Fuzzy Logic Toolbox 2.1

Design and simulate fuzzy logic systems

The Fuzzy Logic Toolbox extends the MATLAB® technical computing environment with tools for designing systems based on fuzzy logic. Graphical user interfaces (GUIs) guide you through the steps of fuzzy inference system design. Functions are provided for many common fuzzy logic methods, including fuzzy clustering and adaptive neurofuzzy learning.

The toolbox lets you model complex system behaviors using simple logic rules and then implement these rules in a fuzzy inference system. You can use the toolbox as a stand-alone fuzzy inference engine. Alternatively, you can use fuzzy inference blocks in Simulink® and simulate the fuzzy systems within a comprehensive model of the entire dynamic system.

Working with the Fuzzy Logic Toolbox

The Fuzzy Logic Toolbox provides GUIs to let you perform classical fuzzy system development and pattern recognition. Using the toolbox, you can develop and analyze fuzzy inference systems, develop adaptive neurofuzzy inference systems, and perform fuzzy clustering.

In addition, the toolbox provides a fuzzy controller block that you can use in Simulink to model and simulate a fuzzy logic control system. From Simulink, you can generate C code for use in embedded applications that include fuzzy logic.

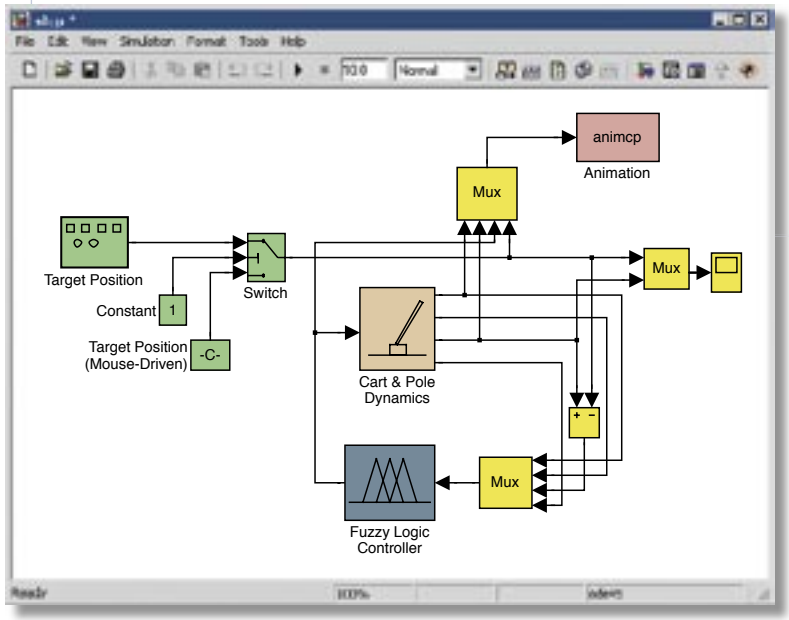
Building a Fuzzy Inference System

Fuzzy inference is a method that interprets the values in the input vector and, based on user-defined rules, assigns values to the output vector. Using the GUI editors and viewers in the Fuzzy Logic Toolbox, you can build the rules set, define the membership functions, and analyze the behavior of a fuzzy inference system (FIS). The following editors and viewers are provided:

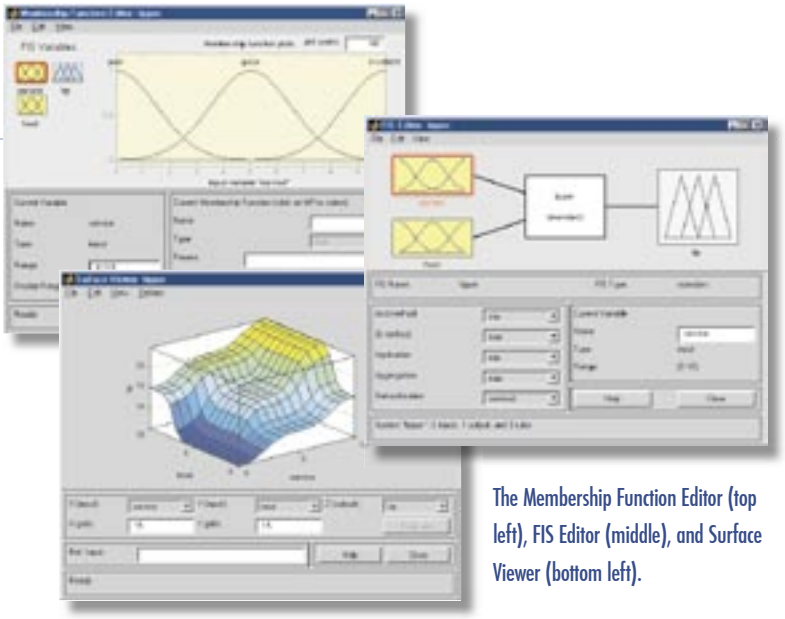
FIS Editor—Displays general information about a fuzzy inference system

KEY FEATURES

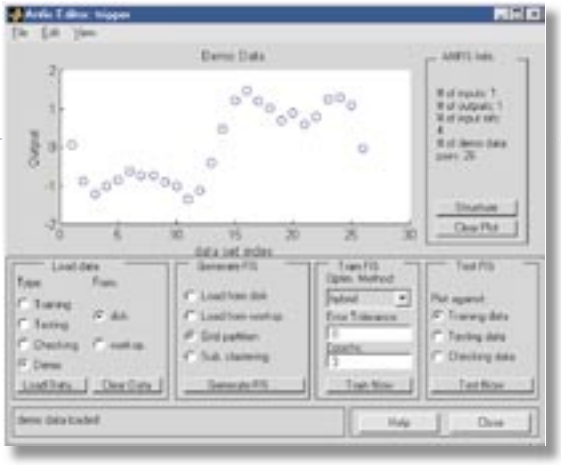
- Specialized GUIs for building fuzzy inference systems and viewing and analyzing results
- Membership functions for creating fuzzy inference systems
- Support for AND, OR, and NOT logic in user-defined rules
- Standard Mamdani and Sugeno-type fuzzy inference systems
- Automated membership function shaping through neuro-adaptive and fuzzy clustering learning techniques
- Ability to embed a fuzzy inference system in a Simulink model
- Ability to generate embeddable C code or stand-alone executable fuzzy inference engines



Balancing a pole on a moving cart. The system, which is similar to an inverted pendulum, uses a fuzzy controller block within Simulink to balance the pole.



The Membership Function Editor (top left), FIS Editor (middle), and Surface Viewer (bottom left).



The ANFIS Editor constructs and tunes an FIS based on the data being modeled.

Membership Function Editor— Lets you display and edit the membership functions associated with the input and output variables of the FIS

Rule Editor—Lets you view and edit fuzzy rules using one of three formats: full English-like syntax, concise symbolic notation, or an indexed notation

Rule Viewer—Lets you view detailed behavior of an FIS to help diagnose the behavior of specific rules or study the effect of changing input variables

Surface Viewer—Generates a 3-D surface from two input variables and the output of an FIS

Modeling Using Fuzzy Logic

The Fuzzy Logic Toolbox lets you apply neurofuzzy and clustering techniques to model and classify system behavior.

Adaptive Neurofuzzy Inference

Using the Adaptive Neuro-Fuzzy Inference System (ANFIS) Editor, you can shape membership functions by training them with input/output data rather than specifying them manually. The toolbox uses a back propagation algorithm alone or in combination with a least squares method, enabling your fuzzy systems to learn from the data.

Fuzzy Clustering

The Fuzzy Logic Toolbox provides support for fuzzy C-means and subtractive clustering, modeling techniques for data classification and modeling.

Simulating and Deploying Fuzzy Inference Systems

You can evaluate FIS performance by using the Fuzzy Logic Controller block in a Simulink model of your system. The Fuzzy Logic Controller block automatically generates a hierarchical block diagram representation for most fuzzy inference systems. This representation uses only built-in Simulink blocks, enabling efficient code generation (using Real-Time Workshop®, available separately).

You can also save your FIS in ASCII format for use outside the MATLAB environment. The toolbox supplies a fuzzy inference engine that can execute your fuzzy system as a stand-alone application or embedded in an external application.

Required Products

MATLAB

Related Products

Simulink. Simulation and model-based design

Neural Network Toolbox. Design and simulate neural networks

Real-Time Workshop. Generate optimized, portable, and customizable code from Simulink models

System Identification Toolbox. Create linear dynamic models from measured input-output data

For more information on related products, visit *www.mathworks.com/products/fuzzylogic*

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