

Software for Definition and Simulation of Fuzzy Controllers

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Abstract: A software is presented for the definition and simulation of fuzzy controllers, in which the user defines the parameters that determine the controller. The constant simulation and in their defect adaptation, they allow to evaluate it, for what is considered to the software like a didactic tool in the area of the control.

1 Introduction

Fuzzy Logic has been applied in fields such as process control, images recognition, robotics and expert systems. Fuzzy Control is the first successful industrial application of fuzzy logic [1].

Fuzzy Control primarily refers to the control of processes through fuzzy linguistic descriptions [2]. The aim of controller is to incorporate expert human knowledge in the control algorithm.

A fuzzy controller is that controls processes by means of a fuzzy algorithm; to design it consists on to generate and to simulate this algorithm starting from the following sequence of steps:

- To determine the variables and linguistic values.
- To define the membership functions.
- To establish the fuzzy rules.
- For each entrance value to determine the degree of membership of the linguistic value (Fuzification).
- For each rule to determine the degree of the consequent and the linguistic output value (Inference).
- To calculate the output value (Defuzzification).

The use of the software is directed to users that familiarized in the atmosphere of windows, have the intention of experiencing the design and simulation of a fuzzy

algorithm. The software will request the necessary data to define the fuzzy controller in a sequential way and for the simulation the entrance data that the user provides will be evaluated directly or detailing the process. The diffuse controllers that are defined can be stored in a file for their future observations.

The uses of this software is directed to expert users in the windows environment, which had intention of

The application of the diffuse logic in the control area has proposed from its model several beginnings for the definition of a fuzzy algorithm, for what is important to conserve the following points:

- The definition of membership functions with triangular form.
- Minimum two linguistic variables of entrance and one of exit.
- For the inference of exit values the use of the composition max - min, the implication operator Mandani - min and the method of defuzificación centroide.

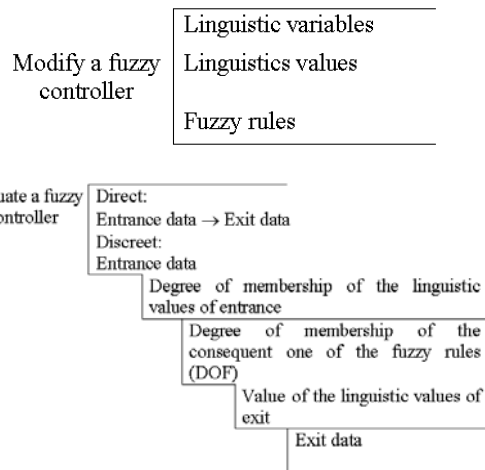
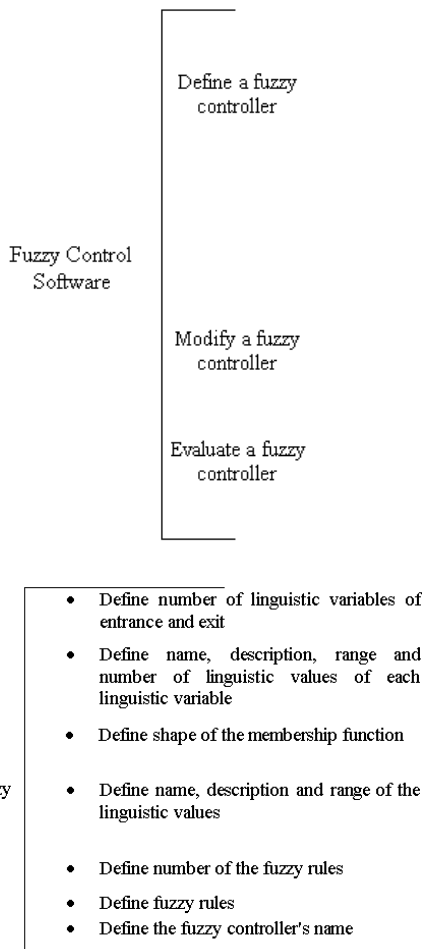
2 Formulation of the Problem

The development of a control system based on fuzzy logic requires before putting it into practice, to simulate the best thing possible its operation, this obeys to that the results are not completely predictable and many times it is required of adjustments in the fuzzy rules

before finding the appropriate parameters [2]. The most important applications have been developed by the experimentation of the system to control using software that simulates the behavior. When one has the wanted behavior, the controller is materialized so that it operates in the wanted atmosphere. For the above-mentioned, a software is needed where the user defines the values that determine a fuzzy controller and he can simulate his response to different entrance values.

3 Solution of the Problem

A software for the development of fuzzy controllers basically should allow the definition and simulation. The general outline is the following one:



For the development of the Software of Diffuse Control the Visual environment J++ 6.0 was used that allowed to generate the following forms:

For the controller's definition, they are accepted as maximum 5 input variables and two of output (Fig. 1).

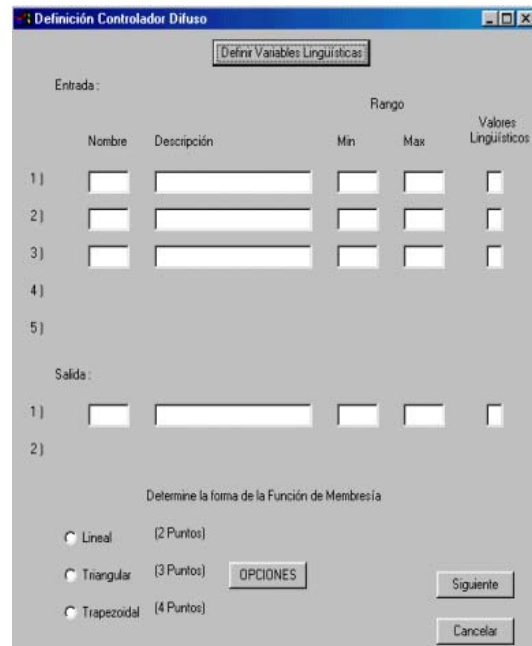


Fig.1

The data of the linguistic variables should be given when one gives clic in the button to Define Linguistic Variables, the maximum number of linguistic values for variable is 5. The name will be an abbreviation of maximum three letters of the linguistic variable. The form of the

membership function should be determined, together it is a button to see the possible combinations in the established ways (Lineal, Triangular and Trapezoidal). When giving clic in the **Next** button if the data are characteristic to the system, the following window opens up, otherwise the error messages are shown (Fig. 2).

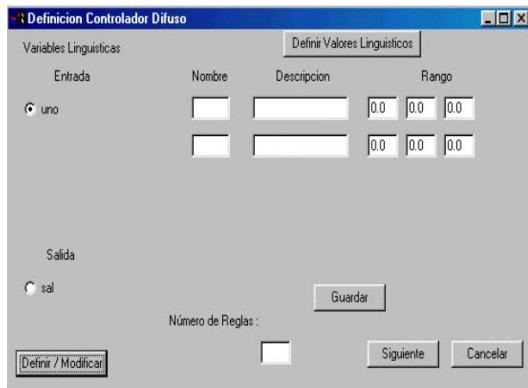


Fig. 2

When giving clic in the button to **Define Linguistic Values** the defined variables they appear, in the inferior part a button to define or to show the values of the selected variable, the data are stored when one gives clic in the button **Keep**. In the inferior part it is a field to give the number of rules to define (maximum 25, Fig.3).



Fig. 3

To conclude the controller's definition the system of rules it is generated, the values should only be given of having entered the variables then they are fixed. According to the number of rules one is chosen of them and the corresponding data are inserted, when concluding all, the controller's name is written and the process is finished when giving clic in the button to Finish returning to the beginning menu.

For the evaluation a window appears where the controller's name to evaluate is chosen, once selected it is determined the option to carry out: to **Detail** or **Direct**.



Fig. 4

The form to **Detail** works in the following way: when pressing the button **Start** (Fig. 4) the fields characteristic of the controller's entrance data are activated, when writing them the following option it is the button **Membership Degrees** that will show in the window the degree corresponding of the membership functions to the given data; the **Consequent** button is activated that will allow to see which you rule they were "shot" for the entrance data what the DOF of the rule represents; now the button **Exit Values** is activated that shows in the window which it is the degree that corresponds to the values of the membership functions of exit that contribute to the final value that is the last button in being activated to provide the name and exit value.

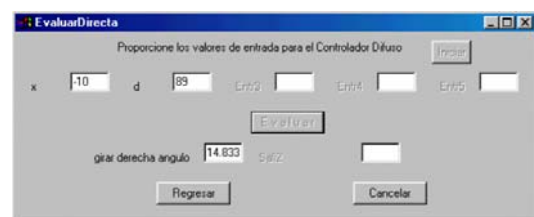


Fig. 5

In the Direct evaluation when giving clic in the button **Start** activate the necessary fields for the entrance data as well as the button **Evaluate** that when pressing it will give the name and exit value (Fig. 5).

To modify the controller, the options to change they are: variables, linguistic values and the fuzzy rules, when the option was chosen, clic in the **Next** button and they are carried out the changes in the same way

that they are defined or the window is canceled returning to the beginning menu; the figures 6, 7 and 8 show it.

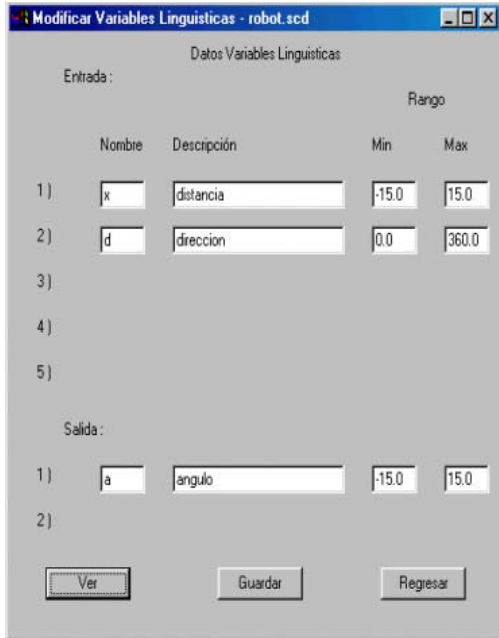


Fig. 6

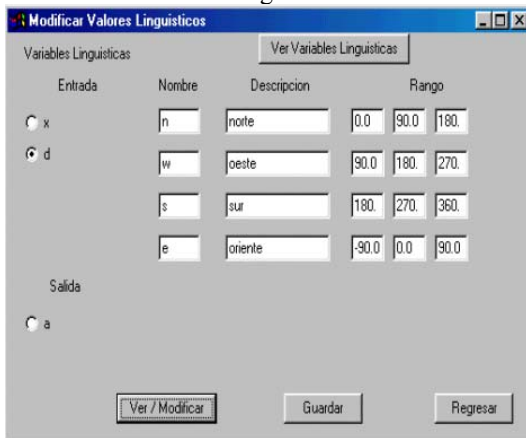


Fig. 7



Fig. 8

4 Conclusion

A software was developed able to illustrate the form commonly used to define and to evaluate a fuzzy controller, that is to say, the operative operation for the inference.

Development to software that dog the techniques were used but used

The most commonly methods were used to evaluate the controller: the method of composition max-min, the implication operator Mandani - min and the method of defuzzification centroide.

The data can be seen obtained in each one of the stages of the evaluation confirming the result and finally the characterized fuzzy controller can be stored in a file for their future references.

The number of the fuzzy applications continues being increased every year, generating a great incentive to the investigators dedicated to the development of the fuzzy control. The necessity of the feigned experimentation exists, because it was not possible to embrace the whole theory and existent methods, at the moment this it is the first version of the software and it is our intention to continue with its growth.

References:

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