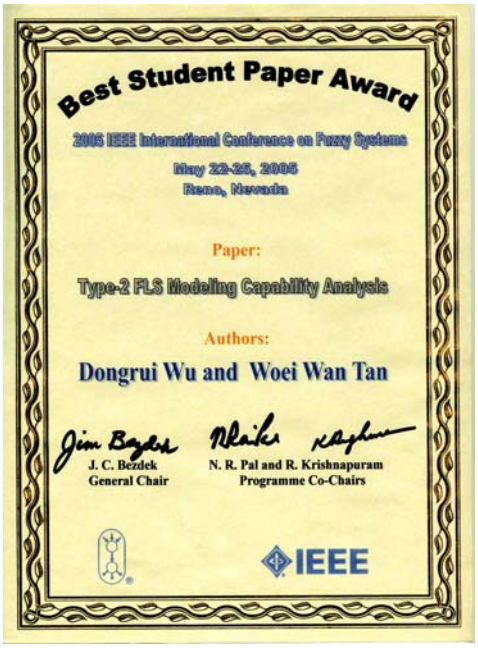
2005 IEEE International Conference on Fuzzy Systems
Best Student Paper Award

Mr Wu Dongrui, a M.Eng student, received the **2005 IEEE International Conference on Fuzzy Systems Best Student Paper Award.** The IEEE International Conference on Fuzzy Systems (FUZZ-IEEE) is a prestigious series of conferences sponsored by the IEEE Computational Intelligence Society. It is held annually and brings together scientists, engineers and practitioners working in fuzzy logic and related areas. FUZZ-IEEE 2005, the 13th conference in the series, was held from May 22-25 2005 in Reno, Nevada, USA. A total of 200 papers were presented at the conference. The title of the winning paper is "Type-2 FLS Modelling Capability Analysis", and it is co-authored with his advisor, Dr Tan Woei Wan.



Currently the most widely used fuzzy logic systems (FLSs) are based on type-1 fuzzy sets, which were proposed by Zadeh in 1965. Fuzzy set theory has been applied to many fields; including but not limited to approximate reasoning, pattern recognition, image processing, vision, data mining, fuzzy mathematics, decision analysis, web mining, software engineering, computing with words, bioinformatics, neural networks, evolutionary computing, control, neuro-fuzzy and other hybrid systems. Though type-1 FLSs have been successful, research has shown that there may be limitations in the ability of type-1 FLSs to model and minimize the effect of uncertainties. One restriction being that a type-1 fuzzy set is certain in the sense that the membership grade for each input is a crisp value.

Type-2 fuzzy set was introduced by Zadeh in 1975 as an extension of the type-1 set. A type-2 fuzzy set (Figure 1) is characterised by a concept called footprint of uncertainty (FOU). Consequently, the membership grade of each element in a type-2 fuzzy set is a fuzzy set in [0, 1], unlike a type-1 set where the membership grade is a crisp number in [0, 1]. FLSs constructed using type-2 fuzzy sets are type-2 FLSs to distinguish them from the traditional type-1 FLSs. Since type-2 FLSs provide an extra mathematical dimension compared with type-1 FLSs, they are very useful in circumstances where it is difficult to determine an exact membership grade for a fuzzy set. Hence, they can be used to handle more system uncertainties and have the potential to outperform their type-1 counterparts. Recently, type-2 FLSs have been attracting more and more interest.

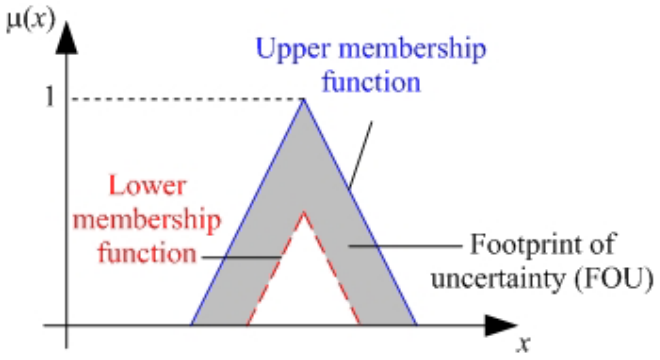


Figure 1 : An interval type-2 fuzzy set

Dongrui Wu and Dr Woei Wan Tan's paper aims at providing insight into how the extra mathematical dimension provided by the FOU differentiates type-2 FLSs from type-1 FLSs. Since the input-output relationships of both types of FLS are fixed once the parameters are selected, the analysis is performed by finding a set of *equivalent type-1 sets* (ET1Ss) that re-produces the input-output map of a type-2 FLS. Results are presented to demonstrate that a type-2 fuzzy system is able to model more complex input-output relationship because the ET1S changes as the input varies. The technique for converting a type-2 fuzzy set into a group of type-1 sets is also useful as it provides a framework for extending the entire wealth of type-1 fuzzy control/identification/design/analysis techniques to type-2 systems.

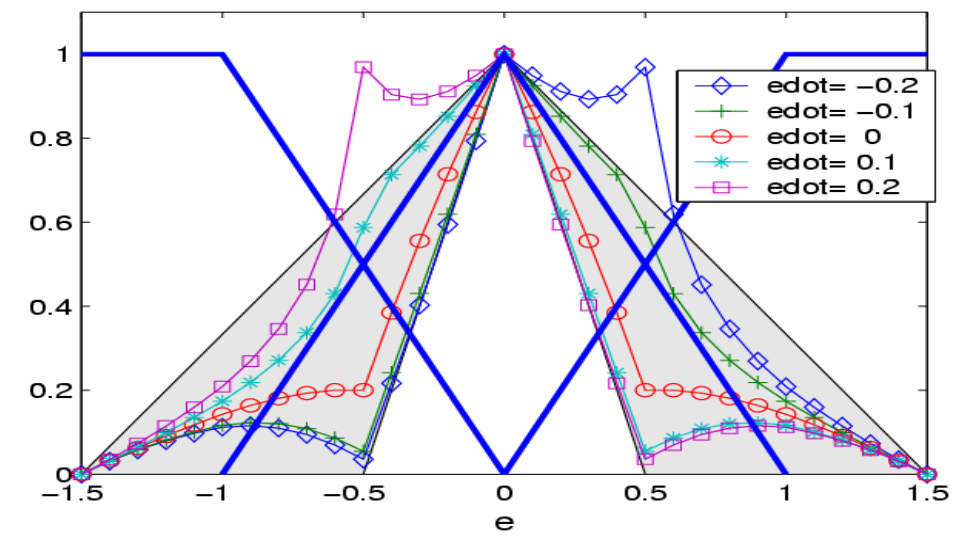


Figure 2 : Illustration of ET1Ss. The ET1Ss can be used to replace the FOUs in a type-2 FLS.