

IMAGE CLASSIFICATION USING NEURAL NETWORK AND SVD

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Abstract-The remote sensing in image classification are most innovative technique. Various method are used to provide accuracy result to image classification. For many year research is following to provide better result. The neural network in which BP and RBF network are used to obtain better segmentation result and by using scale decomposition SVD are used. The result obtained for this method are compared by pixel value and comparing all three network. In experiment show RBF network provided better result accuracy in image classification compare with the other method.

General Terms-Artificial neural network, Image Classification, SVD.

Keywords-Artificial neural network, BP network, RBF network, Singular value decomposition

I. INTRODUCTION

In recent year more and more interest show on remote sensing having more amount of data. The term remote sensing can be defined as any process where by information is gathered about an object, area or phenomenon without being contact with it in developing information about earth's land surface, oceans and the atmosphere. The Advancement in remote sensing make high resolution data are available at short interval of time [1]. Firstly the image are classified on the based on texture information which include angular second moment, contrast, correlation in year in 1973s [2].

Satellite image classification is a key component of remote sensing, which compare the distinguishing and measuring the land portion, urban area, military etc. The methods used in remote sensing image classification are statistic classification method, structural classification method and fuzzy classification method. In these methods, statistic such as mean, variance, standard deviation and discrete degree are taken as criteria to distinguish different categories. All of them need numerous statistic calculation but in a low classification precision. Neural network has been used in remote sensing image classification and gotten a satisfying result.

The neural network is first introduced in year 1991s for RSD classification but failed due to poor classification ability. Artificial neural network are the most innovative technique that have shown great potential in analysing and making use of improved remote sensor data. With development in neural network are been employed to multi spectral remote sensing images [5]. Neural network processes information in the similar way the human brain does. The network is composed of a large number of highly interconnected processing element working in parallel to solving particular problem. Neural network are also applied where the data diversity is large for

segmentation and classification purpose. In image classification artificial neural network give more accurate result then the existing methods. Neural network provide high tolerance to noisy data. It also provide high spatial resolution at high frequency. Neural network are used in the problem of the hyper spectral remote sensing images [6]. Neural network are also used in pattern recognition and provide satisfactory result.

In 1980's the rough sets theory and support vector machine (SVM) are the most attractive method in remote sensing image classification. There is fewer research on SVM in the field of remote sensing image classification. The rough sets theory dealing with various imprecise, incomplete information and also in neural networks. Rough sets simulate abstract logic mind of our human being while neural networks simulate intuition mind. Rough sets theory express logic rules based on indiscernibility relation and knowledge reduction while neural networks state relation between input and output by using nonlinear mapping. In general, neural networks can not reduce dimensions of inputs. More complex structures and training cost required in neural networks of a higher input dimensions. Rough sets theory can be used to decrease redundance among input information through finding their relations, but rough sets theory is very sensitive to noises. Therefore, the good results derived from sample data may not appear good when they are applied in the set of test data.

SVM is proposed by Vapnik et al. in mid 1990s. It is a universal method to solve multidimensional function. It has been applied in function simulation, pattern recognition and data classification and obtained a perfect result. SVM are used in solving the problems of non-linear, pattern selected, high dimension, small specimen, which is complementary with neural network

This paper argues that segmentation process using pixel by pixel and classification using Neural network

the segmentation images are applied to the network .The segmented images are applied to BP network and RBF network and also applied to singular value decomposition SVD and compare among to all three method pixel by pixel and compare the classification images and compare which method provide accuracy and better result .

II. METHODOLOGY

1.1 Artificial neural network (ANN)

An artificial neural network having many inputs and one output. The neuron has two mode of operation the training mode and the using mode. In training mode the neuron can be travelled for particular input pattern and in the using mode where a taught input pattern is detected the input ,its associated output become the current out put as seen in figure 2 .Ann has been applied extensively applied to perform extraction and classification of remote sense data. Ann can simulate human neural system.

The BP network is widely used for information extraction and classification.BP network is distributed free and is more robust. The general training process of Back propagation (BP) method are as follows

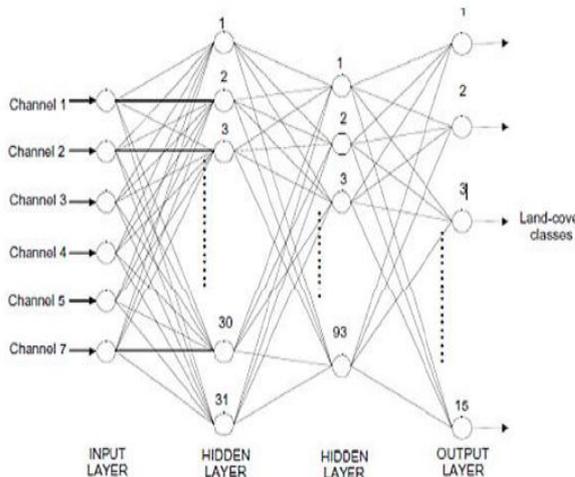


Fig. 2: Back Propagation Network

The learning process of a BP network structure consist of two parts positive dissemination and propagation. In the BP network the error correction with weight and threshold of each layer.

In network training ,the hidden layer is given as

$$O_{kj} = f_j \left(\sum_i a_{ji} o_{ki} + \theta_j \right) \tag{2}$$

Where f_j means activation function, a_{ji} is defined as the weight of the former layer of neuron o_{ki} is defined as the output of the k sample θ_j is the threshold of the neuron.

The training error is shown as

$$\delta_{kj} = O_{kj} (1 - O_{kj}) (t_{kj} - O_{kj}) \tag{3}$$

Where t_{kj} is defined as k samples of a target unit j , δ_{kj} is hidden error of training

The weight is trained as

$$w_{ji}(t + 1) = w_{ji}(t) + n\delta_{kj}O_{kj} + \alpha[w_{ji}(t) - w_{ji}(t - 1)] \tag{4}$$

The threshold is trained as

$$\theta_j(t + 1) = \theta_j(t) + n\delta_j + \alpha[\theta_j(t) - \theta_j(t - 1)] \tag{5}$$

The given input and output of each iteration of equation (3)-(5) will repeat whether the result give the accuracy after all samples trained if the result is not occurs well the sample will be trained again to give more accuracy to the network.

1.2 Radial basis function

Radial Basis Function has one input layer ,one out put layer and a hidden layer .Radial Basis Function Networks derives from the theory of function approximation. Multi-Layer Perceptron networks with a hidden layer of sigmoidal units can learn to approximate functions. . RBF network are two-layer feed-forward networks. The hidden nodes implement a set of radial basis functions (e.g. Gaussian functions). The output nodes implement linear summation functions as in an MLP The network training is divided into two stages: first the weights from the input to hidden layer are determined, and then the weights from the hidden to output layer as shown in figure 3 .The training/learning is very fast.

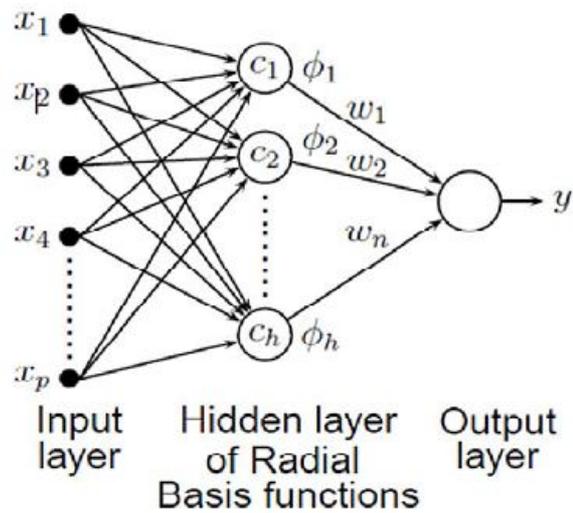


Fig. 3: Radial; Basis Function

There are three parameters needed to be solved in RBF network algorithm: the center of basis function, variance and weight matrix between hidden and output layers.

The specific steps of RBF network learning algorithm are as follows:

Calculated the center vector of all samples, based on the center vector the small random numbers of superposition was as the initial value of the weight vector.

Solving variance .The basis function of RBF neural network is Gaussian function, so the variance can be soluted by the equation

$$\sigma_i = c_{max} / \sqrt{2h} \tag{6}$$

Where c_{max} is the maximum distance between selected centres

Weights calculated between the hidden layer and output layer. Connection weights of the neurons between the hidden layer and output layer can be directly calculated using least squares method.

$$\omega = \exp \frac{h}{c_{max}^2} \|x_p - c_i\| \tag{7}$$

1.3 Singular Value Decomposition

Singular value decomposition (SVD) is a stable and effective method to split the network into a set of linearly independent components and each of them having own energy contribution. Singular value decomposition (SVD) is a numerical technique used to diagonalize matrices in numerical analysis Main advantages of SVD in which maximum energy which is usually used in compression ability to manipulate the image in base of two distinctive subspaces data and noise subspaces which is usually uses in noise filtering and also was utilized in watermarking applications.

The low rank approximation is based on singular value decomposition (SVD) the feature matrix is decomposed in the following form

$$Y = U \Sigma V^T \tag{8}$$

Where U is an M*M matrix with each column representing of an eigenvector of YY^T and V is an N*N matrix with each column representing an eigen vector $Y^T Y$. Σ is an M*N rectangular diagonal matrix with non negative real numbers on its diagonal and zero else where.

Comparing with neural network, SVM is more suitable for processing the complex and high dimensional data.. The performance of SVM depends on the kernel. Selection of kernel function limits the application of SVM greatly. the result is not ideal when Sigmoid kernel are used and training time is longer when use RBF.

III. RESULT

The various method are used for segmentation but by using the neural network BP network , RBF network and SVD compare all method which provide accuracy to image classification .In fig 4 original image is taken and applied to the neural network



Fig. 4: Original image

In fig 5 the image is applied to the BP network and out put is obtained in pixel by pixel value and compare the land portion and water portion in the output images.

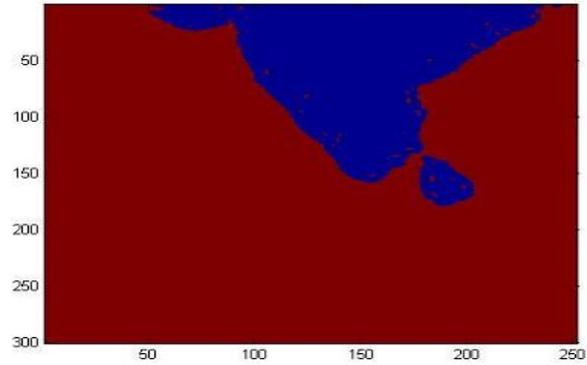


Fig. 5: Out put image of BP network

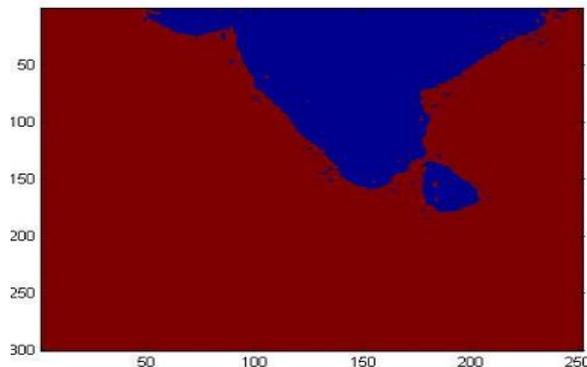


Fig. 6: Out put image of RBF network

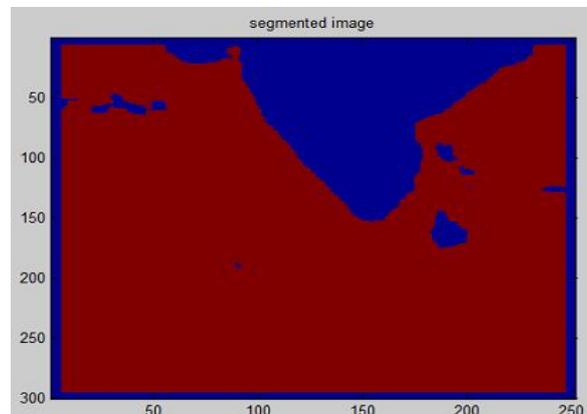


Fig. 7: Out put image of SVD network

In figure 6 the out put images is obtained by using RBF network and in figure 7 by using the reduction method SVD the scale can be reduced so to obtained the appropriate manner .

By comparing the different method available pixel by pixel value can be calculated to obtained the result of land and water in images by calculating the land in BP network ,RBF network and SVD the output can be calculated in SVD the land portion is obtained is 12376 pixel while in BP network is 13423 and in RBF network is 13542. So by comparing all method RBF network provide more accuracy and better result compare the other network .Thus for image

classification RBF network provide more accurate result compare to SVD and BP network

CONCLUSION

In the experiments of artificial data and remote sensing data with neural data and by using SVD the following conclusion are made:

The BP network are compared with RBF network and SVD

The result obtained from the RBF network provide accuracy of 92% which are stable and less consumption of time while compare with BP network and SVD which provide more accuracy to the network for classification in remote sensing.

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