A Combination of Inference Method for Rule Based Fuzzy Classification

Li Na\textsuperscript{1} and Huang Xiaojuan\textsuperscript{2}

\textsuperscript{1} School of Mathematics and Econometrics, Hubei University of Education, Wuhan, 430025, China
\textsuperscript{2} Freshman Education Department, Yangtze University, Jinzhou, Hubei Province, 434023, China
nana63@yahoo.cn

Abstract. In this paper, we provide a combination of inference method for Rule Based Fuzzy Classification. Rule based Fuzzy classification provides an effective way to present the approximate and inexact nature of the real world, especially when the systems are not suitable for analysis by conventional quantitative technique or when the available information on the systems is uncertain or inaccurate. For improve the performance of Rule Based Fuzzy Classification System, novel inference method based on ordered weighted averaging family was introduced.

Index Terms: Classification, Rule based, Fuzzy, Inference method.

1 Introduction

Most of the pattern classification techniques with numerical inputs can be classified into the following group: parametric, semi-parametric and nonparametric. All these three techniques use a set of training patterns that already have class labels. The parametric and semi-parametric classifiers need certain amount of a priori information about the structure of the data in the training set. Fuzzy set theory has been already applied in cluster analysis and classifier design, the applications include fuzzy c-means cluster algorithms and fuzzy syntactic pattern recognition. But these fuzzy algorithms are difficult to realize in optics. In this paper, we consider only rule based pattern classification.

Fuzzy syntactic methods were introduced to optical correlation pattern recognition earlier, but the obtained results were very primitive. The successful applications of fuzzy logic in optical pattern recognition so far include morphological and fuzzy-rule-based correlation post-processing. The former is obtained by replacing the multiplication in linear correlation with the basic operation of fuzzy logic, minimum. Because of the nonlinearity of minimum operation morphological correlation was found to provide improved performance over linear correlation, and it can be realized optically. The performance analysis indicates so far that morphological correlation is optimal in terms of mean absolute error and its correlation peaks are sharper than of linear.

Fuzzy rule-based inference techniques have already been introduced to optical pattern recognition for post-processing of correlation peaks to increase discrimination capabilities of a pattern classification. In pattern classification, the target may be
distorted or corrupted in many different ways. It may be shifted, scaled and rotated. Defocus, noise, obscuration, low illumination and clutter are other factors that contribute to distortion. The task of pattern classification is usually complicated by these distortions, which may lead to false alarms. Accordingly, a large number of algorithms have been proposed to overcome these problems: designing filters to minimize the effects of distortions or using different filters for reducing the probability of false alarm. The fuzzy rule-rule based post processing method has been demonstrated to improve the discriminability in correlation applications.

2 Rule Based Fuzzy Classification

A fuzzy model is a set of if-then rules that maps inputs to outputs. Basically, Rule based fuzzy classification (RBFC) provides an effective way to present the approximate and inexact nature of the real world. In particular, RBFC appears useful when the systems are not suitable for analysis by conventional quantitative technique or when the available information on the systems is uncertain or inaccurate.

Basically, RBFC systems are composed of four principal components: a fuzzification facility, a rule base, an inference engine and a defuzzification facility. The RBFC system may figure out as the following figure 1:

![Fig. 1. Rule Based Fuzzy classification System](image)

The fuzzification facility conducts the mapping that converts the crisp values of input variables into a fuzzy singleton. Before the conversion occurs we need to define the membership function for each input and output variable. We consider a single-output fuzzy rule-based system with m-dimensional inputs. Suppose \( \{x_i| i = 1,2,\cdots,n\} \) and \( \{y_i| i = 1,2,\cdots,n\} \), are the independent and dependent variables, respectively. The training data to generate rules can be represented by n input-output pairs \((x_i, y_i)\), where \(i = 1,2,\cdots,n\). The independent variable vector \(x_i = (x_{i1}, x_{i2}, \cdots, x_{im})\), is of size m while the dependent variable \(y_i\) is of size one. We define membership functions for each of these m input variables as \(\{A_j| j = 1,2,\cdots,m\}\).