Internatinoal Journal of
Intelligent Systems
2001

Shounak Roychowdhury

A Survey of Defuzzification Strategies

Shounak Roychowdhury,[1,*] Witold Pedrycz[2,†]
[1] *Oracle Corporation, 500 Oracle Parkway, Redwood Shores, California 94065*
[2] *Department of Electrical and Computer Engineering, University of Alberta, Edmonton, Alberta, T6G 2G6, Canada*

Defuzzification is an important operation in the theory of fuzzy sets. It transforms a fuzzy set information into a numeric data information. This operation along with the operation of fuzzification is critical to the design of fuzzy systems as both of these operations provide nexus between the fuzzy set domain and the real-valued scalar domain. We need the synergy of both of these domains to solve many of our ill-posed problems effectively. In this paper, we address the problem of defuzzification, we present merits and demerits of various defuzzification strategies that are used in the theory and practice, and in design and implementation of applications involving fuzzy theory, fuzzy control, and fuzzy rule base, and fuzzy inference-based systems. We also present in this paper a simple and yet a novel defuzzification mechanism.

1. INTRODUCTION

Fuzzy control theory has been a very successful pragmatic application of fuzzy set theory. There is no doubt that many researchers are actively involved in this area. Fuzzy control theory effectively handles hard control problems (the ones that are difficult to solve by analytical methods) by using an expert's knowledge base. The knowledge base is expressed in terms of fuzzy rules and these rules are executed through a fuzzy inference engine as shown in Figure 1. Also, in the same figure, we observe that there are two other key components: a fuzzifier and a defuzzifier.

The fuzzifier performs the act of fuzzification—it transforms a numeric value to a fuzzy set. The fuzzification is denoted by $\mathrm{Fuz}(\Re) \rightarrow \mathscr{T}$, where $\Re$ is the domain of real numbers, and $\mathscr{T}$ is a domain of fuzzy sets. The converse of the fuzzification is the process of defuzzification. It transforms a fuzzy set to a numeric value. The defuzzification is denoted by $\mathrm{Def}(\mathscr{T}) \rightarrow \Re$. The inference engine takes a fuzzy set and transforms it by applying a collection of fuzzy rules. In this article, we denote the inference engine as $\mathrm{IE}(\mathscr{T}) \rightarrow \mathscr{T}$. Mamdani's

Roychowdhury, S., & Pedrycz, W. (2001). A survey of defuzzification strategies. International Journal of Intelligent Systems, 16(6), 679–695. https://doi.org/10.1002/int.1030