

UNFUZZY: Fuzzy Logic System analysis, design, simulation and implementation software

Oscar G. Duarte

Department of Electrical Engineering
Universidad Nacional de Colombia
Ciudad Universitaria Ed 453 Of.202
Bogotá . Colombia
ogduarte@ingenieria.ingsala.unal.edu.co

Gustavo Pérez

Department of Electrical Engineering
Universidad Nacional de Colombia
Ciudad Universitaria Ed 453 Of.202
Bogotá . Colombia
gustavo@ingenieria.ingsala.unal.edu.co

Abstract

In this paper we show a free distribution software tool useful for analysis, design, simulation and implementation of Fuzzy Logic Systems (FLS); we have called it UNFUZZY. It runs in operative system Windows 32bits, and helps the user in the task of FLS design through a graphical interface. The package has also two different training algorithms, and is able to generate source code in C and C++ language, so the user can implement in software the FLS. We also show in brief some of the applications we have had notice.

Keywords:Fuzzy Logic Systems, Fuzzy Controllers, Software

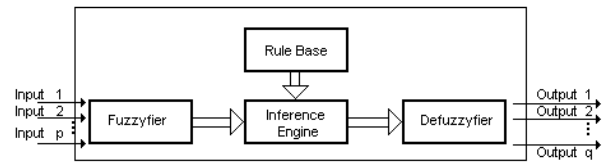


Figure 1: Fuzzy Logic System.

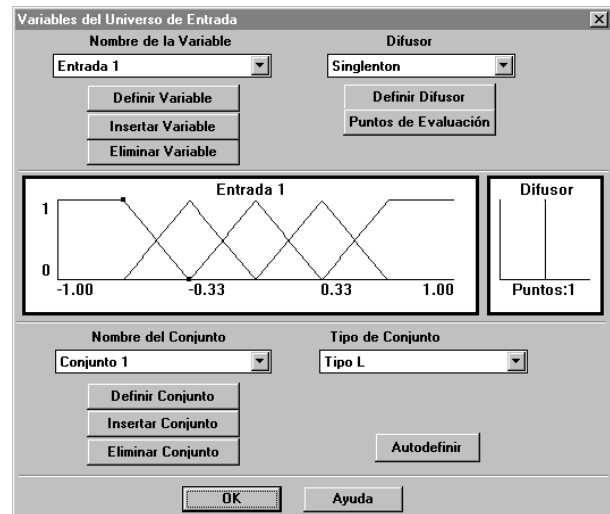


Figure 2: Graphicak interface

1 INTRODUCTION

UNFUZZY¹ is a free distribution software tool , whose main purpose is to make easier some usual tasks related with Fuzzy Logic Systems (FLS) analisis, design, simulation and implementation. It runs on Windows 32 bits, and is capable to manipulate to FLS with an internal structure as shown in figure 1. The main aim of this paper is to divulgate the UNFUZZY scope and to enumerate some of the applications that different users have reported us.

2 DESIGN OPTIONS

Fuzzy Logis System design is made using the graphical interface of UNFUZZY (see figure 2). The design options of UNFUZZY are listed below:

- Unlimited number of input and output variables.
- Unlimited number of labels in every linguistic variable
- 9 types of membership functions for every label
- 5 types of fuzzyfication operators for the input variables

¹This package has been developed at the Engineering Faculty of National University of Colombia (Universidad

Nacional de Colombia), and is free available in internet at address <http://ohm.ingsala.unal.edu.co/ogduarte>

- 5 types of defuzzification operators for the output variables
- 9 implication operators
- 9 AND operators
- 9 composition operators
- 13 agregation operators
- Rule base is inherently coherent
- In every rule, the antecedent terms may have linguistic hedges.
- Input and output variables can be auto- defined with an usual partition.
- Rule base can be auto-defined using increasing, decreasing or constant tendencies.

3 FLS DESIGN USING TRAINING ALGORITHMS

UNFUZZY has two different training algorithms for automation FLS design

- Fixed Universes: it is a descriptive algorithm proposed by Wang & Mendel [13]; user can get a rule base from a set of training patterns; user must design previously the other components of the FLS.
- Variable Universes: it is an aproximative algorithm proposed by Wang [7]; user can get the labels of the input and output variables, as well as the rule base, from a set of training patterns; user must design previously the other components of the FLS.

4 ANALYSIS AND SIMULTION TOOLS

UNFUZZY has the followign analysis and simulation tools:

- It calculates the crisp outputs for a set of crisp inputs
- It makes the previous calculus using an Step by Step procedure with graphical views (see figure 3).
- It generates Input-Output tables
- It shows graphically the Input-Output relation. Graphics are bidimensional, so user can do sensibility analysis (see figure 4).

- It creates a text file with a description of the FLS.

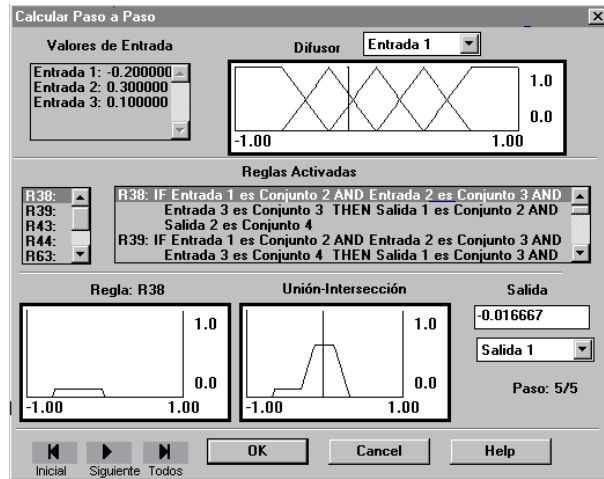


Figure 3: Step by setp analysis

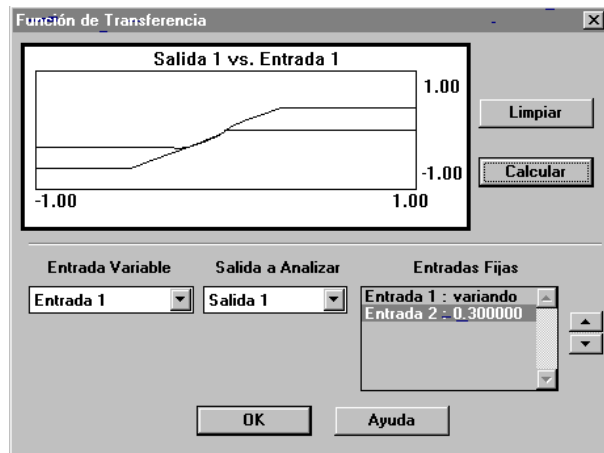


Figure 4: Transfer function

5 IMPLEMENTATION

UNFUZZY makes easy software implementation, because it generates source code; this source code can be:

- Structurated code using C language: the functions and procedures, and a brief demonstrative program are written in the same file. The program shows how to use the routines.

- Object Oriented code using C++: A constructor of the FLS class and a brief demonstrative program are written in the same file. The user gives the class name; this class inherits properties and functions from a more generic class that is specified in two different files (available with UNFUZZY). If user chooses Object Oriented code, then he/she can use the training algorithms explained in the previous section.

Structured code is a good option for those users with a low programming level; in the other hand, Object Oriented code is very useful if the application has two or more FLS.

6 APPLICATIONS

Since september 1997, when release 1.0 was developed, we have received some messages from the users of UNFUZZY. According to these messages, the package has been used at least in Colombia, Venezuela, Cuba, Brasil, Ecuador, Bolivia, Chile, Argentina, Mexico, Spain, Italy, Canada and USA (see figure 5).

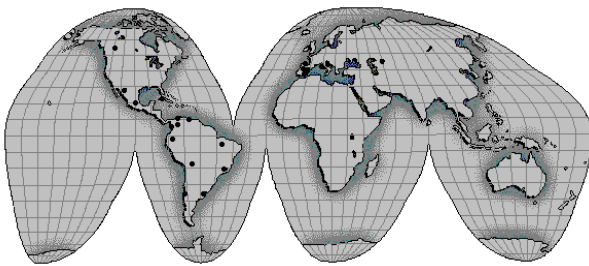


Figure 5: Impact of UNFUZZY

Some of the applications that has been reported are listed below:

- Controllers design:
 - Air conditioning control
 - Control to cure tobacco
 - Industrial oven control
- Fuzzy control hardware:
 - contrasting results
- Robotics:
 - Robot navigation system
- Educational purpose:
 - Didactic tool in undergraduate and postgraduate courses
 - Simulations

- Helping research projects

- Decision Support Systems:
 - National Planning of Energy resources
 - Cost-benefit analysis in power plants
- Expert Systems:
 - Inventory management system
 - Helping gas chromatographic analysis

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