CHAPTER - 2

OVERVIEW OF RSI CLASSIFICATION

2.1. Introduction

The present research work on remote sensing image classification is focused on the development of new statistical and neural classification algorithms. This chapter presents the multidimensional approaches and analysis of image classification of real images of remote sensing. The different combinations of classification algorithms and analysis are used to reduce the complexity of accuracy.

2.2. Remote Sensing Image Classification Process

Remote sensing classification is a complex process and requires consideration of many factors. The remote sensing image classification may include determination of a suitable classification system such as selection of training samples, image preprocessing, feature extraction, selection of suitable classification approaches and accuracy assessment. The user's need of the study area consists of scale, economic condition, and analyst's skills are important factors influencing the selection of remotely sensed data, the design of the classification procedure and the quality of the classification results [1]. This section focuses on the description of the major steps that may be involved in remote sensing image classification.

2.2.1. Selection of Remotely Sensed Data

Remotely sensed data vary in spatial, radiometric, spectral, and temporal resolutions. Understanding the strengths and weaknesses of different types of sensor data is essential for the selection of suitable remotely sensed data in image classification. The selection of suitable sensor data is the first important step for a successful classification for a specific purpose. It requires considering factors such

as user's need, the scale and characteristics of a study area, the availability of various image data and their characteristics, cost and time constraints and the analyst's experience in using the selected image. Another important factor influencing the selection of sensor data is the atmospheric condition [2]. The frequent cloudy conditions in the moist tropical regions are often an obstacle for capturing high-quality optical sensor data. Since multiple sources of sensor data are now readily available, image analysts have more choices to select suitable remotely sensed data for a specific study.

2.2.2. Selection of Classification System and Training Samples

A suitable classification system and a sufficient number of training samples are prerequisites for a successful classification. We have identified three major problems for vegetation classifications: defining adequate hierarchical levels for mapping, defining discrete land-cover units discernible by selected remote-sensing data and selecting representative training sites. In general, a classification system is designed based on the user's need, spatial resolution of selected remotely sensed data, compatibility with previous work, image processing and classification algorithms available and time constraints. A sufficient number of training samples and their representativeness are critical for image classifications. Training samples are usually collected from fieldwork or from fine spatial resolution photographs and satellite images [3]. Therefore, selection of training samples must consider the spatial resolution of the remote-sensing data being used, availability of ground reference data and the complexity of landscapes in the study area.

2.2.3. Image Preprocessing

Preprocessing of satellite images prior to image classification and change detection is essential. Image preprocessing may include the detection and restoration of bad lines, geometric rectification or image registration, radiometric calibration and atmospheric correction, normalization, masking and topographic correction. The normalization of satellite imagery takes into account the

combined, measurable reflectance of the atmosphere, aerosol scattering and absorption and the earth's surface. It is the volatility of the atmosphere which can introduce variation in the reflectance values of satellite images acquired at different times. Geometric rectification of the imagery resamples or changes the pixel grid to fit that of a map projection or another reference image. Accurate geometric rectification or image registration of remotely sensed data is a prerequisite for a combination of different source data [4] in a classification process.

2.2.4. Feature Extraction and Selection

The first step in the process is extracting image features to a distinguishable extent. The second step involves matching these features to yield a result that is visually similar. Selecting suitable variables is a critical step for successfully implementing an image classification. Many approaches such as principal component analysis, minimum noise fraction transform, discriminant analysis, decision boundary feature extraction, non-parametric weighted feature extraction, wavelet transform and spectral mixture analysis may be used for feature extraction, in order to reduce the data redundancy inherent in remote sensing data. In practice, comparisons of different combinations of selected variables are often implemented and a good reference dataset is vital [5].

2.2.5. Selection of a Suitable Classification Method

Many factors such as spatial resolution of the remotely sensed data, different sources of data, a classification system, and availability of classification software must be taken into account when selecting a classification method for use. Different classification methods have their own merits and results may be obtained depending on the classifiers chosen in [6]. The following diagram shows the major steps in two types of image classification. The corresponding diagram is shown in the Figure 2.1.

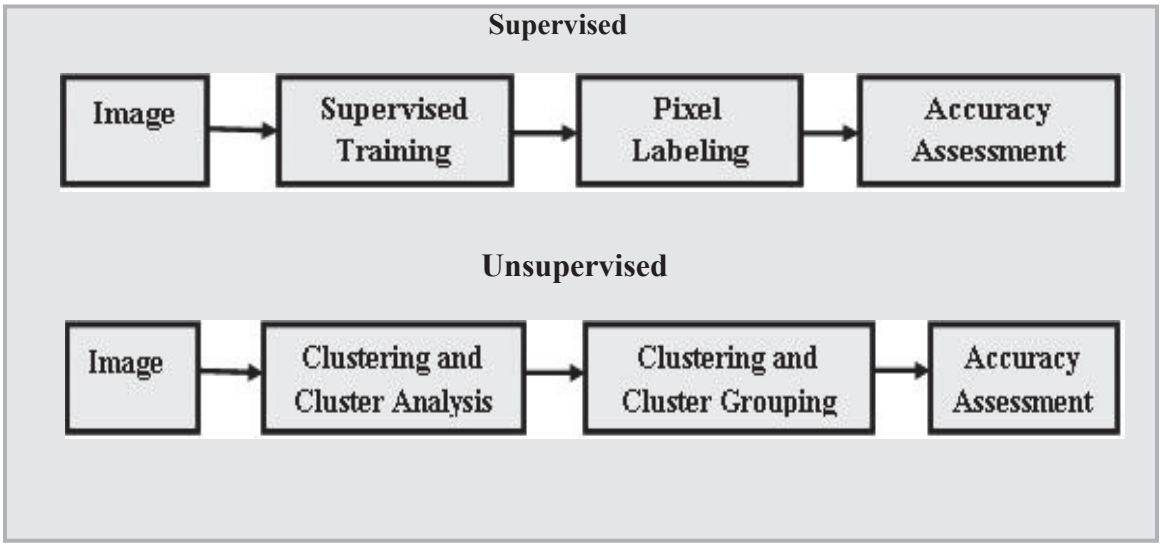

Fig. 2.1. Supervised and Unsupervised Remote Sensing Image Classification

2.2.6. Evaluation of Classification Performance

Evaluation of classification results are important process in the classification procedure. Different approaches may be employed, ranging from a qualitative evaluation based on expert knowledge to a quantitative accuracy assessment based on sampling strategies. To evaluate the performance of a classification methods there are six criteria needs to be proposed are accuracy, reproducibility, robustness, ability to fully use the information content of the data, uniform applicability and objectiveness [7].

2.2.7. Classification Accuracy Assessment

Before implementing a classification accuracy assessment, one needs to know the sources of errors. In addition to errors from the classification itself, other sources of errors, such as position errors resulting from the registration, interpretation errors, and poor quality of training or test samples, all affect classification accuracy. A classification accuracy assessment generally includes three basic components: sampling design, response design, and estimation and analysis procedures. The error matrix approach is the most widely used accuracy assessment classification process. In order to properly generate an error matrix,

one must consider the following factors: reference data collection, classification scheme, sampling scheme, spatial autocorrelation, and sample size and sample unit. The basic accuracy assessment method is systematically involved and explained principles and practical considerations in designing and conducting accuracy assessment of remote-sensing data [7].

2.3. Standard Approaches of Image Classification Algorithms

A few number of image classification algorithms have proved good precision in classifying remote sensing data. Some of the classification algorithms are listed below:

2.3.1. Simulation Technique of Remote Sensing Data

The simulation approach involves three components: The real image scene is assumed as a random realization of a spectral probability model governed by an unknown underlying process. The reference map represents a reasonable estimate of the unknown process that generated the real image scene. The simulated image scene is generated as a random realization of the spectral probability model governed by the estimated process represented in the reference map [7].

2.3.2. Accuracy Assessment Methods

An integral component of image classification, accuracy assessment is usually conducted to evaluate the agreement between the classified map and corresponding reference map in [8]. Two limitations of current accuracy assessment methods are:

The quality of reference data and probability sampling design is often hard to implement and to the spatial representation of classification uncertainties. It leads to possible propagation errors, confusion and spatial distribution of class errors.

2.3.3. Supervised Classification Algorithms

Supervised classification uses the spectral signatures obtained from training samples to classify an image. The quality of a supervised classification depends on the quality of the training sites [8]. All the supervised classifications usually have a sequence of operations to be followed:

- ☆ Defining of the Training Sites
- ☆ Extraction of Signatures
- ☆ 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.

2.3.4. Unsupervised Classification Algorithms

Unsupervised classification finds the spectral classes or clusters in a multiband image without the analyst's intervention. We can automatically groups the pixels in the image into separate clusters, depending on their spectral features. Unsupervised classifications are spectral classes which based on natural groupings of the image values. Unsupervised classification is becoming increasingly popular in agencies involved in long term GIS database maintenance [9]. The reason is that there are systems nowadays that use clustering procedures that are extremely fast and require little in the nature of operational parameters.

2.3.5. Classical Statistical Methods

Classification of remote-sensing images has traditionally been performed by classical statistical methods for example Bayesian and K-Nearest-Neighbor classifier (KNN) over the Multilayer Perception (MLP) neural network. The superiority of the KNN classifier over the MLP neural network strongly depends on the efforts devoted to the related designing phases: selection of the appropriate

k value and of the appropriate distance measure for the KNN classifier, selection of the appropriate architecture and suitable learning parameters for the MLP. In addition, according to our experience, any algorithm may reach a certain level of classification accuracy through a reasonable designing effort. The combination of results provided by statistical and neural algorithms provides classification accuracies better than the single classifier [9].

2.3.6. Image Classification Based on Multi-level Neural Networks

Artificial Neural Network (ANN) architectures have been increasingly employed to deal with many tasks of image processing especially image classification and retrieval. The neural classifier has the advantage of being fast, easily trainable and capable of creating arbitrary partitions of feature space [9]. The multi-level neural model makes use of a new activation function named multilevel sigmoid function. The simulation results on image classification show that the MSNN model is very effective in terms of learning capabilities and classification accuracies.

2.3.7. Classification Tree Analysis

Rule-based classification using classification tree analysis (CTA) is increasingly applied to remotely sensed data. This employs splitting rules to construct decision trees using training data. CTA methods have shown promise for improving classification accuracy in several assumptions and can easily handle nonlinear relationships and missing values. We evaluated image classification accuracy using various splitting rules available in CTA using diversity of remotely sensed imagery. CTA methods are reasonably robust to variable selection for each of the data types examined [10]. So decision tree classification has higher classification accuracy and adaptability, and is easier to implement automation of computer classification processes.

2.3.8. Continuous K-Means Clustering Algorithms

The K-Means clustering algorithm is faster than the standard version and extends the size of the datasets that can be clustered. In the standard algorithm the initial reference points are chosen more or less arbitrarily. The proposed k-means cluster algorithm reference points are chosen at random sampling from the whole population of data points. If the sample is sufficiently large, the distribution of these initial reference points should reflect the distribution of points in the entire set. Another difference between the standard and the new k-means clustering algorithms is the way the data points are treated as random sampling. The each complete iteration, the standard algorithm examines all the data points in sequence. In contrast, the proposed k-means clustering algorithm examines only a random sample of data points [10]. If the data set is very large and the sample is representative of the dataset, the algorithm should coverage much more quickly than the standard algorithm.

2.4. Challenges in Remote Sensing Image Classification

At present the great challenges use this multi scale imagery to improve the classification accuracy and assessment in order to boost the remote sensing application. There are five major problems which are faced in classification of remote sensing image application.

First, a Classifier ensemble is a good choice for further improvements in classification accuracy. Some researchers propose the classifier ensembles outperform the single classification algorithm.

Second, Best feature extraction is still a pendent problem. It focused histogram properties such as variation, skewness of image histogram, measures of image texture such as smoothness, entropy are all the features we commonly used.

Third, in hyper spectral imagery may be large amount of features become heavy burden for image classification computations.

Fourth, optical scale selection, the transformation from different scales and the uncertainty of scales effects are the tough problems in multi-scale approach.

Finally, focuses with the enhancements of temporal, spatial and spectral resolution of remote sensing images in the field of urban, environmental monitoring, forest management and meteorology.

2.5. Training and Prediction of Remote Sensing Classification

Remote sensing image classification prediction encompasses two levels: classifier construction and the usage of the classifier constructed. The building of a classification model by describing a set of predetermined classes from training set as well as the result of learning from that dataset. Each sample in the training set is assumed as a predefined class, it may be determined by the class attribute label. The use of SVM classifier built to predict or classify unknown objects based on the patterns observed in the training set [11]. The predication training method of remote sensing classification is shown in Figure 2.2.

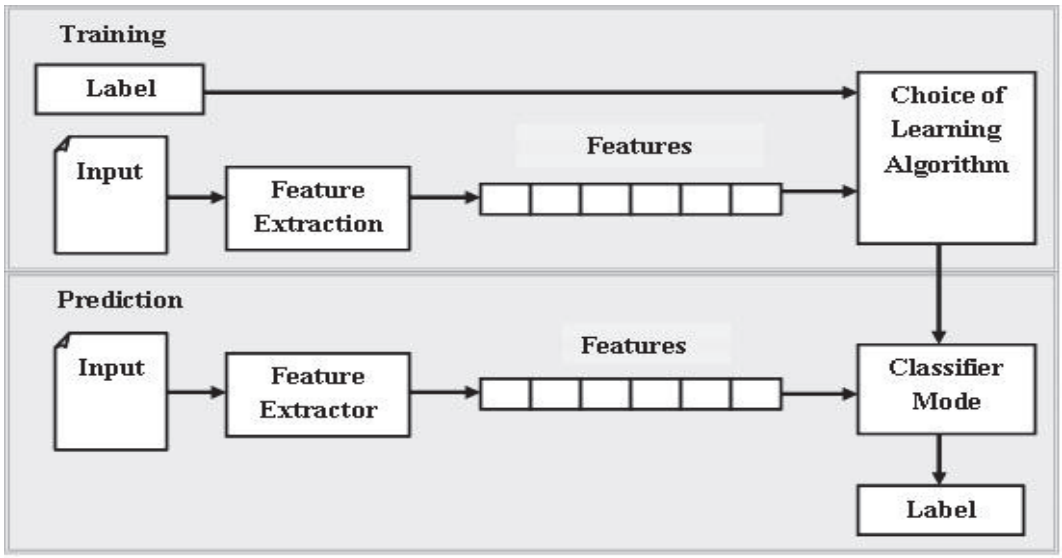

Figure. 2.2. Training and Prediction method of RSI Classification

Classification algorithms typically employ two phases of processing namely, training and testing. In the initial training phase, characteristic properties of typical image features are isolated and based on a unique description of each

classification category, i.e. training class is created. In the subsequent testing phase, these feature-space partitions are used to classify image features. The description of training classes is an extremely important component of the classification process. In supervised classification, statistical processes or distribution-free processes can be used to extract class descriptors. Unsupervised classification relies on clustering algorithms to automatically segment the training data into prototype classes.

- ☆ **Self-determining** - a change in the description of one training class should not change the value of another.
- ☆ **Biased** - different image features should have significantly different descriptions.
- ☆ **Consistent** - all image features within a training group should share the common definitive descriptions of that group.

2.6. Review of Related Literature

Remote sensing image classification is the most important part in digital image processing. Currently there are many different algorithms available for remote sensing image classification. Each have their own advantages and purpose. In this chapter, different image classification algorithms with their prospects are reviewed. The review of the literature is suggested in this chapter under the basic technological aspects of digital image processing with special reference to remote sensing image processing. Basically, all satellite image processing operations can be grouped into three categories: Image Rectification and Restoration, Enhancement and Information Extraction. The different studies reviewed in this chapters are related to effective feature classification algorithms of remote sensing image classification.

Topic 1 **:** The Factor of Scale in Remote Sensing.

Researcher **:** Curtis E. Woodcock and Alan H. Strahler, Remote Sensing of Environment, 1987, pp. 311-332.

Objectives: Curtis E. Woodcock and Alan H. Strahler proposed a new method that has been presented which measures the spatial structure of images as a function of spatial resolution. These graphs have illustrated several points about the local variance in images: The local variance in images is related to the relationship between the size of the objects in the scene and the spatial resolution of the sensor. The spatial resolutions of high local variance change as a function of environment. Multiple scales of variation in an environment will produce multiple ranges of spatial resolution with high local variance. The concept of a scene model is particularly important to the interpretation of the graphs of local variance as a faction of resolution. The graphs of local variance as a function of resolution for the urban/suburban, agricultural, and forested scenes generally support and help explain the results found by individual investigators in studies of the effect of spatial resolution on classification accuracy.

Topic 2 **:** Digital Remotely Sensed Data and their Characteristics.

Researcher **:** M. Barnsley, Springer-Verlag Berlin Heidelberg, 1990, pp. 451- 466.

Objectives **:** M. Barnsley has attempted to provide a broad overview of the nature of digital remote sensing such as the physical, chemical, and biological properties. They control the interaction of electromagnetic radiation with Earth surface materials, the impact of sensor and platform design on the ability to record these signals and the nature of the data that are produced and the derivation of useful information from these data.

Topic 3 **:** Principles of Remote Sensing.

Researcher **:** Shefali Aggarwal, Remote Sensing Community, 1990, pp. 23-38.

Objectives **:** Shefali Aggarwal has presented the basic principles of remote sensing. Authors also stats in remote sensing various kinds of tools and devices are used to make electromagnetic radiation outside this range from 400 to 700 nm visible to the human eye, especially the near infrared, middle-infrared, thermal-infrared and microwaves.

Topic 4 **:** Advances in Hyper Spectral Remote Sensing for Geologic Mapping and Exploration.

Researcher **:** Ian Ragisingha, Remote Sensing of Environment, 1998, pp. 1-13.

Objectives **:** Ian Ragisingha expressed classical geologic mapping and mineral exploration utilize physical characteristics of rocks and soils such as mineralogy, weathering characteristics, geochemical signatures, and landforms to determine the nature and distribution of geologic units and to determine exploration targets for metals and industrial minerals. Hyper spectral remote sensing, the measurement of the Earth's surface in up to hundreds of spectral images, provides a unique means of remotely mapping mineralogy. A wide variety of hyper spectral data are now available, along with operational methods for quantitatively analyzing the data and producing mineral maps. This study serves to illustrate the potential of these data and how they can be used as a tool to aid detailed geologic mapping and exploration.

Topic 5 **:** Thermal Remote Sensing: Concepts, Issues and Applications.

Researcher **:** Anupma Prakash, International Archives of Photogrammetry and Remote Sensing, 2000, pp. 239-243.

Objectives **:** Anupma Prakash explained that remote sensing has reached from an experimental to an operational level. This paper deals with the concepts and issues of thermal remote sensing and presents a variety of applications where thermal data finds its way. The benefits and limitations of thermal data are discussed and the potential of thermal remote sensing, especially in light of future high resolution satellites, is highlighted. The paper concludes with the author's views on the importance of these aspects specially in the standard remote sensing educational programs.

Topic 6 **:** The Use of Remote Sensing Data for Drought Assessment and Monitoring in Southwest Asia.

Researcher **:** Thenkabail, P. S., Gamage, D. N. and Smakhtin, V. U., International Water Management Institute, 2004, pp. 1-26.

Objectives : Thenkabail, P. S., Gamage, D. N. and Smakhtin, V. U. suggested methods and techniques for continuous drought monitoring by linking historical AVHRR sensor data with modern day MODIS sensor data. The results indicate that TCI is found to be an unreliable indicator for drought assessment and is not recommended for future drought monitoring.

Topic 7 : Optimizing Two-Pass Connected-Component Labeling Algorithms.

Researcher : Kesheng Wu, Ekow Otoo, Kenji Suzuki, Indian Journal of Science and Technology, Vol. 5, 2005, pp. 1-17.

Objectives : Kesheng Wu, Ekow Otoo, Kenji Suzuki presented two optimization strategies to improve connected component labeling algorithms. The first optimization strategy reduces the number of neighboring pixels accessed through the use of a decision tree and the second one streamlines the union-find algorithms used to track equivalent labels.

Topic 8 : Connected Component Labeling Algorithms for Gray-Scale Images and Evaluation of Performance using Digital Mammograms.

Researcher : Roshan Dharshana Yapa and Koichi Harada, International Journal of Computer Science and Network Security, Vol. 8, 2008, pp. 33- 41.

Objectives : Roshan Dharshana Yapa and Koichi Harada stated that this study is to compare performance of connected component labeling algorithms on gray scale digital mammograms. However, these algorithms have been tested and evaluated on binary images. Necessary modifications are introduced to those original algorithms to use them with gray scale images. Using connected component algorithms directly on gray scale images would increase the performance and accuracy of computer vision applications such as medical image analysis and computer aided diagnosis.

Topic 9 : Registration Techniques for Multisensory Remotely Sensed Imagery Data.

Researcher : John A. Richards, Xiuping Jia**,** Springer-Verlag Berlin Heidelberg, 2009, pp. 1- 43.

Objectives : John A. Richards, Xiuping Jia explained remote sensing energy which originating from the earth's surface is measured using a sensor mounted on an aircraft or spacecraft platform. This study contains descriptive and technical information on satellite and aircraft missions and the characteristics of their sensors. It commences those programs intended principally for gathering weather information and proceeds to missions for earth observational remote sensing radar platforms and sensors.

Topic 10 : Introductory Digital Image Processing and Remote Sensing.

Researcher : Jensen, GE 5150 - Natural Hazards, 2009, pp. 1-30.

Objectives : Jensen examined that remote sensing is the art, science and technology of obtaining reliable information about physical objects and the environment through the process of recording, measuring and interpreting imagery and digital representations of energy patterns derived from noncontact sensor systems.

Topic 11 : Digital Image Processing Fundamentals.

Researcher : Minakshi Kumar**,** Photogrammetry and Remote Sensing Division**,** Indian Institute of Remote Sensing, Dehra Dun, Satellite Remote Sensing and GIS Applications in Agricultural Meteorology, 2009, pp. 81-102.

Objectives : Minakshi Kumar defined the basic technological aspects of digital image processing with special reference to satellite image processing. Basically, all satellite image processing operations can be grouped into three categories: Image Rectification and Restoration, Enhancement and Information Extraction.

The intent of classification process is to categorize all pixels in a digital image into one of several land cover classes or themes. This classified data may be used to produce thematic maps of the land cover present in an image.

Topic 12 **:** Digital Image Processing and Remote Sensing Interpretation.

Researcher **:** Qiming Zhou, Department of Geography, Remote Sensing and Image Interpretation, 2009, pp. 1-50.

Objectives **:** Qiming Zhou observed that the digital images particularly from remote sensing technology have become important sources of spatial information. However, in most applications, the remotely sensed data may only be used with their greatest potentials if they can be correctly interpreted, classified and presented in the same way as other terrestrial spatial information such as thematic maps.

Topic 13 **:** Comparison of Four Classification Methods to Extract Land Use and Land Cover from Raw Satellite Images for Some Remote Arid Areas, Kingdom of Saudi Arabia.

Researcher **:** F. S. Al-Ahmadi and A. S. Hames, Remote Sensing Dept., Ministry of Water and Electricity, Journal of Earth Science, Vol.20, 2009, pp. 167-191.

Objectives **:** F. S. Al-Ahmadi and A. S. Hames illuminated that the remote sensing (RS) technologies is utilized to extract some of the important spatially variable parameters such as land cover and land use (LCLU). Four different classification techniques: unsupervised (ISODATA) and supervised (Maximum likelihood, Mahalanobis Distance and Minimum Distance) are applied in three sub-catchments in Saudi Arabia for the classification of the raw TM5 images. It is found that the maximum likelihood method gave the best results and both minimum distance and mahalanobis distance methods overestimated agriculture land and suburban areas.

Topic 14 **:** Image classification Perspectives.

Researcher **:** Mario Caetano, ESA Advanced Remote Sensing, 2009, pp. 1-73.

Objectives **:** Mario Caetano said that development of new systems level approaches that augment the underlying classifier algorithms like fuzzy or similar

approaches that soften the results of a hard classifier, multi-classifier systems that integrate the outputs of several classification algorithms.

Topic 15 **:** Recent Advances in Remote Sensing Image Processing.

Researcher **:** Devis Tuia and Gustavo Camps-Valls, Spanish Ministry of Science, Swiss National Science Foundation, 2009, pp. 1-4.

Objectives **:** Devis Tuia and Gustavo Camps-Valls held that the remote sensing image processing is nowadays a mature research area. The techniques developed in the field allow many real life applications with great societal value. This study serves as a survey of methods and applications and reviews the latest methodological advances in remote sensing image processing.

Topic 16 **:** Semi-supervised Remote Sensing Image Classification with Cluster Kernels.

Researcher **:** Devis Tuia and Gustavo Camps-Valls, IEEE Geoscience and Remote Sensing., Vol. 6, No. 2, 2009, pp. 224-228.

Objectives **:** Devis Tuia and Gustavo Camps-Valls believed that a semi-supervised support vector machine is presented for the classification of remote sensing images. The method exploits the wealth of unlabeled samples for regularizing the training kernel representation locally. Despite the simplicity of the design, the proposed semi-supervised method reaches excellent performances which confirms that suitable image pixel relations have been learned.

Topic 17 **:** Classification of Hyper Spectral Remote Sensing Images with Support Vector Machines.

Researcher **:** Farid Melgani and Lorenzo Bruzzone, IEEE Transactions on Geoscience and Remote Sensing, 2009, Vol. 142, pp. 1778-1790.

Objectives **:** Farid Melgani and Lorenzo Bruzzone communicated that this paper addresses the problem of the classification of hyper spectral remote sensing images by support vector machines (SVMs). Different performance indicators have been used to support the experimental studies in a detailed and accurate way such as the classification accuracy, the computational time, the stability to

parameter setting and the complexity of the multiclass architecture. The results obtained on a hyper spectral dataset allow concluding that the SVMs are a valid and effective alternative to conventional pattern recognition approaches for the classification of hyper spectral remote sensing data.

Topic 18 **:** High Efficient Classification on Remote Sensing Images Based on SVM.

Researcher **:** Qiu Zhen Ge, Zhang Chun Ling, Li. Qiong, Xin Xian Hui, Guo Zhang, The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences. Vol. 12, Part 2, 2009, pp. 1011-1014.

Objectives **:** Qiu Zhen Ge, Zhang Chun Ling, Li. Qiong, Xin Xian Hui, Guo Zhang talked automatic image categorization using low-level features is a challenging research topic in remote sensing application. In this study, the image categorization problem forms as an image texture learning problem by viewing an image as a collection of regions, each obtained from image classification. The classification problem becomes solvable by a regular classification algorithm. The proposed Sparse SVM is adopted to reduce the regions dramatically that are needed to classify images. The proposed approach is more efficient in computation and less sensitive to the class label uncertainty.

Topic 19 **:** Classification of Images using Support Vector Machines.

Researcher **:** Gidudu Anthony, Hulley Greg and Marwala Tshilidzi, National Science Foundation, 2009, pp. 1-6.

Objectives **:** Gidudu Anthony, Hulley Greg and Marwala Tshilidzi conveyed that Support Vector Machines (SVMs) are a relatively new supervised classification technique to the land cover mapping community. The two approaches commonly used are the One-Against-One (1A1) and One-Against-All (1AA) techniques. The individual performance of the SVM classifiers however show that classification accuracy reduced for the linear and RBF classifiers stayed the same for the polynomial and increased for the quadratic classifier. It can

therefore be concluded that whereas one can be certain of high classification results with the 1A1 approach, the 1AA yields approximately as good classification accuracies.

Topic 20 **:** Image Classification using Cluster Co-occurrence Matrices of Local Relational Features.

Researcher **:** Lokesh Setia, Alexandra Teynor, Alaa Halawani and Hans Burkhardt, Journal of Medical Informatics and Remote Sensing, 2009, pp. 1-9.

Objectives **:** Lokesh Setia, Alexandra Teynor, Alaa Halawani and Hans Burkhardt communicated that image classification systems have a recent boosting method using local features generated over interest points, delivering higher robustness against partial occlusion and cluttered backgrounds. In this study, it is proposed to use relational features calculated over multiple directions and scales around these interest points. Excellent results are achieved for a widely used medical image classification task and ideas to generalize to other tasks are discussed.

Topic 21 **:** Improving Clustering Algorithms for Image Classification using Contour and Region Information.

Researcher **:** Arnau Oliver, Xavier Munoz, Joan Batlle, Lluis Pacheco, and Jordi Freixenet, IEEE Transactions on Geoscience and Remote Sensing, 2010, pp. 1-13.

Objectives **:** Arnau Oliver, Xavier Munoz, Joan Batlle, Lluis Pacheco, and Jordi Freixenet discussed that image classification, clustering algorithms are very popular because they are intuitive and easy to implement. Most of these algorithms could be slightly improved by considering the coordinates of the image as features in the clustering process. Thus the study proposed a significant improvement of clustering algorithms for image classification. The method is qualitatively and quantitative evaluated over a set of synthetic and real images and compared with classical clustering approaches.

A new strategy for clustering classification which integrates region and boundary information has been described. The clustering is subsequently applied only for pixels with low gradient not blunder classify boundary pixels. Subsequently, precise edges are determined by comparing neighborhood of pixels with features of adjacent regions. Finally a merging step is required to merge adjacent regions.

Topic 22 **:** Overview of Remote Sensing.

Researcher **:** Dr. Abdulrahman K. Ali, Republic of Iraq Ministry of Higher Education and Scientific Research University of Technology, 2010, pp. 1-8.

Objectives **:** Dr. Abdulrahman K. and Ali observed that the remote sensing is the collection of information relating to objects without being in physical contact with them. There are two main types of remote sensing: passive remote sensing and active remote sensing.

Passive Remote Sensing detects natural radiation that is emitted or reflected by the object or surrounding area being observed. Reflected sunlight is the most common source of radiation measured by passive sensors. Examples of passive remote sensors include film photography, infrared and radiometers.

Active Remote Sensing emits energy in order to scan objects and areas at which point a sensor then detects and measures the radiation that is reflected or backscattered from the target. RADAR is an example of active remote sensing where the time delay between emission and return is measured, establishing the location, height, speeds and direction of an object.

Topic 23 **:** Recent Advances in Remote Sensing Image Processing.

Researcher **:** Devis Tuia and Gustavo Camps Valls, Spanish Ministry of Science and Swiss National Science Foundation, 2010, pp. 1-4.

Objectives **:** Devis Tuia and Gustavo Camps Valls conveyed that remote sensing image processing is nowadays a mature research area. The techniques developed in the field allow many real-life applications with great societal value.

For instance, urban monitoring, fire detection or flood prediction can have a great impact on economical and environmental issues. To attain such objectives, the remote sensing community has turned into a multidisciplinary field of science that embraces physics, signal theory, computer science, electronics and communications. From a machine learning and signal/image processing point of view, all the applications are tackled under specific formalisms such as classification and clustering, regression and function approximation, image coding, restoration and enhancement, data fusion or feature selection and extraction. This study serves as a survey of methods and applications and reviews the latest methodological advances in remote sensing image processing.

Topic 24 **:** Remote Sensing and GIS Based Forest Cover Change Detection Study in Kal Rayan Hills, Tamil Nadu.

Researcher **:** R. Sakthivel, M. Manivel, N. Jawahar Raj, V. Pugalanthi, N. Ravichandran and Vijay D. Anand, Journal of Environmental Biology, Vol. 31, Issue 5, 2010, pp. 737-747.

Objectives **:** R. Sakthivel, M. Manivel, N. Jawahar Raj and groups stated that the present study focuses on the role of remote sensing and geographic information system (GIS) in assessment of changes in forest cover between 1931 and 2001, in the Kal Rayan Hills, Tamil Nadu. The study revealed that the forest cover is 275.6, 481.7 and 266.5 sq.km in 1931, 1971 and 2001 respectively. It is noticed that forest cover has increased between 1931 and 1971, because of the implementation of various afforestation schemes by the forest department and scared grooves. It also revealed that the forest cover loss between 1971 and 2001 could be due to shifting cultivation and illegal encroachments by villagers and the forest cover drastically decreased on plateau areas due to human population pressure.

Topic 25 **:** A Hybrid FPAB/BBO Algorithm for Satellite Image Classification.

Researcher **:** Navdeep Kaur Johal Samandeep Singh and Harish Kundra,

International Journal of Computer Application, Vol. 6, No.5, 2010, pp. 31-36.

Objectives : Navdeep Kaur Johal Samandeep Singh and Harish Kundra observed that in the past years, remote sensing has been used for the classification of satellite image on a very large scale. This study deals with image classification by using swarm computing technique. In this work, the researchers use a new swarm data clustering method based upon Flower Pollination by Artificial Bees (FPAS) to cluster the satellite image pixels. The aim of clustering is to separate a set of data points into self-similar groups. Those clusters are being further classified using Biogeography Based Optimization (BBO).

Topic 26 : Parallel K-Means Clustering of Remote Sensing Images Based on Map Reduce.

Researcher : Zhenhua Lv, Yingjie Hu, Haidong Zhong, Jianping Wu, Bo Li and Hui Zhao, Springer-Verlag Berlin Heidelberg, , 2010, pp. 162–170.

Objectives : Zhenhua Lv, Yingjie Hu, Haidong Zhong and Groups explained that the K-Means clustering is a basic method in analyzing remote sensing images which generates a direct overview of objects. The study describes the color representation of RS images which means pixels need to be translated into a particular color space CIELAB that is more suitable for distinguishing colors. It also gives an overview of traditional K-Means clustering method.

Topic 27 : Colour Based Image Classification K-Means Clustering.

Researcher : Anil Z Chitade, Dr. S.K. Katiyar, International Journal of Engineering Science and Technology, Vol. 2, 2010, pp. 5319-5325.

Objectives : Anil Z Chitade, Dr. S.K. Katiyar presented a novel image classification based on colour features with k-means clustering unsupervised algorithm. In this the researchers did not used any training data. The entire work is divided into two stages. First enhancement of color separation of satellite image using decorrelation stretching is carried out and then the regions are grouped into a set of five classes using k-means clustering algorithm. This kind of image

classification may be used for mapping the changes in land use land cover region taken over temporal period.

Topic 28 **:** Multi-Scale Classification of Remote Sensing Images.

Researcher **:** Jefersson Alex dos Santos, Philippe-Henri Gosselin, and Alexandre Xavier Falcao, IEEE Transactions on Geoscience and Remote Sensing, 2010, pp. 1-27.

Objectives **:** Jefersson Alex dos Santos, Philippe-Henri Gosselin and Groups inspired a huge effort has been applied in image classification to create high quality thematic maps and to establish precise inventories about land cover use. Their aim is to propose a kind of boost-classifier adapted to multi-scale classification in remote sensing application. They use the paradigm of boosting, whose principle is to combine weak classifiers to build an efficient global one. Each weak classifier is trained for one level of the classification and descriptor.

Topic 29 **:** Color Image Segmentation using K-Means Clustering Algorithm.

Researcher **:** Amanpreet Kaur Bhogal, Neeru Singla and Maninder Kaur**,** International Journal on Emerging Technologies, Vol.1, No. 1, 2010, pp. 18-20.

Objectives: Amanpreet Kaur Bhogal, Neeru Singla and Maninder Kaur deliberated that color image segmentation has been the hotspot for the researchers in the image processing field. Color image classification using the neural networks, k-means clustering algorithm has yielded fruitful results. This study presents theoretical and practical knowledge to image classification and clustering. The application scope of image classification is quite extensive. The experimental data include that the algorithm produces effective results.

Topic 30 **:** A Comparative Performance Study of Several Global Thresholding Techniques for Classification.

Researcher **:** Sang Uk Lee and Seok Yoon Chung, Computer Vision, Graphics, and Image Processing 52, 2010, pp. 171-190.

Objectives : Sang Uk Lee and Seok Yoon Chung presented that a comparative performance study of five global thresholding algorithms for image classification is investigated. An image database with a wide variety of histogram distributions is constructed. The histogram distribution is changed by varying the object size and the mean difference between object and background. The performance of five algorithms is evaluated using the criterion functions such as the probability of error, shape and uniformity measures. Attempts also have been made to evaluate the performance of each algorithm on the noisy image. Computer simulation results reveal that most algorithms perform consistently well on images with a bimodal histogram.

Topic 31 : Image Classification by K-means Clustering.

Researcher : P. Jeyanthi and V. Jawahar Senthil Kumar**,** Advances in Computational Sciences and Technology, Vol. 3, 2010, pp. 1-8.

Objectives : P. Jeyanthi and V. Jawahar Senthil Kumar presented a content based image retrieval system, target images are sorted by feature similarities with respect to the query. In this study, the researchers proposed to use K-Means clustering for the classification of feature set obtained from the histogram. Histogram provides a set of features for proposed for Content Based Image Retrieval (CBIR). This study proposes to use K-Means clustering for the feature set obtained using the histogram refinement method which is based on the concept of coherency and incoherency.

Topic 32 : Color Image Classification Based on Adaptive Local Thresholds.

Researcher : Ety Navon, Ofer Miller, Amir Averbuch, IEEE Geoscience and Remote Sensing, 1-35, pp. 2010.

Objectives : In this study the researchers presented a new method for color image classification. The proposed algorithm divides the image into homogeneous regions by local thresholds. The number of thresholds and their values are adaptively derived by an automatic process, where local information is taken into consideration.

Topic 33 **:** Geometric Processing of Remote Sensing Images: Models, Algorithms and Methods.

Researcher **:** Thierry Toutin, Natural Resources Canada, International Journal of Remote Sensing, Vol. 124, 2011, pp. 1-51.

Objectives **:** Thierry Toutin observed that the geometric processing of remote sensing images become a key issue in multisource, data integration, management and analysis for many geometric applications. This study first reviews the source of geometric distortions, compares the different mathematical models being currently used for the geometric distortion modeling, details the algorithms, methods and processing steps and finally tracks the error propagation from the input to the final output data.

Topic 34 **:** Multispectral Satellite Image Understanding.

Researcher **:** C. Unsalan, K.L. Boyer, Advances in Computer Vision and Pattern Recognition, 2011, pp. 7-15.

Objectives **:** C. Unsalan, K.L. Boyer expressed that the properties of satellite images should be known in advance to develop an automated satellite image understanding system. Therefore, this study introduces various remote sensing satellites and airborne systems. These studies give a brief historical development of the sensor family with the operation dates, resolution, and revisit interval. It also give the spectral properties of the latest sensor for each family. Finally, the research paper summarizes and compares the properties of these sensors and their usage through time to give brief information to the potential user.

Topic 35 **:** Classification of Multispectral Satellite Images using Clustering with SVM Classifier.

Researcher **:** S.V.S Prasad, Dr. T. Satya Savitri, Dr. I.V. Murali Krishna, International Journal of Computer Applications, Vol. 35, No.5, 2011, pp. 32-44.

Objectives **:** In this study, the researchers have proposed an efficient image classification technique for multispectral remote sensed satellite images with the

aid of clustering and Support Vector Machines (SVM). Classification of multispectral remotely sensed data is investigated with a special focus on uncertainty analysis in the produced land cover maps. Here, the researchers have proposed an efficient technique for classifying the multispectral satellite images using SVM into land cover and land use sectors. The experimentation is carried out using the multi spectral satellite images and the analysis ensures that the performance of the proposed technique is improved and compared with traditional clustering algorithm.

Topic 36 **:** Land Cover Classification using Reformed Fuzzy C-Means.

Researcher **:** B. Sowmya and B. Sheelarani, Indian Academy of Sciences, Vol. 36, Part 2, 2011, pp. 153-165.

Objectives **:** B. Sowmya and B. Sheelarani explained that the task of land cover classification using reformed fuzzy C means. Clustering is the assignment of objects into groups called clusters so that objects from the same cluster are more similar to each other than objects from different clusters. The most basic attribute for clustering of an image is its luminance amplitude for a monochrome image and colour components for a colour image. Since there are more than 16 million colours available in any given image and it is difficult to analyze the image on all of its colours, the likely colours are grouped together by using fuzzy c-means clustering techniques. The classified images are compared using image quality metrics.

Topic 37 **:** Classification and Feature Extraction for Remote Sensing Images from Urban Areas Based on Morphological Transformations.

Researcher **:** Jon Atli Benediktsson, Martino Pesaresi, IEEE Transactions on Geoscience and Remote Sensing, Vol. 41, No. 9, 2011, pp. 1940-1949.

Objectives **:** Jon Atli Benediktsson, Martino Pesaresi projected that classification of panchromatic high-resolution data from urban areas using morphological and neural approaches is investigated.

The proposed approach is applied in experiments on high resolution IKONOS remote sensing data from urban areas. In this study, methods to preprocess the differential morphological profiles are investigated in order to reduce the computational load when differential morphological profiles are used for classification by neural networks. Although the original data are different in many ways, good overall accuracies are achieved for both datasets.

Topic 38 **:** Color Image Classification for Satellite Images.

Researcher **:** Manimala Singha and K. Hemachandran, International Journal on Computer Science and Engineering, Vol. 3, No. 12, 2011, pp. 3756-3762.

Objectives **:** Manimala Singha and K. Hemachandran introduces efficient and fast algorithms for unsupervised image classification using low-level features such as color, applied on satellite images. The proposed approach is based on that first enhance multispectral image and then applying clustering technique, using La*b* color space and the vectors are used as inputs for the k-means or fuzzy c-means clustering methods. For a classified image whose regions are distinct from each other according to color and texture characteristics. So the surface features have become much more clearly visible.

Topic 39 **:** Using Active Learning to Adapt Remote Sensing Image Classifiers.

Researcher **:** D. Tuia, E. Pasolli, W.J. Emery, Remote Sensing Of Environment, 2011, pp. 1-35.

Objectives **:** D. Tuia, E. Pasolli, W.J. Emery exposed that the validity of training samples collected in field campaigns are crucial for the success of land use classification models. In this study, the researchers have proposed a simple, but effective way to use active learning to solve the problem of dataset, which may occur when a classifier trained on a portion of the image is applied to the rest of the image. The experimental results obtained on hyper spectral and VHR datasets

demonstrate good capability of the proposed method for selecting pixels that allow rapid convergence to an optimal solution.

Topic 40 : A new Local Adaptive Thresholding Technique in Binarization.

Researcher : T. Romen Singh , Sudipta Roy, O. Imocha Singh, Tejmani Sinam , Kh. Manglem Singh**,** International Journal of Computer Science Issues, Vol. 8, No 2, 2011, pp. 271-277.

Objectives : T. Romen Singh , Sudipta Roy, O. Imocha Singh and groups discussed that image binarization is the process of separation of pixel values into two groups, white as background and black as foreground. This study describes a locally adaptive thresholding technique that removes background by using local mean and mean deviation. The technique uses integral sum image as a prior processing to calculate local mean. It does not involve calculations of standard deviations as in other local adaptive techniques. This along with the fact that calculations of mean is independent of window size speed up the process as compared to other local thresholding techniques. The proposed technique is compared with other relevant methods and found to be better than other contemporary methods, both in terms of quality and speed.

Topic 41 : Remote Sensing Perceptions.

Researcher : Bichlien Hoang and Ashley Caudill, IEEE Emerging Technology Portal, 2012, pp. 1-2.

Objectives : Bichlien Hoang and Ashley Caudill proved that remote sensors gather information by measuring the electromagnetic radiation which is reflected, emitted and absorbed by objects in various spectral regions from gamma-rays to radio waves. While the majority of remote sensing technologies utilize electromagnetic radiation for measurements, other methods use seismic waves or acoustics. Sonar technology is used to collect measurements from the sea floor by collecting point or raster data derived from the strength and time of the acoustic return. Remote sensing methods are used to gain a better understanding of the

Earth and its functions. A Global Earth Observation System (GEOS) is being developed to connect earth observation systems around the world.

Topic 42 **:** Introduction to Remote Sensing and Image Processing.

Researcher **:** IDRISI and GIS Group, 2012, pp. 1-34.

Objectives **:** IDRISI and GIS group described of all the various data sources used in GIS, one of the most important is remote sensing image. By the use of satellites to continuing program of data acquisition for the entire world with time frames ranging from a couple of weeks to a matter of hours. It is very important that all the remotely sensed images in digital form allowing rapid integration of the results of remote sensing analysis into a GIS. The development of digital techniques for the restoration, enhancement and computer-assisted interpretation of remotely sensed images initially proceeded independently and somewhat ahead of GIS. IDRISI is a combined GIS and image processing system that offers advanced capabilities in both areas. Because of the extreme importance of remote sensing as a data input to GIS, it has become necessary for GIS analysts to gain a strong familiarity with IPS.

Topic 43 **:** On Combining Multiple Features for Hyper Spectral Remote Sensing Image Classification.

Researcher **:** Lefei Zhang, Liangpei Zhang, Dacheng Tao and Xin Huang, IEEE Transactions on Geoscience and Remote Sensing, Vol. 50, No. 3, 2012, pp. 879-893.

Objectives **:** Lefei Zhang, Liangpei Zhang, Dacheng Tao and Xin Huang expressed that hyper spectral remote sensing image classification, multiple features, e.g., spectral, texture, and shape features, are employed to represent pixels from different perspectives. In this study, the researchers introduced the patch alignment framework to linearly combine multiple features in the optimal way and obtain a unified low dimensional representation of these multiple features for subsequent classification. Each feature has its particular contribution to the

unified representation determined by simultaneously optimizing the weights in the objective function.

Topic 44 **:** Satellite Remote Sensing Technology in Spatial Modeling Process: Technique and Procedures.

Researcher **:** Y. Ghobadi and B. Pradhan, International Journal of Science and Technology, 2012, pp. 309-315.

Objectives **:** Y. Ghobadi, B. Pradhan focuses on remote sensing image technique and procedures which includes image acquisition, processing, validation, classification and image data presentation. This paper also considers digital image processing (DIP) software and geographic information system (GIS) in terms of compatibility with image data modeling process. This is aimed at outlining the standard procedure for spatial data modeling via satellite remote sensing (SRS).

Topic 45 **:** Image Classification Techniques.

Researcher **:** Rajeshwar Dass, Priyanka and Swapna Devi, International Journal of Electronics & Communication Technology, Vol. 3, Issue 1, 2012, pp. 66-70.

Objectives **:** Rajeshwar Dass, Priyanka and Swapna Devi presented the various image classification techniques. This study describes the different classification techniques used in the field of ultrasound and SAR Image Processing. Firstly this study investigates and compiles some of the technologies used for image classification. Then a bibliographical survey of current classification techniques is given in this study and finally general tendencies in image classification are presented.

Topic 46 **:** Remote Sensing of Forestry Studies.

Researcher **:** Kai Wang, Wei-Ning Xiang, Xulin Guo and Jianjun Liu, Journal of Global Perspectives on Sustainable Forest Management, 2012, pp. 205-216.

Objectives: Wang, Wei-Ning Xiang, Xulin Guo and Jianjun Liu acknowledged that the advent of satellite remote sensing, the forestry studies have made the unprecedented development. Remote sensing has long been identified as an effective and efficient tool in forestry studies such as forest inventory, forest health and nutrition, forest sustainability, forest growth and forest ecology.

Remote sensing is the noncontact recording of information from the ultraviolet, visible, infrared and microwave regions of the electromagnetic spectrum by means of instruments such as cameras, scanners, lasers, linear arrays, and area arrays located on platform such as aircraft or spacecraft and the analysis of acquired information by means of visual and digital image processing. This study emphasized remote sensing is both technology and methodology.

Topic 47 **:** Feature Identification in Satellite Images using K-Means Classification.

Researcher **:** K. Somasundaram and N. Kalaichelvi, National Conference on Signal and Image processing, 2012, pp. 264-269.

Objectives **:** K. Somasundaram and N. Kalaichelvi focuses on the feature identification in each band of data using K-Means clustering algorithm. The clusters identified are compared with those produced using unsupervised classification in remote sensing image. The quantitative and qualitative measurements indicate that K-Means algorithm can be used to cluster effectively in green and blue band images and the clusters can be used to identify land features such as water bodies, mountains, waste land and cultivable land.

Topic 48 **:** Image Classification through integrated K-Means Algorithm.

Researcher **:** Balasubramanian Subbiah and Seldev Christopher. C, International Journal of Computer Science Issues, Vol. 9, 2012, pp. 518-524.

Objectives **:** Balasubramanian Subbiah and Seldev Christopher. C articulated that image classification has a significant role in the field of medical diagnosis as well as mining analysis and is even used for cancer diagnosis in the recent years. Clustering analysis is a valuable and useful tool for image classification and object

diagnosis. A variety of clustering algorithms are available and still this is a topic of interest in the image processing field. However, these clustering algorithms are confronted with difficulties in meeting the optimum quality requirements, automation and robustness requirements.

Topic 49 **:** Comparing Different Satellite Image Classification Methods: An Application in Western Turkey**.**

Researcher **:** Aykut Akgun, A. Husnu Eronat and Necdet Turk, IEEE Transactions on Geoscience and Remote Sensing, Vol. 40, 2012, pp. 1-7.

Objectives **:** Aykut Akgun, A. Husnu Eronat and Necdet Turk defined that the different satellite image classification methods are compared by using the satellite images located on the western coast of Turkey covering approximately 560 km^2. For this purpose, land use classification of the investigation area is made by different supervised image classification procedures and the results are compared with one another. Landsat satellite image, IDRISI image processing and the GIS package are used in this study. Of the classified images, the maximum likelihood method is found to be more applicable and reliable for the satellite image classification purposes. While the minimum distance method has given more reliable results than the linear discriminant procedures, the parallelepiped method.

All these points are applied to this study and it has been seen that maximum likelihood classifier is the most suitable classification method for land use mapping purpose. Minimum distances classifier is also determined as suitable as the maximum likelihood classifier.

Topic 50 **:** Hyper spectral Remote Sensing Data Analysis and Future Challenges.

Researcher **:** Jose, M. Bioucas-Dias, Antonio Plaza, Gustavo Camps-Valls, Paul Scheunders, Nasser M. Nasrabadi, and Jocelyn Chanussot, IEEE Geoscience and remote sensing magazine, 2013, pp. 6-36.

Objectives : Jose, M. Bioucas-Dias, Antonio Plaza and other explained that hyper spectral remote sensing technology has advanced significantly in the past two decades. Current sensors on board airborne and space borne platforms cover large areas of the Earth surface with unprecedented spectral, spatial, and temporal resolutions. These characteristics enable a myriad of applications requiring fine identification of materials or estimation of physical parameters. Very often, these applications rely on sophisticated and complex data analysis methods. The sources of difficulties are, namely, the high dimensionality and size of the hyper spectral data, the spectral mixing (linear and nonlinear) and the degradation mechanisms associated to the measurement process such as noise and atmospheric effects. This study presents a tutorial/overview cross section of some relevant hyper spectral data analysis methods and algorithms, organized in six main topics: data fusion, unmixing, classification, target detection, physical parameter retrieval, and fast computing.

Topic 51 : Hyper Spectral Image Classification using Support Vector Machine.

Researcher : T A Moughal**,** Journal of Physics: Conference Series 439**,** 2013, pp. 1-10.

Objectives : T A Moughal explained that the conventional multiclass classifiers have the ability to map the class of interest but the considerable efforts and large training sets are required to fully describe the classes spectrally. Support Vector Machine (SVM) is suggested in this study to deal with the multiclass problem of hyper spectral imagery. The attraction to this method is that it locates the optimal hyper plane between the class of interest and the rest of the classes to separate them in a new high-dimensional feature space by taking into account only the training samples that lie on the edge of the class distributions known as support vectors and the use of the kernel functions made the classifier more flexible by making it robust against the outliers. A comparative study has undertaken to find an effective classifier by comparing Support Vector Machine (SVM) to the other

two well-known classifiers i.e. Maximum likelihood (ML) and Spectral Angle Mapper (SAM). .

Topic 52 : Performance Analysis of K-Means Clustering for Remotely Sensed Images.

Researcher : K. Venkateswaran, N. Kasthuri, K. Balakrishnan and K. Prakash, International Journal of Computer Applications, Vol. 84, No 12, 2013, pp. 23-27.

Objectives : K. Venkateswaran, N. Kasthuri, K. Balakrishnan and K. Prakash articulates that remote sensing plays a vital role in overseeing the transformations on the earth surface. Unsupervised clustering has a indispensable role in an immense range of applications like remote sensing, motion detection, environmental monitoring, medical diagnosis, damage assessment, agricultural surveys, surveillance. In this study, a novel method for unsupervised classification in multi-temporal optical image based on DWT Feature Extraction and K-means clustering is proposed.

Topic 53 : A novel based Fuzzy Clustering Algorithms for Classification Remote Sensing Images.

Researcher : Lakshmana Phaneendra Maguluri, Shaik Salma Begum, T Venkata Mohan Rao, International Journal of Scientific & Engineering Research, Vol. 4, Issue 6, 2013, pp. 1415-1420**.**

Objectives : Lakshmana Phaneendra Maguluri, Shaik Salma Begum, T Venkata Mohan Rao presented that clustering is an unsupervised classification method widely used for classification of remote sensing images. In this study, six different clustering algorithms such as K-Means, Moving K-Means, Fuzzy K-Means and Fuzzy Moving K-Means, Adaptive Moving K-Means, Adaptive Fuzzy Moving K-Means are used for classification of remote sensing images. The Adaptive Fuzzy Moving K-means clustering algorithm avoids the problems such as the occurrence of dead centers, center redundancy and trapped center at local minima. The final center values obtained are located with their respective group of data.

Topic 54 **:** Semi-automatic Classification of Remote Sensing Images.

Researcher **:** Jefersson Alex Dos Santos, Alexandre Xavier Falcao, Ricardo da Silva Torres, IEEE Transactions on Geoscience and Remote Sensing, Vol. 41, 2013, pp. 1-6.

Objectives **:** Jefersson Alex Dos Santos, Alexandre Xavier Falcao addressed the classification dependence problem by introducing two new approaches that rely on multiple scales instead of using only one classification result. The selection of representative samples, on the other hand is supported in this work by the development of a new interactive classification approach based on active learning. The researchers proposed solutions that address important challenges related to classification of remote sensing images such as data representation, interactivity, and feature extraction.

Topic 55 **:** A Survey of Image Classification Methods and Techniques for Improving Classification Performance.

Researcher **:** D. Lu and Q. Weng, International Journal of Remote Sensing, Vol. 28, No. 5, 2013, pp. 823-870.

Objectives **:** D. Lu and Q. Weng discussed that image classification is a complex process that may be affected by many factors. This study examines current practices, problems, and prospects of image classification. The emphasis is placed on the summarization of major advanced classification approaches and the techniques used for improving classification accuracy.

Topic 56 **:** Study of Image Classification using Thresholding Technique on a Noisy Image.

Researcher **:** Fari Muhammad Abubakar, International Journal of Science and Research, Vol. 1, No. 1, 2013, pp. 49-51.

Objectives : Fari Muhammad Abubakar articulated that image classification is often used to distinguish the foreground from the background of an image. The focus of this paper is an attempt to study image classification using thresholding technique on an image corrupted by Gaussian Noise as well as Salt and Pepper

Noise which is implemented using MATLAB software and the results obtained are studied and thereby discussed, highlighting the techniques performance.

Topic 57 **:** A Survey of Image Classification Techniques.

Researcher **:** Er. Pratibha Thakur, Er. Nishi Madaan, International Journal of Research in Computer Applications, Vol. 2, 2014, pp. 158-165.

Objectives **:** Er. Pratibha Thakur, Er. Nishi Madaan expressed that image classification and its classification is difficult but important problem in computer vision. The main objective of image classification is to extract various features of the image that are used for analyzing, interpretation and understanding of images. It divides a digital image into multiple regions in order to analyze them. It is also used to distinguish different objects in the image. In this study, the researchers have critically analyzed various classification techniques such as thresholding, edge based classification, fuzzy theory based classification, region based classification, clustering and also covered image classification overview such that its major types, classification and applications.

Topic 58 **:** Survey on Remotely Sensed Image Classification Techniques using Support Vector Machines and Swarm Intelligence.

Researcher **:** Humayun Khan, Sandeep Kumar, International Journal of Emerging Technology and Advanced Engineering, Vol. 4, Issue 1, 2014, pp. 507-511.

Objectives **:** Humayun Khan, Sandeep Kumar thought that image classification is elementary step of the remote sensing applications, which is to extract useful geographic information from raw image data. Many new methods for remote sensed image classification have been developed such as machine learning, support vector machine (SVM), neural network classifier, fuzzy set, genetic algorithm and Artificial intelligence. Though these method may have higher accuracies than conventional classifiers. However, there is still a vast scope for further increases in classification accuracies so that the results can satisfy most of the applications.

Topic 59 **:** Pixel Based Approach of Unsupervised Satellite Image Classification.

Researcher **:** M. Suganthi, S. Chidambaram**,** International Journal of Advanced Research in Computer and Communication Engineering, Vol. 3, Issue 3, 2014, pp. 5865-5868.

Objectives **:** M. Suganthi, S. Chidambaram stated that this pixel-based approach for urban land covers classification from high resolution satellite image using k-means clustering and ISO data clustering. Pixel based image analysis of image classification that is, clustering of pixels into homogenous objects and subsequent classification or labeling of the pixels and modeling based on the characteristics of pixels. The algorithm is tested on remotely sensed images of different sensors, resolutions and complexity levels. This levels of partitions can be mined separately and such two steps procedure might give improved results as compared to data mining without using clustering.

Topic 60 **:** Local Thresholding Techniques in Image Binarization

Researcher **:** Yan Feng and Weing, International Journal of Engineering and Computer Science Vol. 3, Issue 3, 2014, pp. 4062-4065.

Objectives **:** Yan Feng and Weing indicated that binarization is a process of separation of pixel values of an input image into two pixel values like white as background and black as foreground. Most of the binarization techniques associate a certain intensity value called threshold. Each and every pixel of the concerned gray scale input image should be compared with the threshold value and pixels are separated into two classes background and foreground. Thus threshold plays a major role in binarization and choosing of an appropriate threshold value is an important one. In this study various local thresholding techniques are compared.

Study #61

Topic 61 **:** Positional Connected Component Labeling Algorithm

Researcher **:** G. Gayathri Devi and C. P. Sumathi, Indian Journal of Science and

Technology, Vol. 7, No. 3, 2014, pp. 306–311.

Objectives : G. Gayathri Devi and C. P. Sumathi presented a new positional connected component labeling algorithm to label the connected component and to give the number of components present in the binary image. The algorithm is based on the position value of the foreground pixel of the image. All the connected components are identified by the algorithm and are assigned by a new label or the same label of their adjacent component. Experiments are conducted by applying proper threshold technique on various images collected and tagged by various sources. It is observed that the proposed method finds the entire connected components in the image.

2.7. Conclusion

Although all the mentioned methodologies have the capability to retrieve the selective features at certain conditions and have their strengths and weaknesses, estimating spatial and spectral features using remote sensing image. The review demonstrates the strong role remote sensing plays within the agricultural sector. The remotely provided information is urgently needed for various decision makers. Requests for objective information will increase in the future, as a result of the expected changes in the remote sensing sector. The literature presents these themes in a variety of contexts, this study will primarily focus on their application to self-motivation.

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