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AN IMPROVED LEARNING OF LOCAL SEARCH FOR FUZZY CONTROLLER NETWORK

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Abstract. *In this paper, we propose an improved version of local search learning for a fuzzy controller network. Local search learning has a reputation for fast convergence and straightforward. However premature convergence makes it unsuitable for optimization problems. Comparison with temporal back propagation and canonical local search showed that the proposed method converges faster and is suitable for fuzzy controller problem.*
Keywords: Fuzzy controller, Local search, Back propagation

1. **Introduction.** The introduction of fuzzy controller by Mandami is a further elaboration to the methodology of vagueness and uncertainty as suggested by Prof. Zadeh [1]. Based on this understanding, fuzzy controllers have successfully been employed for various applications such as information systems, consumer products, industrial process control, medical instrumentation and decision analysis [2, 3, 4]. It has proven to be an effective tool for complicated and imprecise processes because it can easily approximate what human experts perform well under such ill-defined environments when no mathematical formulation is able to define [5]. Despite the advantages of fuzzy controllers, its limitation lies in its inability to tune the membership functions effectively, which can be well accommodated by the learning in neural network [6, 7, 8].

The effort to construct learning algorithms that is able to handle fuzzy controllers automatically has been a on going effort. As reported in [9, 10, 11, 12], temporal back propagation (TBP) learning algorithm has been successfully applied to the training of fuzzy controller systems. This algorithm is based on gradient descent's method of searching the space of weights and aims to minimize the energy function which is normally defined as the sum of squared error. Despite the effectiveness of back propagation, it suffers from slow convergence and being entrapped at local minima in the parameter space [5]. Considering the limitations of BP, many researchers have found evolutionary algorithms based learning such as genetic algorithms (GA) [13] to be a better candidate. Gen and Cheng [14] suggested GA in their efforts to further extend the fuzzy logic technique to adaptively regulate the GA parameter strategy as introduced by Lee and Takagi [15], Xu and Vukovich [16] and Zeng and Rabenasolo [17]. These methods are thought to be a solution for the gradient-based learning algorithms since they are less likely to result in a premature convergence or local minima. However, it has proved to be not so efficient because it results in a very long learning process [18] with complicated process.