Abstract

Fuzzy neural networks are hybrid systems that combine the theories of fuzzy logic and neural network thus can make effective use of easy interpretability as well as superior learning ability.

Compared to type-1 fuzzy logic systems (T1 FLSs), type-2 FLSs have extra mathematical dimensions and they are useful in circumstances where it is difficult to determine an exact MF for a fuzzy set. They can therefore better handle uncertainties. A general type-2 fuzzy neural network (T2FNN) is computational intensive due to the complexity of type-2 to type-1 reduction. Therefore the interval T2FNN (IT2FNN) is adopted in this thesis to simplify the computational process. Also for both systems the learning algorithm is applied to minimize the difference between the desired and actual outputs by adjusting the parameters through iterations.

To illustrate the effectiveness of IT2FNN, these approaches are applied to several problems such as (function approximation, predication, and nonlinear system identification), in comparison with T1FNN; excellent results are obtained by using IT2FNN especially when there is noise in the data.

To increase the efficiency of both systems, a hybrid system that results from combining them with the steady state genetic algorithm is used in order to obtain the optimal architecture and guarantee maximum error reduction through the learning process. Then after the testing, it is found that genetic interval type-2 fuzzy neural network (GIT2FNN) gives better results with simpler structure and faster learning using smaller epochs.