Study of Classification Techniques on Multispectral Remote Sensing Data for Agricultural Application

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ABSTRACT : *India is a country where agriculture is the backbone of economy. It is need of hour to estimate agricultural production based upon its sown area, which deems to be not achievable manually every year. The underlying reason behind is the existing facilities and mechanism is inadequate to achieve the same. However, with the advent of state of the art technologies in Remote Sensing and GIS, it is quiet easy to predict acreage of agricultural product in advance. In order to identify the land use by the crops, classification is the important task to be done. Still, it's a real challenge to get better classification accuracy. Various supervised and unsupervised classification techniques are introduced by the researchers. The reviews of those techniques with their respective problems and prospects, is highlighted in the paper. The main objective is to find out the efficient classification technique that applied on multi-spectral remote sensing data for agricultural applications and to explore futuristic research in this domain.*

*Keywords: Remote sensing images**, supervised classification **, unsupervised classification,GIS*

I. INTRODUCTION

  Remotely sensed satellite image analysis is a challenging task considering the volume of data and combination of channels in which the image is acquired. The traditional classification techniques for analyzing images on a pixel by pixel basis suffer from radiometric differences between adjacent pixels, as well as noise due to short observation times and large radiometric resolution when applied to high resolution images. These are information rich, containing spectral information as well as textural, shape, contextual and topological information.

Artificial neural network(ANN)[1], Decision Tree classifier(DT)[2] ,Maximum likelihood Classifier(MLC)[3] and now a days Support Vector Machine(SVM)[4] are the classifiers use for the classification. Examining all the literature on various classifiers, it is obvious that Support Vector Machine (SVM), a machine learning algorithm has proven records for excellent results regarding Classification of Image or other data formats[1][2][3][4].

Remote Sensing Images are considered as most complex in nature as far as classification is concern. Hence, more precise Kernel based SVM algorithm is evaluated [4]. SVM is one of the kernel based machine learning algorithm. SVM learning theory is developed for solving pattern recognition problem, to build classification and

regression techniques in diverse technological fields including remote sensing discipline [4]

SVM uses density estimation function for developing easy and efficient learning parameters. Like other supervised algorithms, SVM also undergoing into Training, Learning and Testing Phase for classifying any image. Besides all parameters, training sample selection and optimization is crucial part that affects the classification accuracy of remote sensing images. This issue is addressed in different literature using various algorithms. In order to achieve high classification accuracies, the kernel function of the SVM classifier is selected beforehand. Furthermore, the kernel parameters are also optimized using different evolutionary computation techniques, including Genetic Algorithm (GA),Particle Swarm Optimization (PSO) and Comprehensive Learning Particle Swarm Optimization (CLPSO)[5]. A novel batch mode active learning technique based on self-organizing map (SOM) neural networks [6] and support vector machine (SVM) classifiers are implemented to find out the optimization results. Gene expression Program (GEP) based fuzzy logic approach for multiclass crop classification using Multispectral satellite image is proposed. The purpose of this work is to utilize the optimization capabilities of GEP for tuning the fuzzy membership functions. The

capability of GEP as a classifier is also studied[7]. The proposed method is compared to Bayesian and Maximum likelihood classifier in terms of performance evaluation. This all algorithms are evaluated in order to devise noble algorithm or approach, which could make SVM, a more robust statistical learning model.
All optimization algorithms along with SVM are checked on multispectral data taken from various satellites. The accuracy and Kappa Coefficients are compare with other algorithms.

II. METHODOLOGY

II.1 Classification using ANN

Paper [1] gives the methodology based on ANN. ANN is used for classification on the image .Classification results given by Bayesian (Clustering based classifier), are approximately 15% less than Kohonen SOFM and the HLVQ networks. Because of which the interest in above two SOFM & HLVQ increases.

The Kohonen SOFM (Self Organization Feature Maps) being the non supervised classification methods permitting the determination of homogeneous categories in the input data space. As they use a non supervised learning algorithm, hence their performances in classification problems are generally lower than the MLP (Multi Layer Perceptron) classification method .The HLVQ (Hybrid Learning Vector Quantization) network is a Kohonen SOFM using a hybrid non-supervised/supervised learning algorithm based on the combined use of the non-supervised learning algorithm of the SOFM and the supervised LVQ2 (Linear Vector Quantization2) algorithm. The main objective of this network is to obtain high recognition classification rates, while preserving the topology mapping of the SOFM. Above methods are proposed by Haihui Wang ,Junhua Zhang , kai Xiang .

II.2 Classification using Decision Tree

In paper [2] the decision tree classification method is proposed. Decision Tree is the classification used for the remote sensing images , this method is proposed by Jiejun HUANG and Yanbin YUAN . It adopts the top-down recursive fashion. By comparing the node attributes of the tree, the branch starting from the current node was decided according to different attributes. The conclusion was gained at the leaf node of the tree. Hence a rule was made respectively according to the route from the root node to the leaf node, and the whole tree represents a group of expression rules. The fundamental thought of Decision Tree is to carry out analysis on a large amount of sample information based on information theory, then calculate the information capacity.

II.3 Classification using SVM

In Paper [3] Krishna Mohan Buddhiraju and Imdad Ali Rizvi proposed the SVM algorithm based classification. The support vector machine (SVM) is superior to all machine learning algorithms which are based on statistical learning theory. There are a number of publications detailing the mathematical formulation and algorithm development of the SVM .The inductive principle behind SVM is structural risk minimization (SRM), which constructs a hyper-plane between two classes, such that the distance between support vectors to the hyper-plane would be maximum. In order to deal with non-linearly separable classes, the input data are first mapped using a kernel to a higher dimensional space in SVM. The radial basis function (RBF) kernel is popularly used in SVM. Cloud based technique proposed is relatively new in remote sensing arena. Hence require more study.SVM which gives the best result on remote sensing images out of . Hence has a scope in finding better optimization technique.

II.4 Classification using Kernel Based SVM

In Paper S.Manthira Moorthi , Indranil Misra ,Rajdeep Kaur , Nikunj P Darji and R. rmakrishnan [4] proposed the approach for kernel based SVM. Georeferencing is a need to tag every image pixel to a geographic coordinate (latitude and longitude) in satellite images. This information is used in subsequent geospatial tasks. Registering the input image to a reference image further improves the georeferencing model and thus sure about the geographic location of the image pixels. Image sub setting is to select region of interest to classify images.

II.5 Classification Using SVM With GA ,PSO & CLPSO

Wei Yao and Min Han concentrated on the optimization of data using various algorithms like GA(Genetic Algorithm), PSO(Particle Swarm optimization), CLPSO (Comprehensive Learning particle Swarm optimization). GA is established on the Darwinian principle of 'survival of the fittest'. The candidate

solutions to the optimization problem are represented as chromosomes. GA generates successive populations of chromosomes in a series of iterative computations and searches for the best. In the optimization of SVM, the chromosome comprises two parts, corresponding to the parameter C and g, and the chromosomes are coded using the binary coding system.

II.6 Classification using SVM with SOM algorithm

The SOM based active learning Technique is proposed by Swarnajyoti Patra and Lorenzo Bruzzone. Technique first select the $h1$most uncertain and diverse samples by using the SVM classifiers and the SOM neural networks.

 The proposed technique incorporates uncertainty, diversity and cluster assumption criteria to find out the most informative samples at each iteration of the active learning process. The uncertainty criterion is implemented by taking into account the properties of the SVM classifiers. The diversity and cluster assumption criteria are defined by exploiting the properties of the SOM(Self Optimization Map) neural networks. It is the iterative method .

II.7 GEP –FL Classification

S.N.Omkar along with the other co-others proposed the new algorim for classification of agricultural images.
 For classification using fuzzy logic the non-conventional GMF is used. The GMF can be expressed .
where μ is the mean and ð is the deviation. The shape of the GMF i.e the value of μ and ð is optimized using GEP. The fuzzy logic modeling and GEP optimization is coded in Python programming language. In this present work as we have considered eight crop classes of four bands we define a fuzzy rule for each class and hence there are eight If-Then rules.

III. CONCLUSION

In early days when ANN used for the multispectral image classification, it is found that HLVQ give the comparatively better recognition rates in less time hence can be used as an alternative to the Maximum Likelihood classifier. However, Neural network doesn't make any assumption on PDF. Decision Tree base algorithms being very popular in classification, when used with agricultural land grading succeeded with 86% classification accuracy. Regarding SVM, it is found that kernel type and kernel parameters influence the performance of the SVM for classifying remote sensing data. In fact, some optimization techniques proved the better classification records when used along with the kernel based SVM. Hence, further there is scope to find out a novel optimization algorithm with SVM which could give the relatively better accuracy for Indian Agricultural Remote sensing images. Nowadays, the cloud basis function is seems to be relatively new technique in remote sensing that of great interest for researchers.

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