GALAXY INTERNATIONAL INTERDISCIPLINARY RESEARCH JOURNAL (GIIRJ)
ISSN (E): 2347-6915
Vol. 11, Issue 2, Feb. (2023)

ADVANTAGES OF FUZZY CONTROL. FUZZY CONTROLLER WITH TWO BASIC RULES

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ABSTRACT

Fuzzy logic is reminiscent of a human decision-making methodology. It deals with vague and inaccurate information. This is a gross simplification of real world problems based on degrees of truth rather than the usual true/false or 1/0 like Boolean logic. In other words, we can say that fuzzy logic is not fuzzy logic, but logic that is used to describe fuzziness. There can be many similar examples, with the help of which we can understand the concept of fuzzy logic.

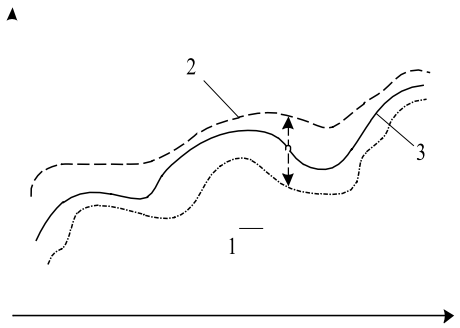
Keywords: fuzzy controller, fuzzy logic, values, temperature, conceptual models.

The main advantages of fuzzy management are the applicability of expert knowledge in an explicit form, high speed, smooth implementation of multidimensional essentially nonlinear dependencies.

A fuzzy regulator is a multidimensional nonlinear static element. To synthesize HP, it is enough to determine its desired static characteristic and adjust it so that it coincides with the required [2 – 4]. Now there is a problem because the fuzzy regulator is not accurate. To solve this problem, a fuzzy regulator with a double base of rules was developed.

In connection with the change in the structure of the fuzzy regulator, the task of developing an algorithm for its synthesis arose. This article discusses two fuzzy regulator synthesis algorithms, fuzzy synthesis, and fuzzy regulator training.

A fuzzy regulator with a double base of rules can be represented as two classic fuzzy regulators using the same linguistic variables. The static characteristic of one of them is always slightly lower than the required characteristic, and the second is slightly higher. These fuzzy regulators can be represented as two "experts" (Fig. 1), one of which always reduces the control effect, and the second always slightly increases it. When you are on the right static characteristic and look at these "experts", you see them from opposite sides. "Experts" begin to "argue"; as a result, they come to a solution that will be closer to each of them to the desired value. If an "arbitration" system is introduced in the process of "dispute", then he will begin to trust some of the "experts" more. If the "arbitrator" is right, the "experts" will come to the desired decision. The weights of individual rules can be used as a "referee".

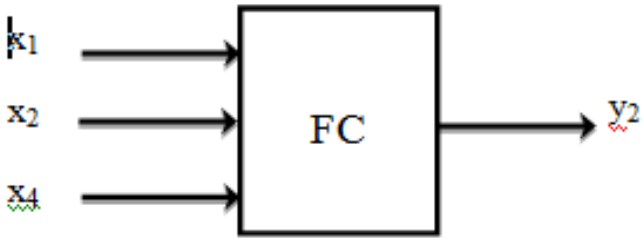


Rice. 1. Fuzzy conclusion with two "experts".
1 – "Expert 1", 2 – "Expert 2", 3 – the desired static characteristic.

As a result, while maintaining high performance, fuzzy control can be obtained with precision adjustable by the computer system on which it is performed. This new quality can be explained by the dialectical law of unity and the struggle of opposites. Unity is a single structure, goals, initial data, a similar result. The conflict of opposites lies in the fact that each base of rules pulls the result in a different direction in relation to the desired.Before proceeding to the synthesis of a fuzzy regulator (HP), it is necessary to develop its conceptual models for each output. The conceptual model shows the influence of input signals (sensor values) on the result of the fuzzy regulator - the value of its output. This model can be represented either graphically (Fig. 2) or analytically.In analytical form, it is enough to represent the dependence of the output on the input as follows (for the same Fuzzy Controller):

$$and_2=f(x\ 1.x_{\ 2.x\ 4}) \quad (1)$$

In either case, you only need to specify the fuzzy controller inputs that should affect its output. At the same time, the input of the woofer regulator, if necessary, can be fed the values of its outputs, as well as derivatives (or increments of the value per 1 cycle) to the input of the woofer regulator to give them certain dynamic properties. fuzzy controller. Once all conceptual models have been compiled, they can be combined into a fuzzy regulator. If the inputs of different HP do not match, the feasibility of combining should be checked experimentally (system performance is chosen as a criterion).



Rice. 2. Conceptual model

The collection of expert information is possible in two ways:

1) Conducting an experiment;
2) Analysis of existing information.

In any case, it is necessary to describe the measurement ranges of all the parameters involved in the fuzzy regulator. After that, values (reference points) are selected in each range from five to seven. The maximum and minimum input values of the fuzzy regulator are always control points.In the case of an experiment, these values can be distributed evenly or in the presence of extremes or points of significant dispersion affecting the output, then the values along the

abscissa axis of these points are taken into account. After selecting all the reference points to the optimal values of the fuzzy regulator, the outputs should be selected by conducting an experiment. An experiment can be automated if a well-described mathematical model is available.

When analyzing the available data (experimental data), reference points are selected by dividing the values of the input signals into groups. In the extreme groups, both the minimum and maximum values for the left and right groups, respectively, are selected as reference points. For the remaining groups, their middle reference points are selected. When populating the anchor point table, the value of the nearest point in the experimental data is taken as the output value. As the nearest point, you can take the expected value using the apparatus of mathematical statistics, or a point that has the shortest distance to the reference point. It is also possible to synthesize a fuzzy Mamdani regulator. After hp synthesis, he is trained on experimental data.

As a result of collecting expert information for each fuzzy regulator, a table of reference points can be obtained (Table. I). The table of reference points should describe the entire area of the entrances of the fuzzy regulator. In the example, the input ranges of the fuzzy controller change from 0 to 10. The table of anchor points consists of two parts: the left one describes the inputs, the right one describes the outputs.

Table I. Anchor Point Table

x1	x2	x4	and2	and5
0	0	0	5	0
0	0	2	0	3
…	…	…	…	…
10	10	10	1	5

If it is impossible to fill all reference points, the output value of fuzzy control should be based on the condition of monotony and smoothness of the static characteristic. That is, you need to see the value of neighboring anchor points and choose the value that lies between them.

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