World Academy of Science, Engineering and Technology
International Journal of Computer and Systems Engineering
Vol:17, No:08, 2023

Conflict Resolution in Fuzzy Rule Base Systems Using Temporal Modalities Inference

Authors : Nasser S. Shebka

Abstract : Fuzzy logic is used in complex adaptive systems where classical tools of representing knowledge are unproductive. Nevertheless, the incorporation of fuzzy logic, as it's the case with all artificial intelligence tools, raised some inconsistencies and limitations in dealing with increased complexity systems and rules that apply to real-life situations and hinders the ability of the inference process of such systems, but it also faces some inconsistencies between inferences generated fuzzy rules of complex or imprecise knowledge-based systems. The use of fuzzy logic enhanced the capability of knowledge representation in such applications that requires fuzzy representation of truth values or similar multi-value constant parameters derived from multi-valued logic, which set the basis for the three t-norms and their based connectives which are actually continuous functions and any other continuous t-norm can be described as an ordinal sum of these three basic ones. However, some of the attempts to solve this dilemma were an alteration to fuzzy logic by means of non-monotonic logic, which is used to deal with the defeasible inference of expert systems reasoning, for example, to allow for inference retraction upon additional data. However, even the introduction of non-monotonic fuzzy reasoning faces a major issue of conflict resolution for which many principles were introduced, such as; the specificity principle and the weakest link principle. The aim of our work is to improve the logical representation and functional modelling of AI systems by presenting a method of resolving existing and potential rule conflicts by representing temporal modalities within defeasible inference rule-based systems. Our paper investigates the possibility of resolving fuzzy rules conflict in a non-monotonic fuzzy reasoning-based system by introducing temporal modalities and Kripke's general weak modal logic operators in order to expand its knowledge representation capabilities by means of flexibility in classifying newly generated rules, and hence, resolving potential conflicts between these fuzzy rules. We were able to address the aforementioned problem of our investigation by restructuring the inference process of the fuzzy rule-based system. This is achieved by using time-branching temporal logic in combination with restricted first-order logic quantifiers, as well as propositional logic to represent classical temporal modality operators. The resulting findings not only enhance the flexibility of complex rule-base systems inference process but contributes to the fundamental methods of building rule bases in such a manner that will allow for a wider range of applicable real-life situations derived from a quantitative and qualitative knowledge representational perspective.

Keywords : fuzzy rule-based systems, fuzzy tense inference, intelligent systems, temporal modalities
Conference Title : ICICSAI 2023 : International Conference on Intelligent Computer Systems and Artificial Intelligence
Conference Location : Montreal, Canada
Conference Dates : August 03-04, 2023