

Research on Fuzzy Kohonen Neural Network for Fuzzy Clustering

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Abstract. A model of fuzzy Kohonen neural network for fuzzy clustering is presented. It uses fuzzy membership degree to describe approximate degree for input patterns and clusters' centers, which is represented by learning rate. In addition, in order to extract more useful information from input patterns, a supervised learning, called post-learning phase, is added to adaptive learning. Then the model is applied for a specific clustering's problem, the result shows it can greatly improve performances of recognition and classification.

1 Introduction

1.1 Fuzzy Clustering

Clustering is a process, where data sets are partitioned into several groups or categories. It makes data objects in the same groups are closer to each other, and ones in different groups are not approximate. Using the approach of fuzzy set to solve the problem of clustering is called as fuzzy clustering[1]. Clustering method can be actively bringing together cooperatives to work together in every way possible by both type and parameters. Cooperatives are expected to cluster together to derive the highest return on what they consider to be their competitive advantage[8].

1.2 Fuzzy Kohonen Network

Traditional Kohonen network is a kind of adaptive neural network, which is applied to make rough classifications for data sets. The network has such advantages that the learning rate can decrease with the time and the weights can be ultimately convergent, while it still exists such disadvantages that the learning rate does not make approximate degree for input patterns and clusters' centers under consideration and the network is imperfect for classifications. While fuzzy Kohonen network[2][3], on the basis of the traditional Kohonen network, can heuristically decrease learning rate and correct mistakes by the means of introducing fuzzy membership degree and supervised learning phase. So the learning time and the mistake for clustering are greatly decreased, that is, the clustering's efficiency is greatly increased.

2 Fuzzy Kohonen Neural Network

Artificial Neural Network is composed of a large number of neuron which simulate the way of brain nerve disposing information with information parallel processing and converse-nonlinear. Training neural network by the information of samples endows it with similar capability of memorizing and recognizing to brain.

2.1 TStructure of Fuzzy Kohonen Newtwok

The topological structure of fuzzy Kohonen neural network is displayed by Fig.1, where L_a is the input layer, and L_b is the output layer. The upper layer of the network is represented by output nodes, which form a matrix in a two-dimensional pattern, and the lower one is composed of input nodes, these nodes are all connected by weights. After competitive learning, neighborhoods of one certain node in the matrix must have bigger outputs for closer patterns, through which neighbors of winning nodes are created during the course of training[4][5].

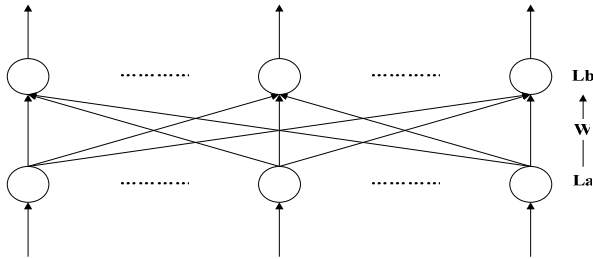


Fig. 1. Structural diagram of fuzzy Kohonen network

2.2 Algorithm Description

The learning algorithm of fuzzy Kohonen network actually combines fuzzy c-means algorithm and traditional Kohonen rules, so it is self-organizing and self-adaptive [6][7].

2.2.1 Basic Concept

$X = \{x_j | j=1, 2, \dots, p\}$, and $x_j = [x_{j1}, x_{j2}, \dots, x_{jn}]^T$ is defined to describe input patterns in a R^n space. $W = [w_1, w_2, \dots, w_c]$ is defined to describe c centers of clusters. u_{ij} is applied to describe fuzzy membership degree for x_j to w_i . The fuzzy c-means algorithm is to make the value of target function minimum:

$$J(W, U, X) = \sum_{i=1}^c \sum_{j=1}^p (u_{ij})^m d^2(x_j, w_i) \quad (1)$$

Where $m \in [1, \infty]$ is called as fuzzy index, $d^2(x_j, w_i)$ is the distance from input pattern x_j to center w_i .