.

The three basic steps involved in supervised classification are,

Select training areas
Generate signature file
Classify.

For supervised image classification

First create training samples

Then add training sites representative in the entire image.

Continue creating training samples until each class have representative samples.

In turn, this would generate a signature file, which stores all training samples' spectral information.

Finally the last step would be to use the signature file to run a classification.

In the final step classification algorithm has to be picked such as,

- Minimum Likelihood
- Minimum Distance
- Principal components
- support Vector Machine (SVM)
- ISO cluster.

⇒ Object Based Image Analysis (OBIA)

Supervised and Unsupervised classification is pixel based.

But object based image classification groups pixels into representative vector shapes with size and geometry.

The steps to perform object based image classification are,

Perform multiresolution segmentation
Select training areas
Define statistics
Classify

OBIA segments an image by grouping pixels. It doesn't create single pixels. Instead it generates objects with different geometrices.

The two most common segmentation algorithms are,

Multi resolution segmentation in eCognition.
The segment mean shift tool in ArcGIS Pro.

In OBIA classification, different methods can be used to classify objects. namely,

> Shape:

If buildings has to be classified a shape statistic such as rectangular fit can be used.

> Texture:

Texture is the homogeneity of an object.
Eg: Water is mostly homogeneous because it's mostly dark blue.
But forests have shadows and are a mix of green and blue.

> Spectral:

The mean value of spectral properties such as near-infrared, short-wave infrared, red, green