Optimization of Neuro-Fuzzy System Using Genetic Algorithm for Chromosome Classification

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Abstract. Neuro-fuzzy system has been shown to provide a good performance on chromosome classification but does not offer a simple method to obtain the accurate parameter values required to yield the best recognition rate. This paper presents a neuro-fuzzy system where its parameters can be automatically adjusted using genetic algorithms. The approach combines the advantages of fuzzy logic theory, neural networks, and genetic algorithms. The structure consists of a four layer feed-forward neural network that uses a GBell membership function as the output function. The proposed methodology has been applied and tested on banded chromosome classification from the Copenhagen Chromosome Database. Simulation result showed that the proposed neuro-fuzzy system optimized by genetic algorithms offers advantages in setting the parameter values, improves the recognition rate significantly and decreases the training/testing time which makes genetic neuro-fuzzy system suitable for chromosome classification.

Keywords: chromosome classification; genetic algorithms; Neuro-fuzzy system; optimization; recognition rate.

1 Introduction

The use of Pattern Recognition and Image Analysis is becoming increasingly popular in many fields of Biology and Medicine. One of these applications is the classification of human chromosomes. Chromosome analysis is important in many situations such as prenatal amniocentesis examination, detection of malignant diseases such as leukemia, gene mutations, and monitoring environmental. The normal human “karyotype” or set of chromosomes consists of 22 homologous pairs or “autosomas” and one pair of sex chromosomes [1].

Chromosome classification and analysis are aided by the use of automated karyotyping systems that yield a preliminary classification for each chromosome, which may be corrected manually as necessary. Automated karyotyping relies upon acquisition of a digital image, followed by extraction of chromosome features. Two general approaches feature extraction are employed: gray level encoding of each chromosome and more complex extraction of...
Comparison of Recognition Rate of NFS and of GNFS is presented in Figure 8.

![Comparison of Recognition Rate of NFS and of GNFS](image)

Figure 8  Comparison of Recognition rate of NFS and of GNFS.

6  Conclusion

The works showed that the NFS with GAs (GNFS) has assisted in automating the optimized setting of the parameter values, hence increased the accuracy of parameter values, accelerated the speed of training/testing, and improved the recognition rate. Our experience suggests that the GNFS provides the recognition rate that is better than that of NFS. The increase of the training pattern number will improve the test recognition rate, at the expense of slightly higher computing load. The best performance of 99.68% is achieved in an experiment with the greatest number of training pattern, i.e. 2200 patterns.

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References


