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A framework for analysis of extended fuzzy logic

Key words: Extended fuzzy logic, Fuzzy logic, *f*-Transformation, *S*-answer, Validity

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Introduction

- Fuzzy logic is a fascinating and dynamic field of study and research.
- What remains widely unrecognized is that, results in fuzzy logic carry a necessary condition of being provably valid.
- Many real world applications do not satisfy this condition.
- The validity term is added to fuzzy logic to meet this condition, which leads to extended fuzzy logic (FLe).

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Objective of this study

Studying FLe-based reasoning in mathematical detail

Proving structural isomorphism between the answers and their validities

Proving the representation theorem about problems in *C* and solutions in *f*-*C*

To show that in the presence of imperfect information, the solutions obtained are near the true ones when applying FLe

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FLe's basic terminology

- ***f*-Transformation**: a map of one-to-many.
- **Validation principle**: *f-p* has a high validity index.
- **Cointensive assumption**: *f-C* is close-fitting to its true prototype, *C*.
- **P/I principle:** $h(f\text{-}C)\ f\text{-}= f\text{-}h(C)$.
- ***S*-answer:** the centroid of the relevant *f*-answer.
- **A-granule:** the smallest granule that contains the *f*-transform of the object.

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Major results (I)

Theorem 1 Suppose Q is an A-granule, f-$s_i(P)$ the f-answer of problem P, s_i the S-answer, v_{si} a validity measure, d a bounded positive quantity, $f\text{-}s_i(P)\big|_{v_{s_i(P)}}=s_i(P)$, i=1, 2 and $\|s_1(Q)-s_2(Q)\|<d$. Then $\|s_1(P)-s_2(P)\|<f\text{-}d$, where f-d is the f-transform of d and is bounded and positive.

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Major results (II)

Theorem 2 Suppose Q is an A-granule, v a validity measure, f-$s_i(P)$ the f-answer of problem P, s_i the S-answer, $f\text{-}s_i(P)\big|_{v_{s_i(P)}} = s_i(P)$, S_i the solution in the C-space, $F_Q(S_i)$ the functional of S_i with respect to Q such that $F_Q(S_i) = f\text{-}s_i(Q)\big|_{v_{s_i(Q)}} = s_i(Q)$, and $v(\|F_Q(S_1)-F_Q(S_2)\|<d)>\delta$, where i=1, 2, and δ, d are positive quantities and are bounded. Then there exists a positive quantity ρ different from δ such that $v(\|s_1(P)-s_2(P)\|<d)>\rho$.

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Major results (III)

Theorem 3 For a problem P on C through f-transformation, there exists a function $s(P)$ defined in f-C that is the centroid (precisiated) of the f-transform of $S(P)$, where $S(P)$ is the solution of problem P on C and $s(P)$ is the best approximation of $S(P)$ in terms of similarity.

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