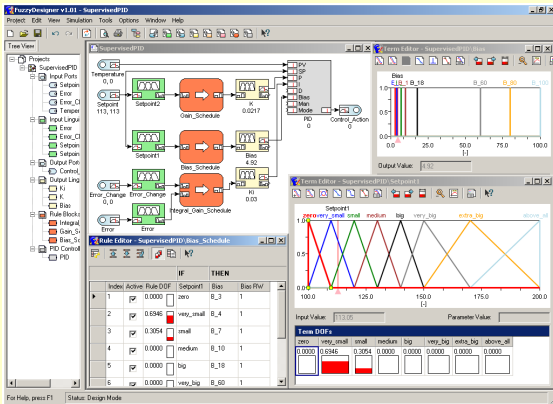


What FuzzyDesigner is









FuzzyDesigner is a software package for designing smart components implemented as Fuzzy Systems with optional hierarchical structure. FuzzyDesigner generates code of the fuzzy system, which runs on PCs and various industrial hardware platforms, primarily on Rockwell Automation Logix5000 family of programmable logic controllers. FuzzyDesigner also generates platform independent C, C#, Java and Matlab code of the fuzzy system and provides means for easy communication with other applications using industrial standard OPC protocol and optionally DDE protocol.

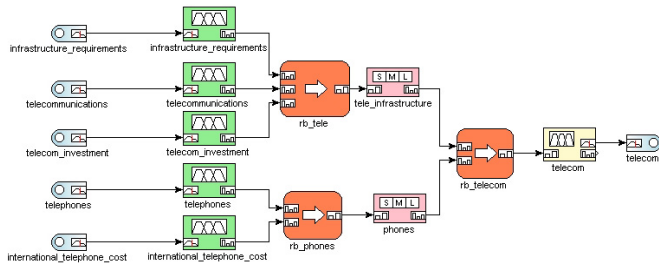


A fuzzy system designed and generated by FuzzyDesigner might be used for example as a direct nonlinear fuzzy-rule based controller, a nonlinear (fuzzy rule based) PID controller supervisor, a smart switch between conventional controllers (Takagi-Sugeno Controller), a nonlinear process model for diagnostic or forecasting purposes, a large hierarchical decision-making system etc.

Hierarchical Fuzzy Logic System

FuzzyDesigner includes library of components, which allows a user to design a complex hierarchical fuzzy systems. The following components are included:

- Input Port** - stores fuzzy or crisp input values of the fuzzy system, crisp value can be preprocessed by the user defined linear digital filter 
- Input Linguistic Variable** - stores linguistic terms and is used for classification of the actual component input (crisp or fuzzy value) into reference fuzzy sets 
- Rule Block** - stores rules, performs fuzzy logic inference based on fuzzy rules and computes degrees of fulfillment of consequent variables from degrees of fulfillment of premise variables 
- Intermediate Linguistic Variable** - is a bridge for logical chaining of rule blocks 
- Output Linguistic Variables** - stores parameters of linguistic terms and computes an output value from degrees of fulfillment of all terms 
- Output Takagi-Sugeno Variable** - stores parameters of functional (linear or constant) terms and computes an output value from degrees of fulfillment of all terms 
- PID controller** - allows intelligent supervision of the conventional PID controller 
- Output Port** - stores fuzzy or crisp output values of the fuzzy system 



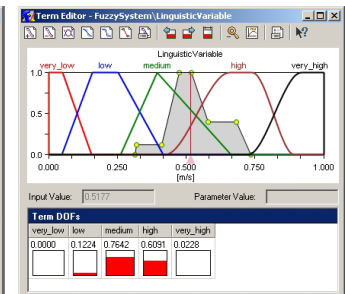
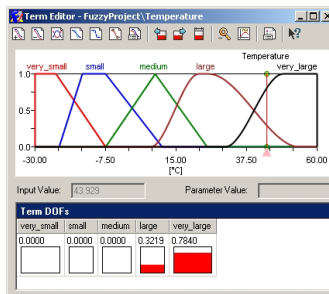
System Requirements

- Intel Pentium (or compatible) 90 MHz or higher
- 64 MB of RAM
- Windows 98, Windows NT 4.0 SP6a, Windows Millennium Edition, Windows 2000, Windows XP Home Edition, Windows XP Professional, or Windows .NET Server family platforms

Supported Membership Functions

Each linguistic term defined for Input or Output Linguistic Variables is defined by a membership function. FuzzyDesigner supports the following membership functions:

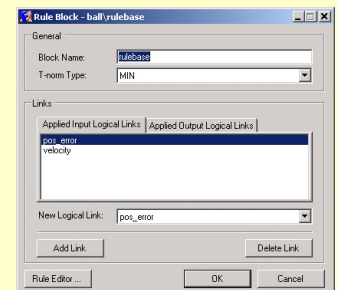
- Trapezoidal** (Input and Output Linguistic Variable)
- Inverse Trapezoidal** (Input Linguistic Variable)
- S-shape** (Input Linguistic Variable)
- Inverse S-shape** (Input Linguistic Variable)
- Singleton** (Output Linguistic Variable)
- Piece-wise linear** (input fuzzy set)



Fuzzy Rule Base

FuzzyDesigner supports:

- two inference methods:
 - Mamdani inference
 - Fuzzy Arithmetic Inference
- t-norms:
 - minimum t-norm
 - product t-norm
- s-norms:
 - maximum s-norm



Fuzzy rules can be designed manually by a user, or automatically, it means that FuzzyDesigner generates rules for all combinations of selected premise variable and a user fills consequent fuzzy terms. Every rule can be deactivated and independent rule weight can be defined for each consequent variable.

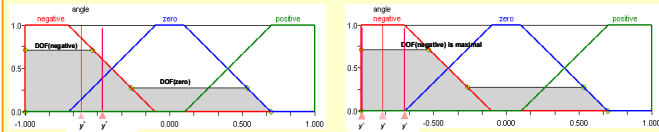
		IF		THEN		
Index	Active	Rule DOF	Position	Velocity	Control_Action	Control_Action
1	<input checked="" type="checkbox"/>	0.4717	very_small	high	high	1
2	<input checked="" type="checkbox"/>	0.6418	very_small	medium_low	very_high	1
3	<input checked="" type="checkbox"/>	0.0000	very_small	medium_high	medium_high	1
4	<input checked="" type="checkbox"/>	0.0000	very_small	high	low	1
5	<input checked="" type="checkbox"/>	0.4717	small	low	low	1
6	<input checked="" type="checkbox"/>	0.6418	small	medium_low	medium_low	1
7	<input checked="" type="checkbox"/>	0.0000	small	medium_high	medium	1
8	<input checked="" type="checkbox"/>	0.0000	small	high	high	1

Defuzzification Methods

FuzzyDesigner supports 5 defuzzification methods:

- Centroid Average (CA)
- Maximum Center Average (MCA)
- Mean of Maximum (MOM)
- Smallest of Maximum (SOM)
- Largest of Maximum (LOM)

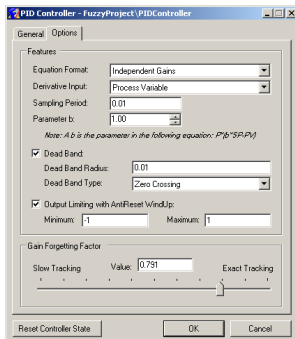
Centroid Average and Maximum Center Average methods belong to continuous ones and are frequently used in control engineering and process modeling. The rest represent discontinuous methods, which are mainly used in decision making and pattern recognition applications for selecting the alternative.



PID controller Supervision

FuzzyDesigner allows an intelligent supervision of the conventional PID controller. The PID component has following facultative features:

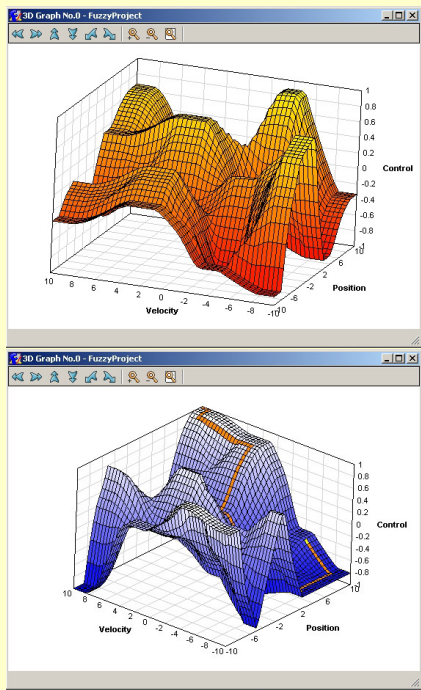
- equation format with independent or dependent gains
- dumping of the influence of the setpoint
- two formats of derivative term (the process variable or the error)
- manual or automatic mode
- output limiting
- dead band control - zero or no zero crossing
- gain forgetting factor for the parameter tracking



Fuzzy System Analysis

FuzzyDesigner offers several methods for the fuzzy system analysis:

- 2D and 3D graphs with many options concerning zoom, line, grid density, range, axis, texture, etc.
- Simulation mode which allows to watch influence of individual component values. Value changes appear also in graphs as "path".



Code Generators

FuzzyDesigner optionally generates designed fuzzy project as a:

- C code
- Java code
- C# code
- Matlab code
- Matlab C-mex code
- Matlab DDE s-function
- Matlab OPC s-function

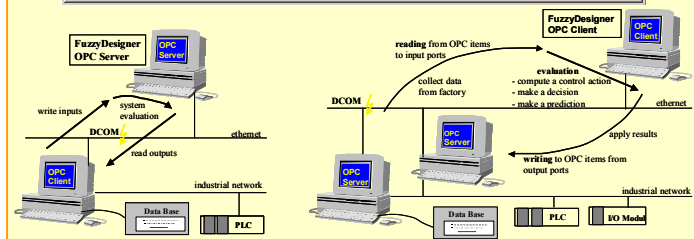
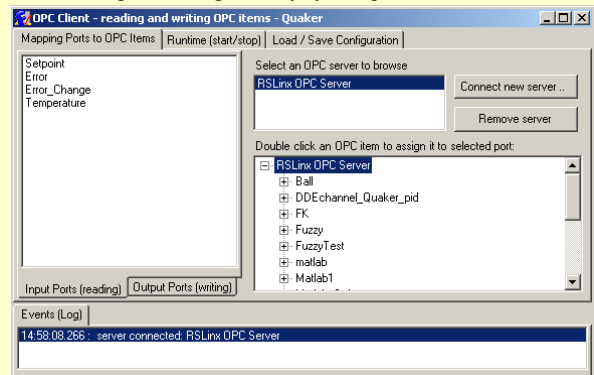
Communication Protocols & External Interfaces

FuzzyDesigner communication server supports following protocols:

- DDE – classical Microsoft Dynamic Data Exchange protocol
- OPC – industrial standard based on DCOM protocol

To quickly incorporate your designs into communication with real time industrial information systems, FuzzyDesigner provides OPC client component, which allows you to easily connect ports of your project to data source and sinks of available OPC servers and periodically evaluate your fuzzy system.

FuzzyDesigner provides plug-in COM(ActiveX) component, DLL library and Microsoft .NET assembly that you can directly use in your applications. These components include OPC server which allows on-line monitoring and tuning of fuzzy system parameters.



Download to Industrial Controllers

FuzzyDesigner allows to download fuzzy systems into Rockwell Automation industrial controllers (Logix 5000 family, SLC500 and PLC5). The size of the fuzzy system (number of inputs, outputs, membership functions, rules, etc.) is limited only by the memory of the controller.

FuzzyDesigner allows to:

- install/uninstall the fuzzy kernel into any RSLogix5000, RSLogix500, RSLogix5 project
- add/remove fuzzy systems
- change parameters of the fuzzy system on-line
- monitor the fuzzy system running on the controller in real-time

