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A Differential Evolution Architecture for Artificial Neural Trees with Applications to Science Foundation Evaluation

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Abstract. This paper presents an evolutionary structure for neural trees by differential evolution. For a neural tree a structure tree and weight tree are defined. A cost function based on the weight matrix of neural connections is applied to measure the energy of the evolution system. Different to traditional evolution method of genetic programming, a variant differential evolution is proposed. A numbering scheme is designed for basic operations of tree structure. Finally we present an application of neural trees to the evaluation of science foundation. A new index system is proposed for evaluation problem. Experiments are presented indicating the effect of parameters to the evolution.

Keywords. Neural trees, differential evolution, multi-population optimization, science foundation, evaluation.

AMS (MOS) subject classification: 68T30, 68T35.

1 Introduction

Evolution of neural networks is a promising and important technique in designing the structure of a multi-layer neural networks, or even more complex nonlinear neural networks such as wavelet networks. Moreover, evolution can be used as an optimizer for improving the performance of the networks. The fact lies in that it is more difficult to evolve the structure of the networks than to evolve their parameters. Indeed, there have been reported extensive works engaged in the evolution of parameters, for example, by genetic algorithms and particle swarm optimizations [7]. In contrast, the evolution of neural structures is less reported while genetic programming is a successful exception.

There are several ways to design neural network architectures automatically. The most popular ways include constructive and pruning algorithms, the EPNet [5][9] and the neuron evolution of augmenting topologies [2]. Another important tool to represent neural structure is tree which was first proposed by B. T. Zhang [14]. Successive research on evolving the structure of networks structures can be found in [13][10]. Based on the representation of neural tree, architecture and weights of higher order sigma-pi neural networks were evolved by using genetic programming and genetic algorithms. Following these lines, Y. Chen [4] proposed