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TRAINING ELMAN NEURAL NETWORK FOR DYNAMIC SYSTEM IDENTIFICATION USING AN ADAPTIVE LOCAL SEARCH ALGORITHM

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Abstract. *Recurrent neural networks, especially for Elman Neural Network, have attracted the attention of researchers in the fields of Dynamic System Identification (DSI) since they took the memory unit through the context delay. In this paper, we propose an Adaptive Local Search (ALS) algorithm to train Elman Neural Network (ENN) for Dynamic Systems Identification (DSI) from a new angle instead of traditional Back Propagation (BP) based gradient descent technique. Experimental results show that the proposed algorithm has greatly effective performances in the identification of linear and nonlinear dynamic systems in comparison with BP based algorithms. The results also demonstrate that the proposed algorithm is an alternative means of training ENN when the gradient-based methods fail to find an acceptable solution. So the proposed algorithm can be regarded as a new tool or identification approach to identify dynamical systems for the auto-control systems.*

Keywords: Elman neural networks (ENN), Back propagation, Adaptive local search (ALS), Dynamical system identification (DSI)

1. **Introduction.** Elman Neural Network (ENN) is one type of the partial recurrent neural network, which consists of two-layer back propagation networks with an additional feedback connection from the output of the hidden layer to its input [1]. This feedback path represents a dynamic mapping between its outputs and inputs. So ENN is more suitable for processing temporal sequence data than multi-layer perception since it maintains state information between the input samples [2]. Recently, ENN and its modified models have been used in applications of Dynamical System Identification problems [3-15].

As a result, the ENN has been widely used in various fields which includes classification [16-17], prediction [18-21] and dynamic system identification, etc. Figure 1 is the academic Modulus of Concern for ENN from the year 1994 to 2006 according to the study of the authority institution CNKI of China [22]. In Figure 1, A [23] represent the reference about the learning algorithm of ENN. Figure 2 is the Modulus of Concern from users for ENN, A [24], B [25], C[26] and D [27] represent the famous papers which are widely cited in different application fields. From Figure 1 and Figure 2, we can see that the ENN has generated considerable effect among various research fields.

Usually the Back Propagation (BP) based algorithms are employed to train ENN. Standard BP algorithm and Backpropagation Through Time (BPTT) algorithm have been studied in detail in [4]. It is certified that both BPTT-trained ENN and BP-trained modified ENN could model systems with orders higher than one whereas the BP-trained