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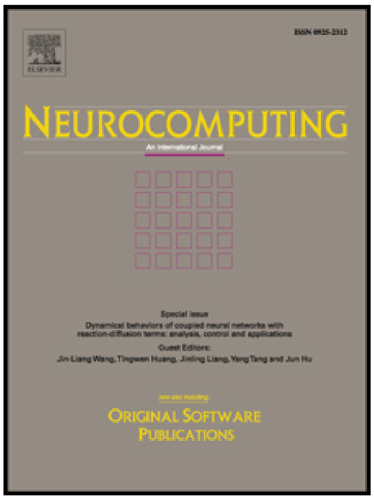

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A Self-Organizing Interval Type-2 Fuzzy-Neural-Network for Modeling Nonlinear Systems

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***Abstract*—Interval Type-2 fuzzy-neural-network (IT2FNN) has been widely used to model nonlinear systems. In current IT2FNN-based schemes, however, one of the main drawbacks is that the structure of IT2FNN is hard to be determined. In this paper, a self-organizing interval Type-2 fuzzy-neural-network (SOIT2FNN) is introduced via considering the structure adjustment and the parameters learning process simultaneously. Two main contributions of SOIT2FNN are summarized: Firstly, an intensity of information transmission algorithm, which can evaluate the independent component contributions of fuzzy rules, is introduced to optimize the structure of SOIT2FNN. Secondly, an adaptive second-order algorithm, which can obtain fast convergence, is developed to adjust the parameters of SOIT2FNN. To demonstrate the merits of SOIT2FNN, several benchmark nonlinear systems and a real world application are examined with comparisons against other existing methods. Moreover, a statistical analysis of the performance results indicates that the proposed SOIT2FNN performs better and is more suitable for modeling nonlinear systems than some existing methods.**

***Index Terms*—Nonlinear system modeling; self-organizing interval Type-2 fuzzy-neural-network; intensity of information transmission algorithm; adaptive second-order algorithm.**

I. INTRODUCTION

IT is well known that most real-world problems are nonlinear, and thus, modeling nonlinear systems has been widely applied to many fields [1]-[3]. Moreover, many different methods have been developed for modeling nonlinear systems, such as nonlinear regression, multivariate statistical method, fuzzy neural network (FNN), and so on [4]-[6]. Among these methods, FNN, owning the advantages of both neural networks and fuzzy systems, i.e., adaptability and high accuracy, has caused wide attention [7]-[9]. Moreover, Type-2 FNNs (T2FNNs), which has been a great success in many real-world problems with the ability to handle uncertainty, have been developed [10]-[12]. However, the current T2FNNs require a preset fixed structure, which reduces learning efficiency significantly for modeling nonlinear systems [13]-[16]. Meanwhile, T2FNNs are more computational expensive than Type-1 FNNs, especially when the structures are large, which may lead to a great performance degradation [17].