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# THE SYSTEMATIC TRAJECTORY SEARCH ALGORITHM FOR THE GENERALIZED FEEDFORWARD NEURAL NETWORK TRAINING

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Abstract. *In this paper, an improved version of the systematic trajectory search algorithm (STSA) is proposed to train the connection weights of the generalized feedforward neural networks. By generalized feedforward neural networks, we mean that links are not restricted to just going from one layer to the next layer. The STSA utilizes the orthogonal array (OA) to uniformly generate the initial population in order to globally explore the solution space, and then applies a novel trajectory search method to exploit the promising area thoroughly. Besides, for classification problems, the authors propose a strong winner concept and a mixed fitness evaluation method to avoid overtraining and to improve the generalization ability of the trained ANNs. The performance of the STSA is evaluated by applying it to solve the n-bit parity problem and the classification problems on three medical datasets from the UCI machine learning repository. By comparing with the previous studies, the experimental results reveal that the neural networks trained by the STSA have very good classification ability for unseen cases.*
**Keywords:** Artificial neural networks, Orthogonal array, $n$-bit parity problem, Systematic trajectory search

1. **Introduction.** Artificial neural networks (ANNs) have been applied to many areas and have gained remarkable success in the last several decades [1, 2, 3]. The key of success is how to tune the architecture and connection weights of the ANN for solving the specific problem. The back-propagation (BP) algorithm is the well-known training algorithm for feedforward neural networks. However, the major drawback of the BP is that it may be trapped in local optima and its activation function must be differentiable.

Thus, many evolutionary algorithms, including evolutionary strategies, evolutionary programming, particle swarm optimization (PSO) and genetic algorithms (GA), had been proposed to train the connection weights and the architectures of neural networks. Yao [4] gave an elaborate survey in 1999. Recently, Mendes et al. [5] proposed a particle swarm optimization algorithm for feedforward neural network training. Su et al. [6] also proposed a hybridization model of the PSO and the ANN, called PSO-ANN, for function approximation. Nikolaev and Iba [7] hybridized the genetic programming and the back-propagation algorithm to train the polynomial feedforward neural networks. Leung et al. [8] proposed an improved genetic algorithm that used multiple crossover operators and mutation operators. Palmes et al. [9] presented a new chromosome representation and proposed a mutation-based genetic algorithm for neural network training. Juang [10] hybridized the genetic algorithm and the particle swarm optimization for recurrent network training. Tasi et al. proposed a hybridized algorithm, which combines the Taguchi method