

# **From Interval to General Type-2 Fuzzy Logic Controllers- Towards FLCs that can Better Handle Uncertainties in Real World Applications**

Plenary Talk

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Most real world applications face high levels of uncertainties that can affect the operations of such applications. Hence, there is a need to develop different approaches that can handle the available uncertainties and reduce their effects on the given application. To date, Type-1 Fuzzy Logic Controllers (FLCs) have been applied with great success to many different real world applications. The traditional type-1 FLC which uses crisp type-1 fuzzy sets cannot handle high levels of uncertainties appropriately. Nevertheless it has been shown that higher order Fuzzy Logic Controllers (FLCs) such as interval type-2 FLCs using interval type-2 fuzzy sets can handle such uncertainties better and thus produce a better performance. Through the review of the various interval type-2 FLC applications, it has been shown that as the level of imprecision and uncertainty increases, the interval type-2 FLC will provide a powerful paradigm to handle the high level of uncertainties present in real-world environments. It has been also shown in various applications that the interval type-2 FLCs have given very good and smooth responses that have outperformed their type-1 counterparts. Thus, using interval type-2 FLC in real-world applications can be a better choice since the amount of uncertainty in real systems most of the time is difficult to estimate.

General type-2 FLCs are expected to further extend the interval type-2 FLC capability. However, the immense computational complexities associated with general type-2 FLCs have until recently prevented their application to real world control problems.

This speech will explain the concepts of interval and general type-2 FLCs and will present a new framework to design general type-2 FLC based on the theory of interval type-2 FLC. The proposed approach will lead to a significant reduction in both the complexity and the computational requirements for general type-2 FLCs while offering the capability of representing complex general type-2 fuzzy sets. This speech will explain how the proposed approach can present a way forward for fuzzy systems in real world environments and applications that face high levels of uncertainties. The talk will present different ways to design interval and general type-2 FLCs. The talk will also present the successful application of type-2 FLCs to many real world settings including industrial environments, mobile robots, ambient intelligent environments video congestion control and intelligent decision support systems. The talk will conclude with an overview on the future directions of type-2 FLCs.