Short note on "Nonlinear optimization problem subjected to fuzzy relational equations defined by Dubois-Prade family of t-norms"

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Introduction

Fuzzy relation equation plays an important role in fuzzy logic, fuzzy reasoning, fuzzy comprehensive evaluation, et al. The resolution of fuzzy relation equation system with max-Dubois-Prade composition were investigated in [1]. It has been verified that the complete solution of such a system is fully determined by its unique maximum solution and a finite number of minimal solutions. In fact, solving the fuzzy relation system is equivalent to obtaining all its minimal solutions. In [1], the authors provided an approach to find all the minimal solutions. However, it is found that their proposed approach is ineffective in some cases.

Phenomenon

In Ref. [1], the authors defined the index sets $J_1, J_2, \ldots, J_n$. Based in these index sets, they provided an approach for obtaining all the minimal solutions of a system of fuzzy relation equations with max-Dubois-Prade composition. However, as shown in Example 1, the vector obtained by the method in [1] might not be a minimal solution.

Reason

Let $E = J_1 \times J_2 \times \cdots \times J_m$. As shown in [1], a corresponding vector X(e) could be generated by each e in the set E. Moreover, it is asserted in [1] that X(e) is a minimal solution of the fuzzy relation equation system. However, this assertion is incorrect. The condition that makes the assertion valid is that the inequality "$X(e) \le X^{max}$" holds, X^{max} where represents the maximum solution. But this inequality doesn't hold for some specific cases (see Example 1).

Correction

Let $E= J_1 \times J_2 \times \ldots \times J_n$. In this paper, we have modified the expression of the index sets J_1, J_2, …, J_n in [1]. The corresponding corrected index sets were denoted by $J_1^=, J_2^=, \ldots, J_n^=$ in this paper. Let $E^= = J_1^= \times J_2^= \times \cdots \times J_m^=$. It was formally proved that for each $e \in E^=$, the corresponding vector X(e) is a solution of the fuzzy relation equation system with max-Dubois-Prade composition. As a result, the complete solution of such a system is exactly the union set $\{ [X(e), X^{max}] \mid e \in E^= \}$. Hence we corrected the method proposed in [1] for solving the fuzzy relation equations with max-Dubois-Prade composition.

Conclusions

This short note aims to make some modification for improving the results presented in [1]. A. Ghodousian et al. discussed the resolution of a system of max-Dubois-Prade fuzzy relation equations based on their proposed index sets J_i, $i \in I$. It is found that not every $e \in E = J_1 \times J_2 \times \cdots \times J_m$ corresponds to a solution. To overcome this flaw, we modify the expression of the index sets, denoted by $J_i^=$, $i \in I$. Based on the modified index sets, resolution of the max-Dubois-Prade fuzzy relation equations becomes easier, regarding the computational cost.