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A NEW STOCHASTIC DYNAMIC ADAPTIVE LOCAL SEARCH ALGORITHM FOR ELMAN NEURAL NETWORK

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Abstract. *Elman Neural Network (ENN) has found numerous applications in such as time series prediction, system identification and adaptive control since it has powerful dynamic memories. However, the local minima problem usually occurs in the process of the learning. In this paper,we firstly propose a new adaptive local search (ALS) method for the ENN by instead of traditional Back-Propagation (BP) algorithm. Based on this algorithm, we further propose a Stochastic Dynamic Adaptive Local Search (SDALS) algorithm for the ENN which introduces stochastic dynamics into the ALS algorithm in order to avoid the possible local minima. The proposed learning algorithm maintains some trends of quick descent to either global minimum or a local minimum, and at the same time has some chance of escaping from the local minima by permitting temporary error increases during learning. Thus, the proposed algorithm may eventually reach the global minimum state or its best approximation with very high probability. Simulation results show that the proposed algorithm has the superior abilities to find the global minimum than other algorithms.*

Keywords: Elman neural network (ENN), Back-propagation, Adaptive local search (ALS), Stochastic dynamic adaptive local search (SDALS), Boolean series prediction questions (BSPQ)

1. **Introduction.** Recurrent Neural Networks have attracted the attention of researchers in the fields of the time sequence prediction and dynamic system identification since they take the memory unit through the context delay [2,4]. The Elman Neural Network (ENN) is one type of the partial recurrent neural network, which consists of a two-layer back propagation network with an additional feedback connection from the output of the hidden layer to its input. The advantage of this feedback path is that it allows the ENN to recognize and generate temporal patterns and spatial patterns. This means that after training, interrelations between the current input and internal states are processed to produce the output and to represent the relevant past information in the internal states [3,17]. As a result, the ENN has been widely employed in broad fields, from a temporal version of the Exclusive-OR function to the discovery of syntactic or semantic categories in natural language data [5].

However, Since the ENN usually uses the Back-Propagation (BP) algorithm to deal with the various signals, it has been proved that it frequently suffers from a sub-optimal solution problem [9,13,20,21]. At the same time, the efficiency of the ENN is limited to low order system due to the insufficient memory capacity when Back-Propagation algorithm is employed [1]. So, several approaches have been suggested in the literature to increase the performance of the BP-trained ENN with simple modifications of net structure [6,10,18].