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## Study and Analysis of Supervised Vs Unsupervised Classification for Remote Sensing Images

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**Abstract:** -Image classification is a procedure to automatically categorize all pixels in an image [9]. Image classification has emerged as a significant tool for investigating digital images [1]. Image classification can be defined as the process of reducing an image to information classes. The categorization of image pixels is based on their digital numbers/grey values in one or more spectral bands. The main objective of image classification is to automatically categorize all pixels in a digital image into information classes or themes. The image classification tool for examination of the digital images. Classification is generally divided into two types as supervised classification and unsupervised classification [8]. This paper gives comparative study of Supervised & Unsupervised image classification.

Keywords: -Image Classification, Supervised Classification, Unsupervised Classification.

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### I. INTRODUCTION

One popular and commonly used approach to image analysis is digital image classification[6]. Classification is a decision making process that is used in all scientific disciplines as a way of comprehending and ordering a mass of data [3]. In image classification, an image is classified according to its visual content. Image classification can be defined as the process of reducing an image to information classes. The categorization of image pixels is based on their digital numbers/grey values in one or more spectral bands. The main Objective of image classification is to automatically categorize all pixels in a digital image into information classes or themes. In image classification usually two or more bands are used for the classification process. Dealing with more than one band will enhance our ability to uniquely identify the sought-after information classes. Working with transformed bands (such as ratios) can improve the classification accuracy. Several methods of image classification exist and a number of fields like image analysis and pattern recognition make use of a significant concept, classification. In some cases, the classification itself may form the entity of the analysis and serve as the ultimate product. The paper focuses on what image classification, need of it, major steps for classification, different image classification techniques, comparison of Supervised & Unsupervised image classification.

### II. NEED OF IMAGE CLASSIFICATION

The goal of image classification is to convert raw data to categorized meaningful information & assign & settle every unknown pixel to one of the categories according to its level of similarity automatically. Maps of land usage are usually produced through image classification that is a process on remotely sensed images for preparing the thematic maps [2]. The selection of the appropriate classification technique to employ can have considerable upshot on the results, of whether the classification is used as an ultimate product or as one of numerous analytical procedures applied for deriving information from an image for additional analyses [3].

### **III. MAJOR STEPS OF IMAGE CLASSIFICATION**

The purpose of image classification is to label the pixels in the image with meaningful information of the real world[6]. Image classification analyzes the numerical properties of various image features and organizes data into categories. The image will be segmented into objects that form the classification units and will be treated as a whole in the classification process[8]. Classifications algorithms typically employ two phases of processing: training and testing.

Following are the steps which are considered for classification of images[3].

- Determination of a suitable classification system
- Selection of training samples
- Image pre-processing
- Feature extraction
- Selection of suitable classification approaches
- Post classification processing
- Accuracy assessment

### **IV. IMAGE CLASSIFICATION TECHNIQUES**

At present, there is different image classification procedures used for different purpose by various researchers. These techniques are distinguished in two main ways as supervised and un-supervised classifications[8]. The image classification techniques can also be grouped as [3, 4, 8]:

- Supervised and unsupervised
- Parametric and non-parametric
- Hard and soft (fuzzy)
- Per-pixel sub-pixel and per-field
- Local and global classification

There are various classification methods available. Following are some of them: -

- ❖ Supervised classification ,Un- Supervised classification
- ❖ Pixel based classification
- ❖ Object base classification
- ❖ Maximum likelihood classifier, Minimum likelihood classifier
- ❖ Parallelepiped classification
- ❖ Spectral Angle Mapper classification
- ❖ Neural Network classification
- ❖ Mahalanobis classification
- ❖ Fuzzy analytical methods for remote sensing digital image classification
  - Fuzzy c-means (FCM)
  - Semi-supervised fuzzy cluster labeling (SFCL)
  - Fuzzy k-nearest neighbor (FNN)
  - Object-oriented fuzzy classifier (OOFCL)

### **V. SUPERVISED VS UNSUPERVISED CLASSIFICATION**

In order to make use of the various types objects in the images it must be processed in a manner that is suitable for the end user. For many projects this processing includes categorizing the object into its

various use functions. There are two main categories that can be used to achieve this outcome and they are called supervised and unsupervised classification techniques[3,8].

#### **Supervised Classification:-**

The concept of supervised image classification is that using samples with known identities (i.e., assigned pixels to information classes) the algorithm classifies pixels with unknown identities. The procedure starts by the user selecting and naming areas on the image, which correspond to the classes of interest. These classes correspond to information classes. Then, the image classification algorithm will find all similar areas. The classification is algorithm dependent. In supervised classification, spectral signatures are developed from specified locations in the image. These specified locations are given the generic name 'training sites' and are defined by the user. Generally a vector layer is digitized over the raster scene. The vector layer consists of various polygons overlaying different land use types. Supervised classification techniques require training areas to be defined by the analyst in order to determine the characteristics of each category. Each pixel in the image is, thus, assigned to one of the categories using the extracted discriminating information. For the supervised classification, the image pixels that represent the categories are collected and characteristic decision functions are calculated from these training samples [3]. The training samples are representative of the known classes of interest to the analyst. Classification methods that rely on use of training patterns are called supervised classification methods [9]. The Parallelepiped Classifier, Minimum Distance Technique, Maximum Likelihood, fisher classifier, Spectral Angle Mapper, Artificial Neural Network (ANN) Classifier and Mahalanobis distance are the different sub-classification methods of supervised classifications. These methods are named as hard classifiers. The supervised image classification procedure is as follows: first select training data, then classify the image and finally make accuracy assessment. The steps are: user defines the spectral parameters of each class of interest i.e. signatures which are effectively assigning the class names before the classification, computer uses the pre-defined class boundaries to group the pixels.

The quality of a supervised classification depends on the quality of the training sites[3]. All the supervised classifications usually have a sequence of operations that must be followed.

- i) Defining of the Training Sites.
- ii) Extraction of Signatures.
- iii) Classification of the Image.

The training sites are done with digitized features. Usually two or three training sites are selected. The more training site is selected, the better results can be gained. This procedure assures both the accuracy of classification and the true interpretation of the results. After the training site areas are digitized then the statistical characterizations of the information are created. These are called signatures. Finally the classification methods are applied.

#### **Advantages:-**

User can defined his own classes based on information categories. This technique is algorithm dependant.

#### **Disadvantages:-**

Training data may be inadequate. Class training is time-consuming and tedious. Defined classes may not match spectral classes.

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### **Unsupervised Classification: -**

The concept of unsupervised image classification is that the image is automatically segmented into spectral classes based on natural groupings found in the data. This techniques do not require the user to specify any information about the features contained in the images. In the unsupervised classification computer groups the pixels into a specified number of classes. The groups are evaluated and class names are manually assigned afterwards “ISO-cluster”, “ISO-data” clustering. An unsupervised classification techniques do not require the user to specify any information about the features contained in the images. Unsupervised classification, on the other hand, searches for natural groups, called clusters, of pixels present within the data by means of assessing the positions of the pixels in the feature space. They are automated procedures and, therefore, require minimal user interaction. Clusters that represent the categories are determined after the classification by using land investigations, maps, and aerial photos. The Genetic Algorithm, Bootstrapping Local, K-Means, Fuzzy C-Means, Fuzzy ART are the different sub-classification methods of unsupervised classification. These methods are named as soft classifiers.

In unsupervised image classification procedure first classify the image then identify clusters and finally make accuracy assessment.

The steps are:-

- i) The user inputs some classification parameters.
- ii) The algorithm proceeds by finding pixels with similar spectral properties.
- iii) After the classification, the user names each class (i.e., the user relates the spectral classes to the relevant information classes).

### **Advantages :-**

Classes are based on spectral properties. This technique is not algorithm dependent.

### **Disadvantages:-**

Unknown classes.

Spectral classes may not match desired classes.

Derived clusters may be unidentifiable.

A posteriori cluster identification is time-consuming and tedious.

Unexpected categories may be revealed.

We have summarized the advantages and disadvantages of both classification methods. The table No-1 shows the comparison between supervised classification and unsupervised classification.

## **VI. CONCLUSION**

Classification is used to obtain meaningful information. There are various types of classification methods that are useful to obtain such meaningful information. Therefore obtaining such meaningful information by using classification technique depends upon the type of images, objective of image analysis, type of classifier used and users need. This paper mainly focuses on supervised as well as unsupervised classification technique. The paper also summarizes the steps required for the classifications and gives advantages and disadvantages of each classification method. At last paper gives difference between supervised as well as unsupervised classification technique. This information is useful for the new research students who work in image classification are specially in remote sensing image classification.

**VII. REFERENCES**

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Supervised Classification	Unsupervised Classification
Known number of classes i.e. Pre-defined classes	Unknown number of classes
Based on a training set	No prior knowledge
Defined classes may not match spectral classes	Spectral classes may not match desired classes
Classes are based on information categories	Classes are based on spectral properties
Selected training data may be inadequate	Derived clusters may be unidentifiable
A priori class training is time-consuming and tedious	A posteriori cluster identification is time-consuming and tedious
Only pre-defined classes will be found	Unexpected categories may be revealed
Algorithm dependent	Algorithm independent
Used to classify future observations	Used to understand (explore data)
Supervised training is closely controlled by the analyst.	Unsupervised training is more computer automated.
Require maximum user interaction	Require minimal user interaction

**TABLE 1 - SUPERVISED VS UNSUPERVISED CLASSIFICATION**