

*Recent Developments in  
Fuzzy Set & Possibility Theory*

Résumé on Dealing with Uncertainty/Ambiguity  
in Conjunction with Knowledge Engineering

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There may exist several types of methodology for dealing with uncertainty/ambiguity in accordance with the classes of its nature accompanied with phenomena, events or matters encountered in the real world.

In the present paper resumed are the schemes for representing ambiguity or uncertainty along with the classification of its nature, and emphasized is the following remark that knowledge-engineering-oriented approach will be of significance and of benefit to dealing with uncertainty/ambiguity in some classes where fuzzy-set-theoretic approach may not always be much well applicable.

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Full Textは当日別刷として当方が用意致します。当日出席以外の方で、特に御入用の方は当方へ連絡下されば10名位の方の余分は用意しておきます。なお、それ以外の入手方法としてはProce. of Int'l Congress on Applied Systems Research and Cybernetics, Dec. 12-15, 1980, Acapulco, Mexicoに招待論文として掲載されていますので下記に御連絡下さい。

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| CLASS OF AMBIGUITY                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | METHODOLOGY used                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | BACKGROUND                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>[A] UNCERTAINTY/RANDOMNESS</p> <p>(a) Events and/or Their Surroundings governed by RANDOMNESS.</p> <p>(b) Phenomena that will not be analyzable and measurable in an unlimitedly precise manner.</p> <p>[B] FUZZINESS</p> <p>(a) FUZZINESS based on Subjectivity or Personality of Individuals</p> <p>(b) FUZZINESS or AMBIGUITY accompanied with Thinking or Inference</p> <p>(i) FUZZY or Inexact Inference</p> <p>(ii) AMBIGUITY owing to Complexity and/or Diversity of Inference</p> <p>[C] FUZZINESS or AMBIGUITY accompanied with Natural Languages</p> <p>(a) FUZZINESS of Description or Representation</p> <p>(b) AMBIGUITY due to Complexity and/or Diversity of Semantics and/or Structures of Natural Languages</p> <p>[D] BLUR or VAGUENESS accompanied with Figures, Pictures and Scenes</p> <p>(a) BLUR of Figures and Pictures</p> <p>(b) VAGUENESS encountered in the course of Interpretation of Figures and Pictures</p> <p>[E] IMPRECISION owing to Structural Complexity and/or Diversity of Information</p> | <p>Theory of Stochastic Process &amp; Theory of Decision-making/Entropic Measure</p> <p>Principle of UNCERTAINTY</p> <p>Fuzzy Set Theory/Subjective Probability Theory</p> <p>Theory of Fuzzy or Approximate Reasoning</p> <p>Invocation of Knowledge Engineering -oriented Approach</p> <p>Fuzzy Set Theory/Fuzzy Logic/Modal Logic</p> <p>Semantics of Information</p> <p>Filtering Technique/Relaxation Operations*</p> <p>Image Interpretation Technique</p> <p>Structural Modelling Technique</p> | <p>Theory of Probability</p> <p>Quantum Mechanics</p> <p>Lukasiewicz' Infinitely-valued Logic</p> <p>Fuzzy Logic (Linguistic Truth Value Logic)/ Propositional Calculus/Predicate Calculus</p> <p>AI Approach backed up by Cognitive Science</p> <p>Knowledge Representation Technique backed up by AI Theory</p> <p>Theory of Stochastic Process</p> <p>*Iterated Parallel Operations by Rosenfeld, A.</p> <p>Knowledge Representation Technique/AI Approach</p> <p>DELEI, PATTERN, ISM, DEMATEL, KJ FSM(Fuzzy Structural Modelling), F-PATTERN(Fuzzy PATTERN METHOD)</p> |

Table 1. Methodologies for Dealing with Uncertainty, Ambiguity, Fuzziness and Imprecision.

|                              | A'                    | B'                    |
|------------------------------|-----------------------|-----------------------|
| Relation I<br>(modus ponens) | A                     | B                     |
| Relation II-1                | <u>very A</u>         | <u>very B</u>         |
| Relation II-2                | <u>very A</u>         | B                     |
| Relation III-1               | <u>more or less A</u> | <u>more or less B</u> |
| Relation III-2               | <u>more or less A</u> | B                     |
| Relation IV-1                | <u>not A</u>          | <u>unknown</u>        |
| Relation IV-2                | <u>not A</u>          | <u>not B</u>          |

Table 2(a) Relations between A' (Ant 2) and B' (Cons) under Ant 1 for the Generalized Modus Ponens in (1)

|                               | B'                        | A'                        |
|-------------------------------|---------------------------|---------------------------|
| Relation V<br>(modus tollens) | <u>not B</u>              | <u>not A</u>              |
| Relation VI                   | <u>not very B</u>         | <u>not very A</u>         |
| Relation VII                  | <u>not more or less B</u> | <u>not more or less A</u> |
| Relation VIII-1               | B                         | <u>unknown</u>            |
| Relation VIII-2               | B                         | A                         |

Table 2(b) Relations between B' (Ant 2) and A' (Cons) under Ant 1 for the Generalized Modus Tollens in (2)

|                               | Ant 2                     | Cons                      | R <sub>m</sub> | R <sub>a</sub> | R <sub>c</sub> | R <sub>s</sub> | R <sub>g</sub> | R <sub>sg</sub> | R <sub>gg</sub> |
|-------------------------------|---------------------------|---------------------------|----------------|----------------|----------------|----------------|----------------|-----------------|-----------------|
| Relation I<br>(modus ponens)  | A                         | B                         | X              | X              | 0              | 0              | 0              | 0               | 0               |
| Relation II-1                 | <u>very A</u>             | <u>very B</u>             | X              | X              | X              | 0              | X              | 0               | X               |
| Relation II-2                 | <u>very A</u>             | B                         | X              | X              | 0              | X              | 0              | X               | 0               |
| Relation III-1                | <u>more or less A</u>     | <u>more or less B</u>     | X              | X              | X              | 0              | 0              | 0               | 0               |
| Relation III-2                | <u>more or less A</u>     | B                         | X              | X              | 0              | X              | X              | X               | X               |
| Relation IV-1                 | <u>not A</u>              | <u>unknown</u>            | 0              | 0              | X              | 0              | 0              | X               | X               |
| Relation IV-2                 | <u>not A</u>              | <u>not B</u>              | X              | X              | X              | X              | X              | 0               | 0               |
| Relation V<br>(modus tollens) | <u>not B</u>              | <u>not A</u>              | X              | X              | X              | 0              | X              | 0               | X               |
| Relation VI                   | <u>not very B</u>         | <u>not very A</u>         | X              | X              | X              | 0              | X              | 0               | X               |
| Relation VII                  | <u>not more or less B</u> | <u>not more or less A</u> | X              | X              | X              | 0              | X              | 0               | X               |
| Relation VIII-1               | B                         | <u>unknown</u>            | X              | 0              | X              | 0              | 0              | X               | X               |
| Relation VIII-2               | B                         | A                         | X              | X              | 0              | X              | X              | X               | X               |

Table 3. Satisfaction of Each Relation in Tables 2(a) and (b) under Each Method