Applications of Diverse Evolutionary Neural Networks based on Information Theory

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Recently, there are many researchers to design neural network architectures using evolutionary algorithms but most of them use the only one fittest solution in the last generation. To exploit much information in the population, an ensemble of the individuals is promising because combining a set of classifiers might produce higher accuracy than the best classifier among them. There is a consensus that one of the major factors for better accuracy is the diversity in the classifier set. In this paper, we present a method of generating diverse evolutionary neural networks through speciation algorithm and combining for better performance. Especially, the proposed method calculates the distance between individuals using modified Kullback-Leibler entropy, average output and Pearson correlation to enhance the fitness sharing performance.

We have applied the evolutionary neural network to classify gene expression profiles into normal or colon cancer cell [1]. Experimental results on colon microarray data show that the proposed method is superior to other classifiers. The advantage of the proposed method can be summarized as follows. At first, human does not need any prior knowledge about neural network structure. Additional research can reveal the relationships between genes and classes from the emerged structure. For example, rule extraction from neural network can be used for this task.

A novel intrusion detection technique based on the evolutionary neural network is proposed [2]. One advantage of using evolutionary neural networks is that it takes less time to obtain superior neural networks than when using conventional approaches. This is because they discover the structures and weights of the neural networks simultaneously. Experimental results with the 1999 DARPA IDEVAL data confirm that evolutionary neural networks are promising tools for intrusion detection.

In [3], we propose the systematic insertion of opening knowledge and an endgame database into the framework of evolutionary checkers. Also, the common knowledge that the combination of diverse strategies is better than a single best one is included in the middle stage and is implemented using crowding algorithm and a strategy combination scheme. Experimental results show that the proposed method is promising for generating better strategies.

[1] K.-J. Kim and S.-B. Cho, "Prediction of colon cancer using evolutionary neural network," *Neurocomputing*, vol. 61, pp. 361-379, Oct 2004.
[2] S.-J. Han, K.-J. Kim, and S.-B. Cho, "Evolutionary learning program's behavior in neural networks for anomaly detection," *Lecture Notes in Computer Science*, vol. 3316, pp. 236-241, 2004.
[3] K.-J. Kim and S.-B. Cho, "Systematically incorporating domain-specific knowledge into evolutionary speciated checkers players," *IEEE Transactions on Evolutionary Computation*, 2005 (To appear).