1 The Concepts of Precisiation and Cointension

Machines cannot think like humans do. As Zadeh states: ”In a one-way communication via natural language between a human (sender) and a machine (recipient), mm-precisiation is a necessity because a machine cannot understand unprecisiated natural language.” [5, 2760]. Because reality is fuzzy, and most concepts in science are fuzzy, a concept need to be translated before machines will be able to understand its meaning. Zadeh explains the different modalities of precisiation and expands on the fact that bivalent logic is often not cointensive. These concepts are explained rigorously in chapter three of the paper. The purpose of the text is to convince the reader of the value that fuzzy logic may offer over a bivalent-logic-based approach, and the importance of the implications for science.

The idea that science is bivalent-logic-based stood out to me. It's true that an hypothesis is proven to be true or false, but the formulation of the hypothesis itself may contain degrees or uncertainties. I'm left wondering why it would be useful to determine the degree to which a proven statement is true or false in science.

In the fifth lecture of Fuzzy Logic, we discussed uncertainty, human reasoning and linguistic modelling. During this lecture, we had a discussion about probability that closely resembles my doubts on this matter. A drink had a membership degree equal to the other drinks probability of being potable. The question was: ”You must drink from the one you choose. Which would you choose to drink from?” [1, slide. 9]. If a drink is potable with a degree of 0.91, is it safe to drink? What about a degree of 0.500001, or 0.499999? Uncertainty could be stated in the hypothesis, for example: given a bottle of water with 0.01% poison, would it be potable? The proposition would by bivalence be true or false. In this case the answer would be more valuable than a degree of truthfulness.
Zadeh states that in large measure, science is bivalent-logic-based, and that because most concepts in science are fuzzy, the bivalent-logic-based definitions are not cointensive [5, 2769]. I agree that this is the case, but I doubt that fuzzy logic is a necessity when it comes to formalizing cointensive definitions of concepts in science. He seems to label scientific concepts with a matter of degree as fuzzy concepts. I also have a strong doubt that scientific questions should be answered with an associated degree of certainty.

The text uses explicit terms, that were often unfamiliar to me, to describe important concepts, forcing me to investigate and broaden my knowledge. The word 'precisiation' may not be found in a dictionary, but Zadeh has defined, used, and expanded upon the concept in preceding chapters and other writings such as [4]. Another term 'cointension' is rigorously explained in the second paragraph of [5, 2760].

The text may not long enough to provide a comprehensive understanding of the topic. But it shows another contribution within the field of fuzzy logic, it's use, and it increased my intuition on the subject.

2 On the Fundamental Differences Between Interval Type-2 and Type-1 Fuzzy Logic Controllers

The interesting bits of this text show some significant arguments that have been made to pin down the differences between T2 and T1 FSs. Each argument is explained and supported by references to approaches used in the comparisons. The text is aimed to help the reader understand the improvements that T2 FSs may have over T1 FSs, by concisely summing up rudimentary differences between the two. In the final part of the introduction, he explains how the rest of his paper is composed.

The second argument of the list in the introduction states: "Using IT2 FSs to represent FLC inputs and outputs will result in the reduction of the rulebase when compared to using T1 FSs" [3], which caught my attention in particular, because rule explosion has been one of the biggest challenges of my project involving fuzzy logic this year. In our project, the amount of input and output variables we defined, depending on the amount of so called features-lists. A more complex in-depth system would depend on more features, and thus increase the amount of input and output variables linearly. Each input and output variable had three membership functions. The number of rules required to cover all possible input variations for a three-term fuzzy controller is 3^n for n feature-lists.

IT2 FSs were brought up during the lectures at the University of Amsterdam, when we were in a later stage of development of the project, but didn't mentioned this particular feat of rule reduction [2].

While I agree with Wu that more input and output domains could be covered with fewer FSs, using the broader footprint of uncertainty, I doubt that this improvement would be beneficial in our solution. A case could be made that a six-term fuzzy controller could have it's number of terms shrunk to four terms, by representing the second and third term by the FOU of the IT2 fuzzy set, and the fourth and fifth term alike. In my opinion, this wouldn't work for a three-term fuzzy controller, because of the inherent uneven shape, and low amount of terms. The end result would either be two terms combined, leaving an asymmetric shape behind, or three terms covered by one single IT2 FS, spoiling the benefits of these mf's all together.

After reading the introduction, I cannot say that my knowledge about the subject has particularly grown. But my interest in the subject has. I've also taken the opportunity to read through some of the other pages of the paper, which seems to contain more concrete material about the subject. The fundamental differences discussed in this paper have broaden my view on the advantages T2 FSs have to offer.

References

[1] A. Bilgin, Lecture 5 - Uncertainty, human reasoning and linguistic modelling, Amsterdam, 2017.

[2] A. Bilgin, Lecture 6 - Types of FL and T2 FS, Amsterdam, 2017.

[3] D. Wu, On the Fundamental Differences Between Interval Type-2 and Type-1 Fuzzy Logic Controllers, in IEEE Transactions on Fuzzy Systems, vol. 20, no. 5, pp. 832-848, Oct. 2012. doi: 10.1109/TFUZZ.2012.2186818.

[4] L.A. Zadeh, "The Concept of Cointensive Precisiation - A key to Mechanization of Natural Language Understanding".

[5] L.A. Zadeh, "Is there a need for fuzzy logic?", In Information Sciences, Volume 178, Issue 13, 2008, Pages 2751-2779, ISSN 0020-0255.