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PREDICTING STOCK PRICE USING NEURAL NETWORKS OPTIMIZED BY DIFFERENTIAL EVOLUTION WITH DEGENERATION

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Abstract. *Structural learning, in which the structures of estimation systems are optimized, has been actively studied in researches on supervised learning of neural networks and fuzzy rules. GA^d(Genetic Algorithm with degeneration) is the structural learning methods, which are modeled on genetic damage and degeneration. In the algorithms, a gene is defined by a pair of a normal value and a damaged rate that shows how much the gene is damaged. Simple one-point crossover and Gaussian mutation are adopted to deal with the pair. However, it was very difficult to incorporate more efficient crossover operations than one-point crossover, because the pair of the value and the rate must be treated. Recently, a new evolutionary algorithm, Differential Evolution (DE), has been proposed and successfully applied to the optimization problems including non-linear, non-differentiable, non-convex and multi-modal functions. It has been shown that DE is fast and robust to these problems. In order to utilize operations of DE, we adopt the idea of unifying the pair of the value and the rate according to a mapping, applying the operations and separating the values according to the inverse mapping and propose DE^d(Differential Evolution with degeneration). In this study, DE^d is applied to the structural learning of neural networks. As an example of structural learning, neural networks for predicting stock price are learned by DE^d, DE, GA^d and GA. It is shown that DE^d can reduce proper number of ineffective parameters and find better estimation models, which have smaller estimation errors for test data, than GA, DE and GA^d. As the result, it is thought that DE^d has better generalization ability for structural learning than GA, DE and GA^d.*
Keywords: Degeneration, Differential evolution, Prediction, Stock price

1. **Introduction.** There are many researches on supervised learning using neural networks and they are applied in various fields [4]. However, there are some difficulties in supervised learning using neural networks as follows: (1) It is difficult to select a proper network structure. If the network is too big, the generalization ability becomes poor. If the network is too small, the learning ability becomes insufficient. In many cases, the information about the proper network structure isn't available. Thus, it is necessary to search the network structure in trial and error. (2) The interpretation of the hidden units is difficult. Generally, sufficient number of hidden units is prepared in order to keep the estimation error small enough. The learned knowledge is distributed to the multiple hidden units. The meanings of each unit become unclear. Thus, the interpretation of the learned knowledge becomes difficult. (3) The local minimum problem is inevitable. Since