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CONCEPTION AND IMPLEMENTATION OF THE INFERENCE SYSTEM WITH PROBABILISTIC-FUZZY KNOWLEDGE BASE

Abstract: The paper describes the conception and implementation in the Matlab environment of the MISO inference system with knowledge base containing weighted IF-THEN rules. The main notes on system constructing and working have been presented.

Knowledge base systems are an alternative for systems based on models and traditional numerical algorithms. They have been used for several years with issues concerning control, diagnostics, identification, or decision making – in situations, where information on a given field contain certain types of uncertainty.

The aim of this paper is to present the concept of an inference system with a knowledge base [1], which allows for uncertainty of information in probabilistic and fuzzy categories at the same time, for modelling a wide variety of issues. The knowledge base of such system contains a representation of linguistic knowledge of a given issue ($A_o^{(1)},...,A_o^{(N)},B_{1/o},...,B_{L/o}$) and the probability of an event in linguistic categories ($w_o,w_{1/o},...,w_{L/o}$), due to placing it in the form of the following file rules [4]:

IF $x_1 is\ A_o^{(1)}$ and ... and $x_N is\ A_o^{(N)}$ with w_o, then $y\ is\ B_{1/o}$ with $w_{1/o}$ ... also $y\ is\ B_{l/o}$ with $w_{l/o}$ … also $y\ is\ B_{L/o}$ with $w_{L/o}$. (1)

Generating a knowledge base is one of the key elements of conceptual assumptions of the model. Rule generating algorithms have been tested for searching the space of variables, structure of the obtained model as well as time of creating the model and inference time on the basis of a given model. Apart from an algorithm generating full probability distribution of fuzzy events, what has been suggested is the use of methods searching fuzzy association rules, by modification of Apriori and FP-Growth algorithms. Calculation methods give identical results in the form of a knowledge base, but they are performed in different times. The parameter of minimum support used in the calculations allows to limit the number of rules in the knowledge base and reduce the time of its generation. Research has shown that limiting the number of rules does not significantly affect the precision of real system modelling. Only exceeding a certain minimum support threshold makes the system unable to create a reality model and averages results.

The developed inference block allows one to receive answers on the basis of the knowledge base and new facts with consideration of uncertainty concerning fuzziness and randomness at the same time. The inference method was applied in accordance with *generalized modus ponendo ponens*, and complying with *First Infer Then Aggregate* [2]. In order to match the model to various empirical data different rules interpretations were enabled (according to Mamdani, Larsen and logical interpretation of rules), as well as the choice of a defuzzification method.

The presented system has been implemented in Matlab environment, that enables testing it with the use of ready functions as well as the interface (Fig.1). Matrix implementation of rule generating algorithms allows one to reduce the time of calculations. However, significant memory use makes the tool suitable for systems with a small number of variables.

Due to its specification the created fuzzy inference system may be applied in identification of both statistic and dynamic properties of real probabilistic systems [1, 3].

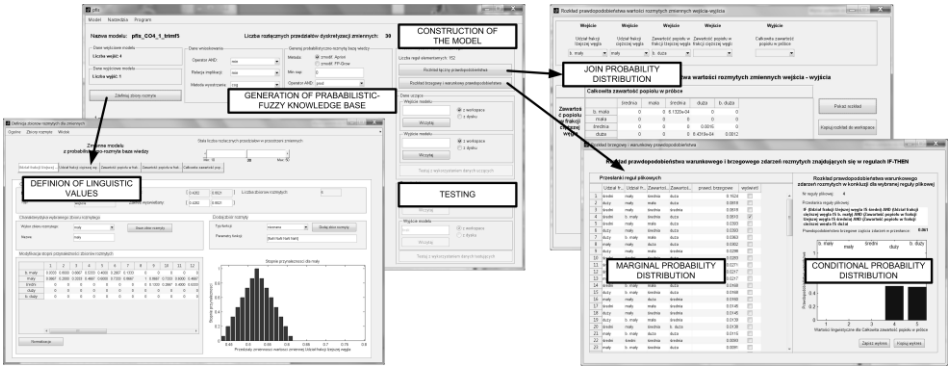

Fig. 1. Interface displaying information about states of work of the inference system with probabilistic-fuzzy knowledge base (implemented in Matlab)

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