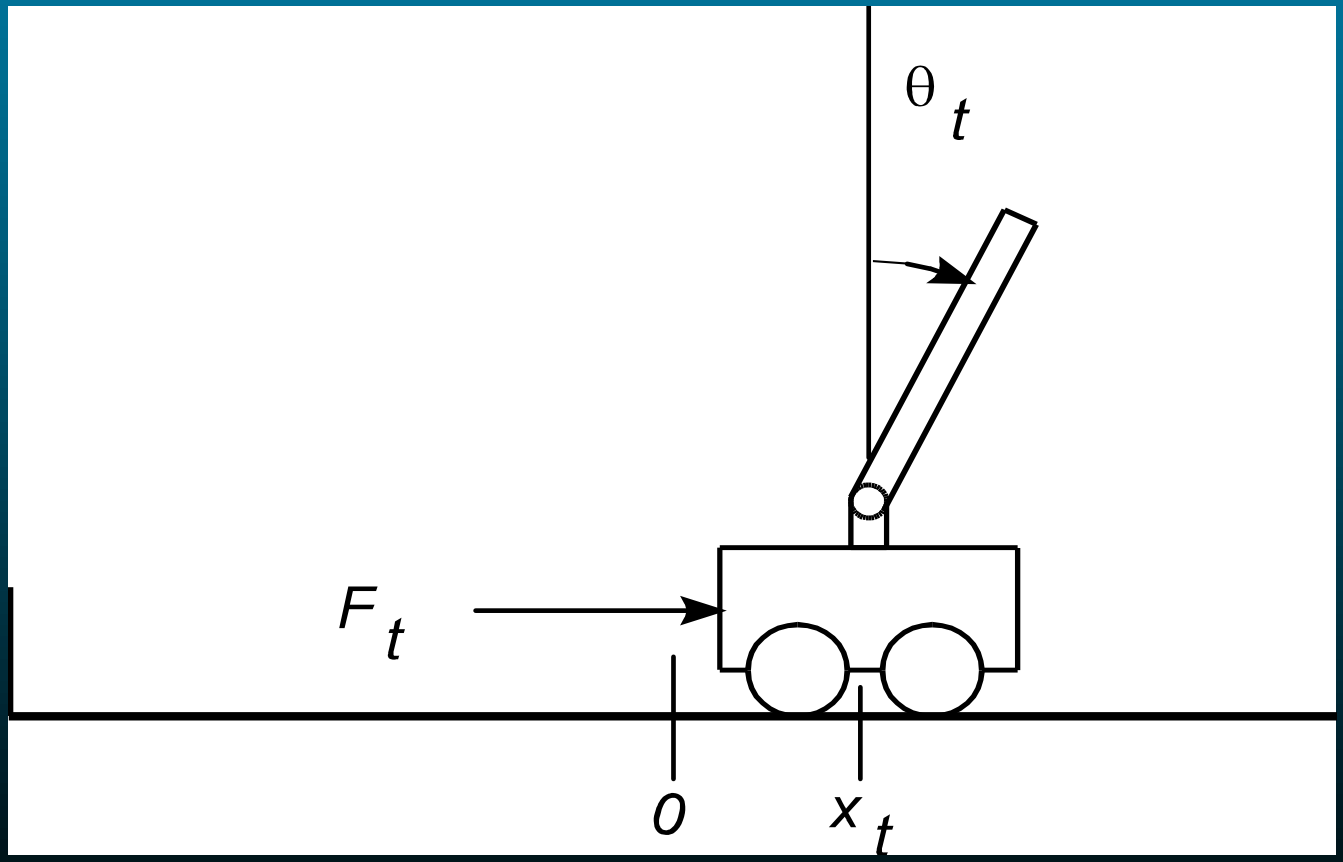
Controladores Fuzzy
EXEMPLOS

Estrutura de um controlador Fuzzy

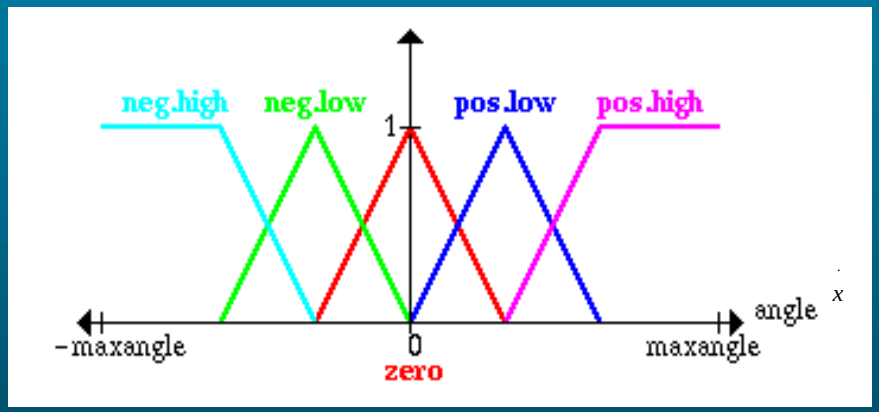
Pêndulo Invertido

OBJETIVO: Manter o equilíbrio vertical do pêndulo controlando-se a velocidade da plataforma

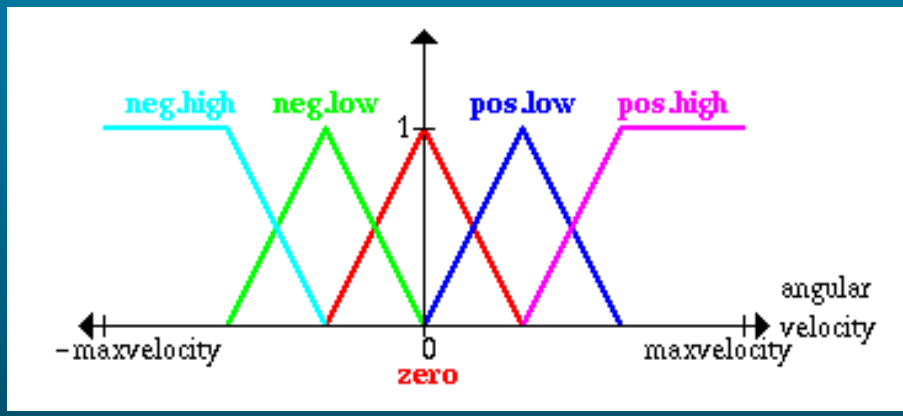


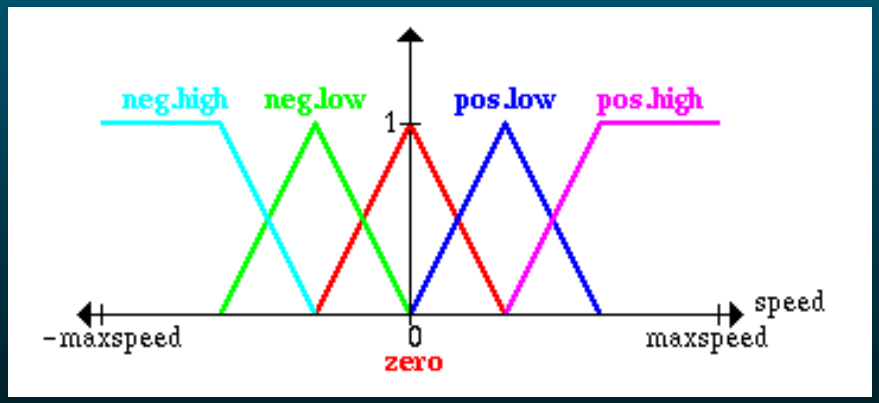
Pêndulo Invertido: Conjuntos Fuzzy e Funções de Pertinência

ângulo θ



Velocidade angular dθ/dt





Velocidade da plataforma dx/dt

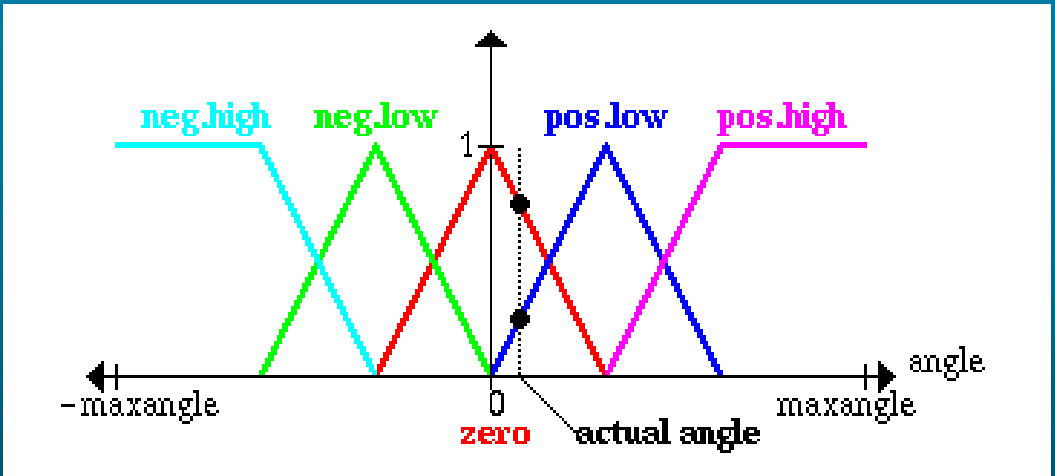
(saída de controle)

Pêndulo Invertido: Regras para Manter o Equilíbrio Vertical

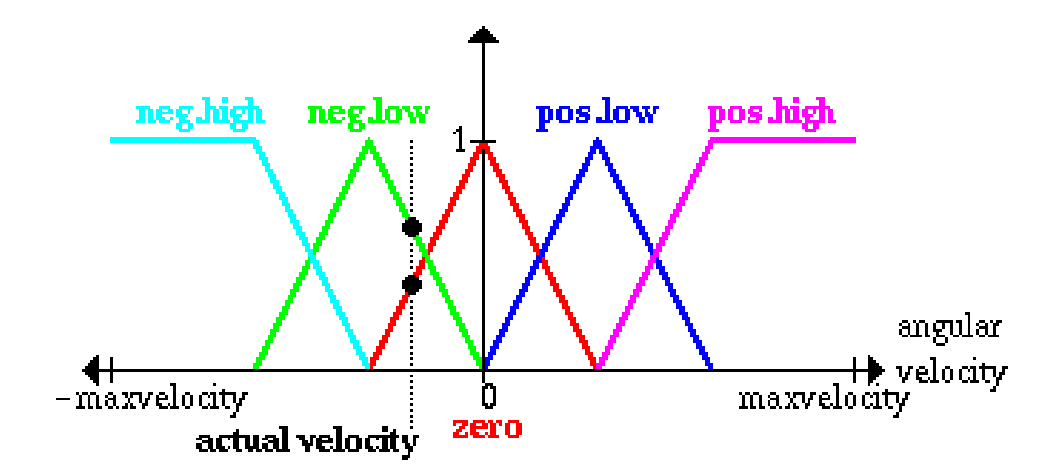
Matriz de Inferência Fuzzy

		Ângulo θ				
	dx/dt	NH	NL	Z	PL	PH
dθ/dt	NH			NH		
	NL			NL	Z	
	Z	NH	NL	Z	PL	PH
	PL		Z	PL		
	PH			PH		

Pêndulo Invertido: Exemplo – "fuzzificação"



ângulo θ

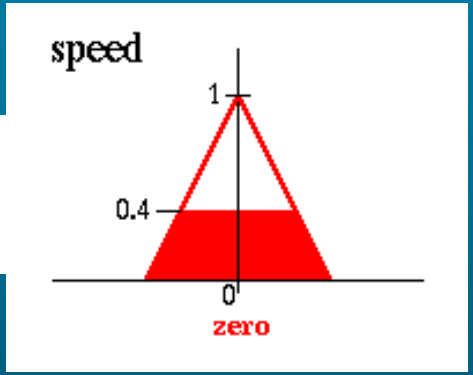


Velocidade angular $d\theta/dt$

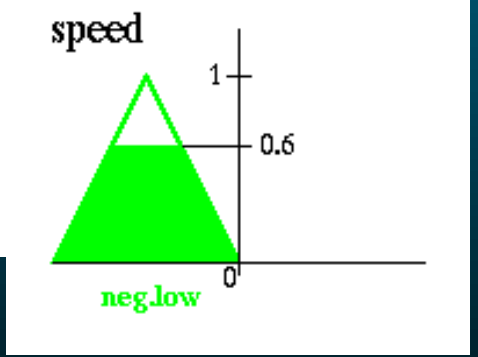
Pêndulo Invertido: Exemplo – Inferência

Disparo de quatro regras:

1- SE ângulo é zero E velocidade angular é zero ENTÃO velocidade é zero

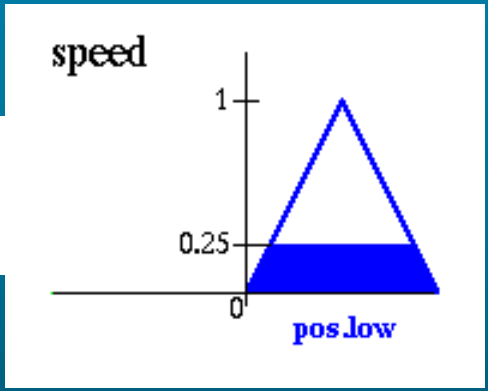


2- SE ângulo é zero E velocidade é neg_low ENTÃO velocidade é neg_low

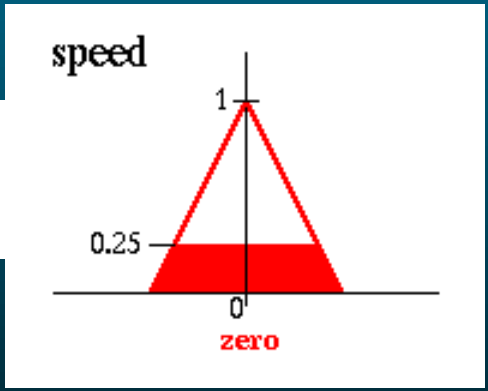


Pêndulo Invertido: Exemplo – Inferência (cont.)

3- SE ângulo é pos_low E velocidade angular é zero ENTÃO velocidade é pos_low

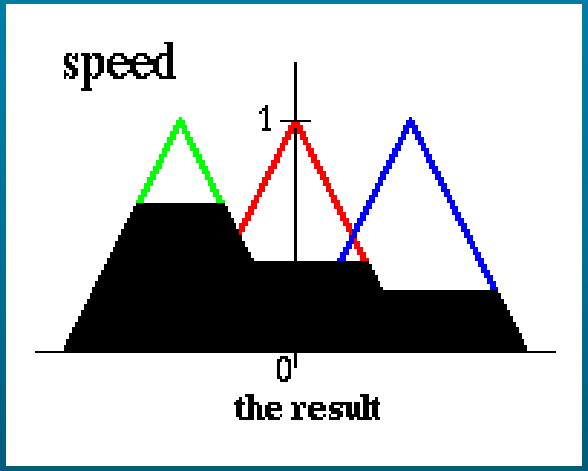


4- SE ângulo é pos_low E velocidade angular é neg_low ENTÃO velocidade é zero



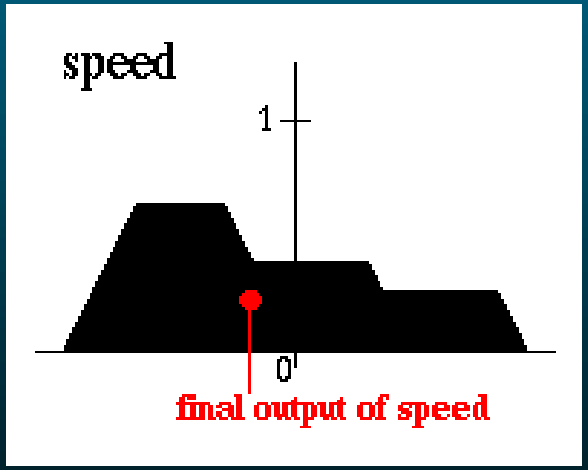
Pêndulo Invertido: Exemplo – "Defuzzificação"

Agregação resultante das regras



"Defuzzificação" pelo centro de área:

Velocidade da plataforma



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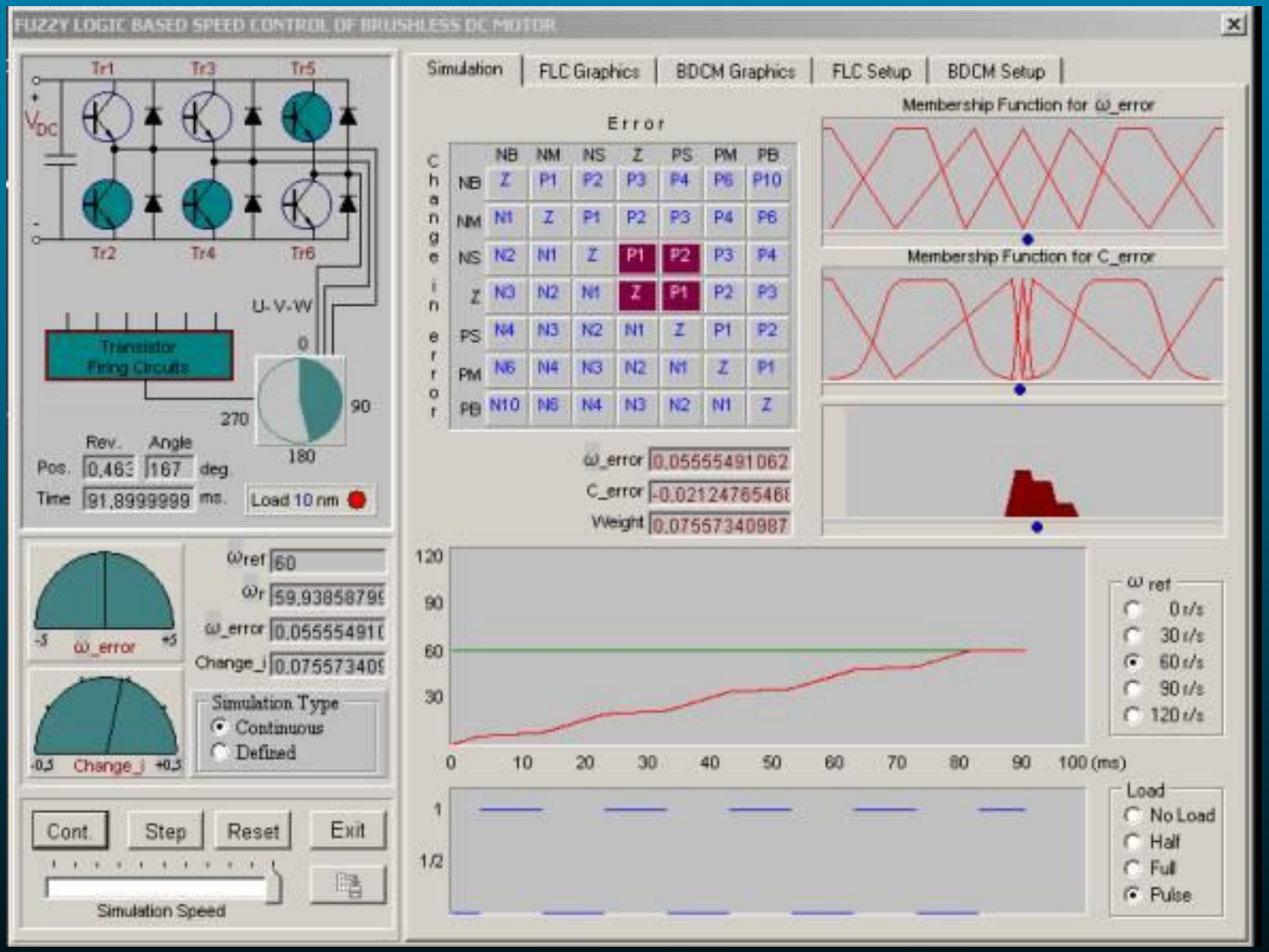
EXEMPLO DE APLICAÇÃO

Motor *Brushless*

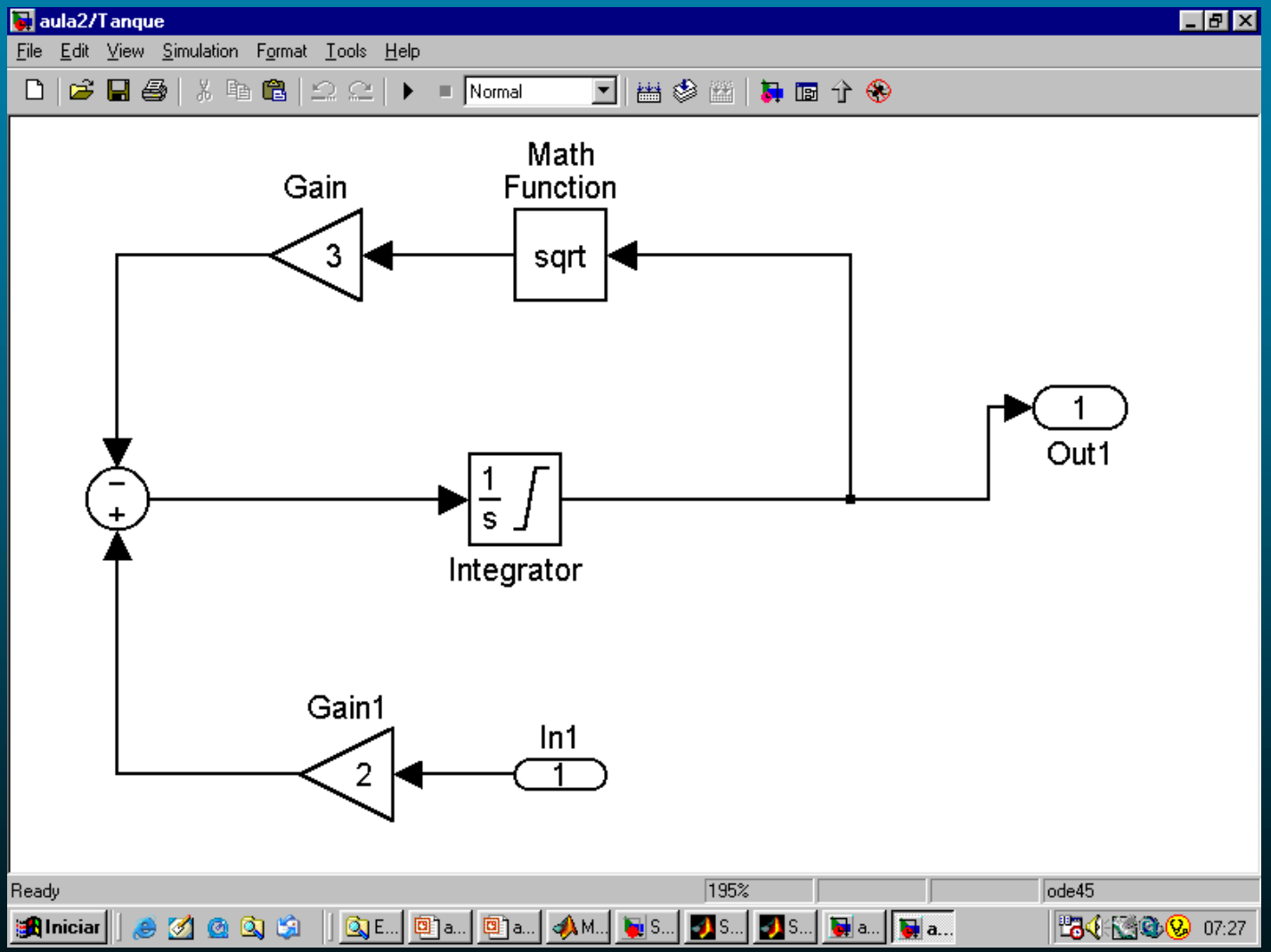
BDCM


FUZZY LOGIC BASED SPEED CONTROL OF BRUSHLESS DC MOTOR
Tr1
Tr3
Tr5
Tr2
Tr4
Tr6
U-V-W
Transistor Firing Circuits
Rev.
Angle
Pos.
deg
Time
ms.
Load 10 nm
Simulation
FLC Graphics
BDCM Graphics
FLC Setup
BDCM Setup
Error
Change in error
NB NM NS Z PS PM PB
Membership Function for ω_error
Membership Function for C_error
ω_error
C_error
Weight
ωref
ωr
Change_i
Simulation Type
Continuous
Defined
ω ref
0 r/s
30 r/s
60 r/s
90 r/s
120 r/s
Load
No Load
Half
Full
Pulse
Cont
Step
Reset
Exit
Simulation Speed

UTILIZANDO AS FERRAMENTAS DE LÓGICA *FUZZY* DO MATLAB E DO SIMULINK

CONTROLE DE NÍVEL DE UM TANQUE

Modelo do Tanque



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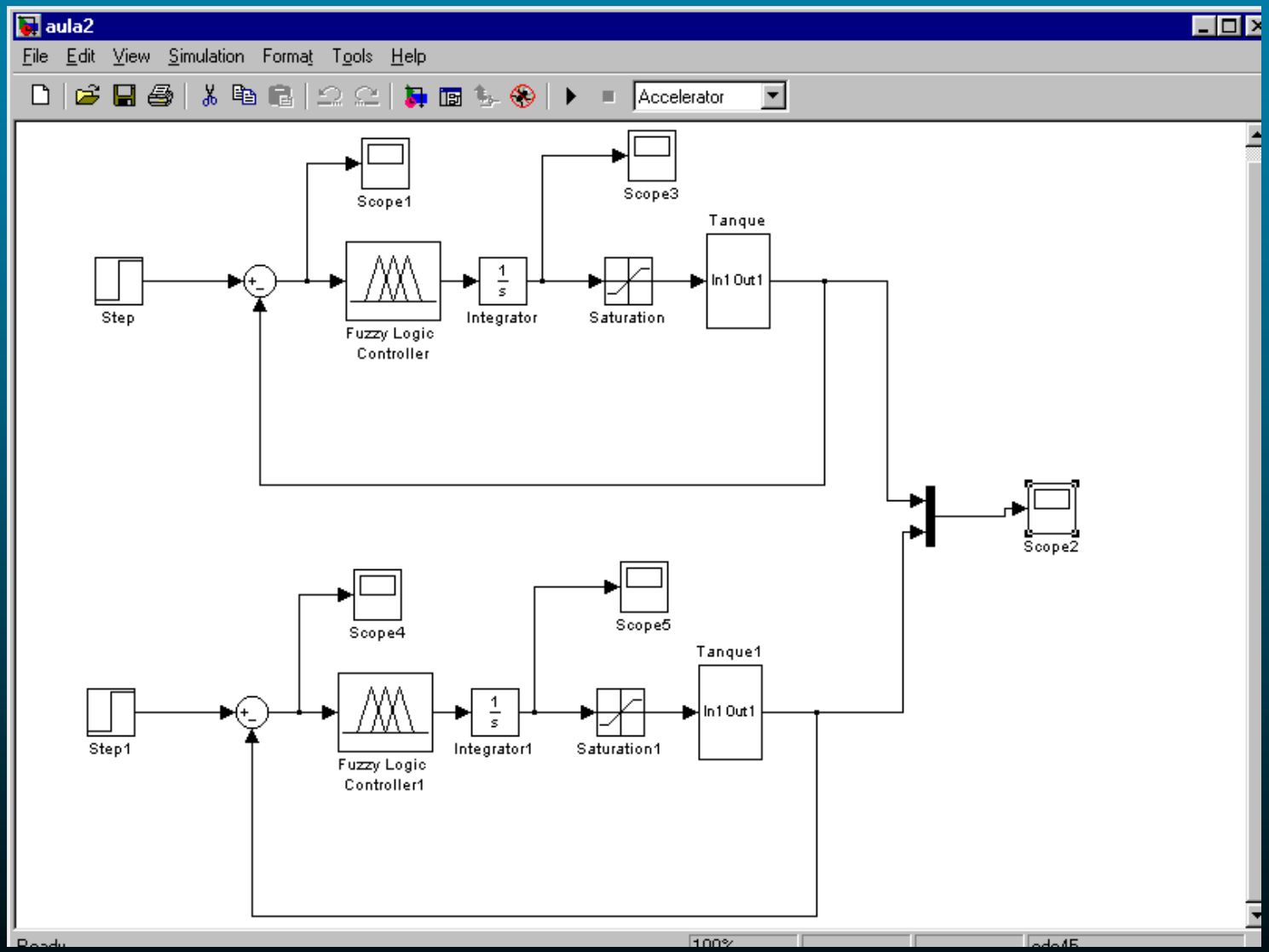
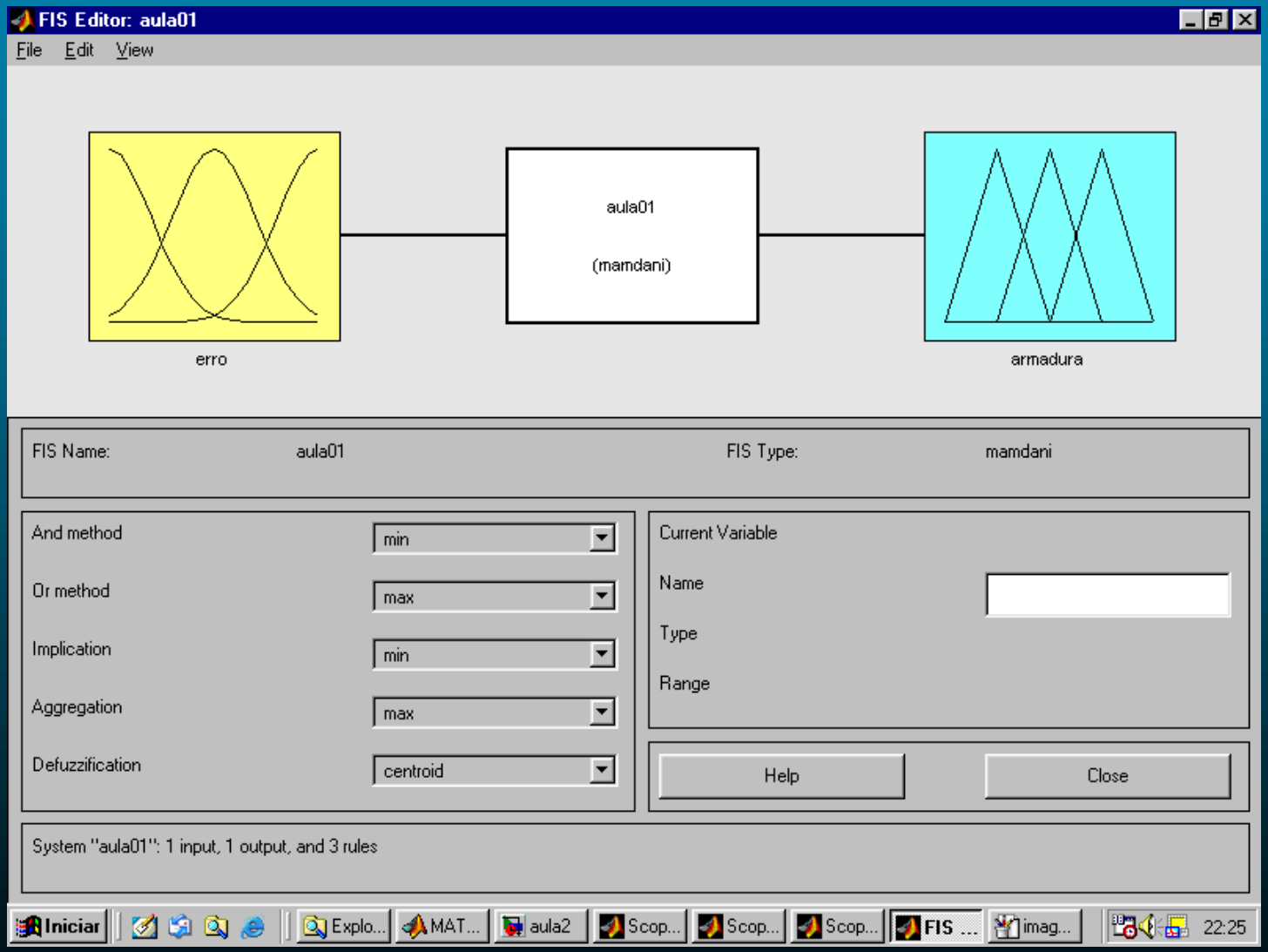
Controlador *Fuzzy* Utilizado



Definindo as propriedades do Sistema de Inferência *Fuzzy*



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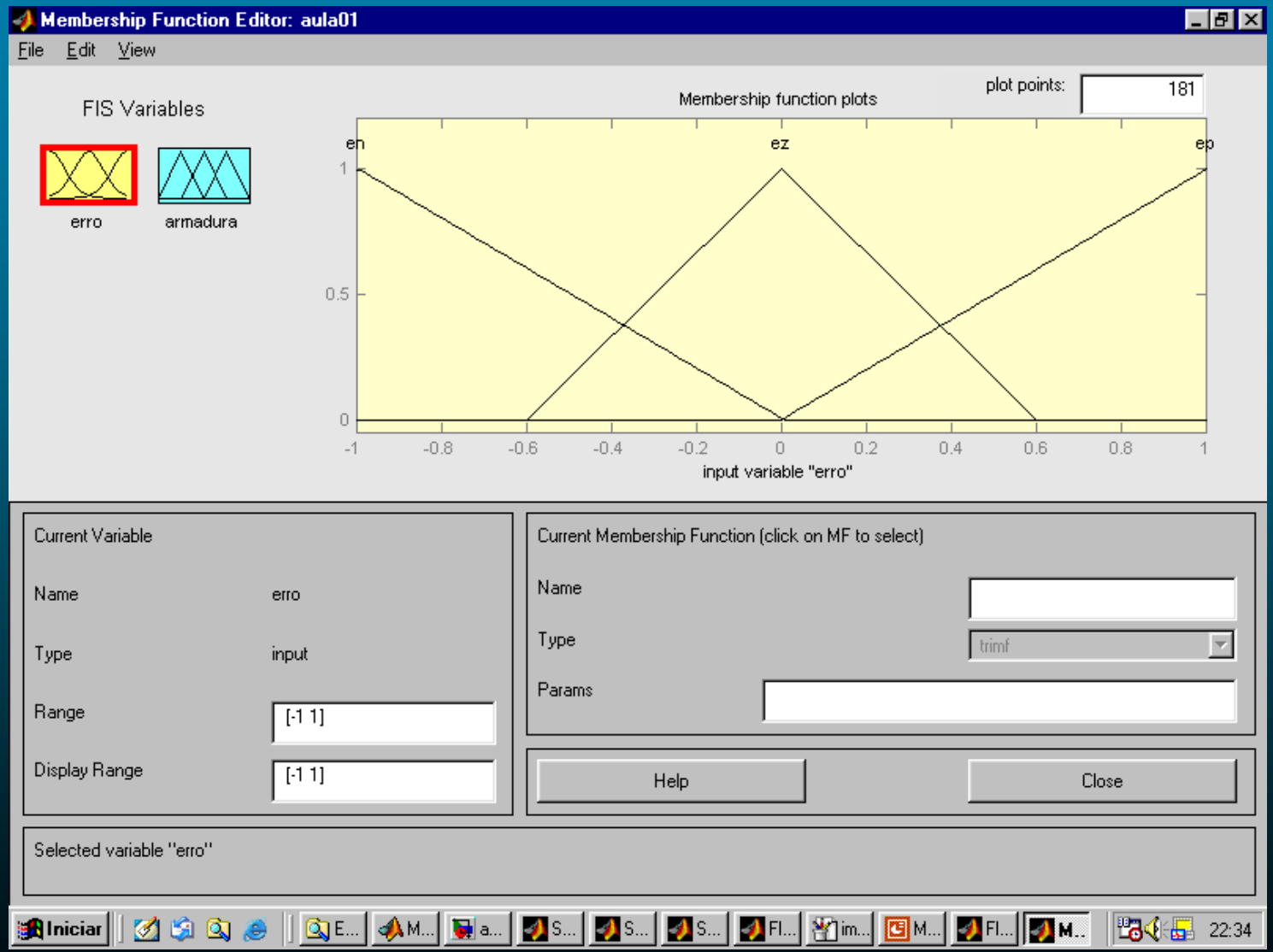
Definindo os Conjuntos *Fuzzy* da Entrada



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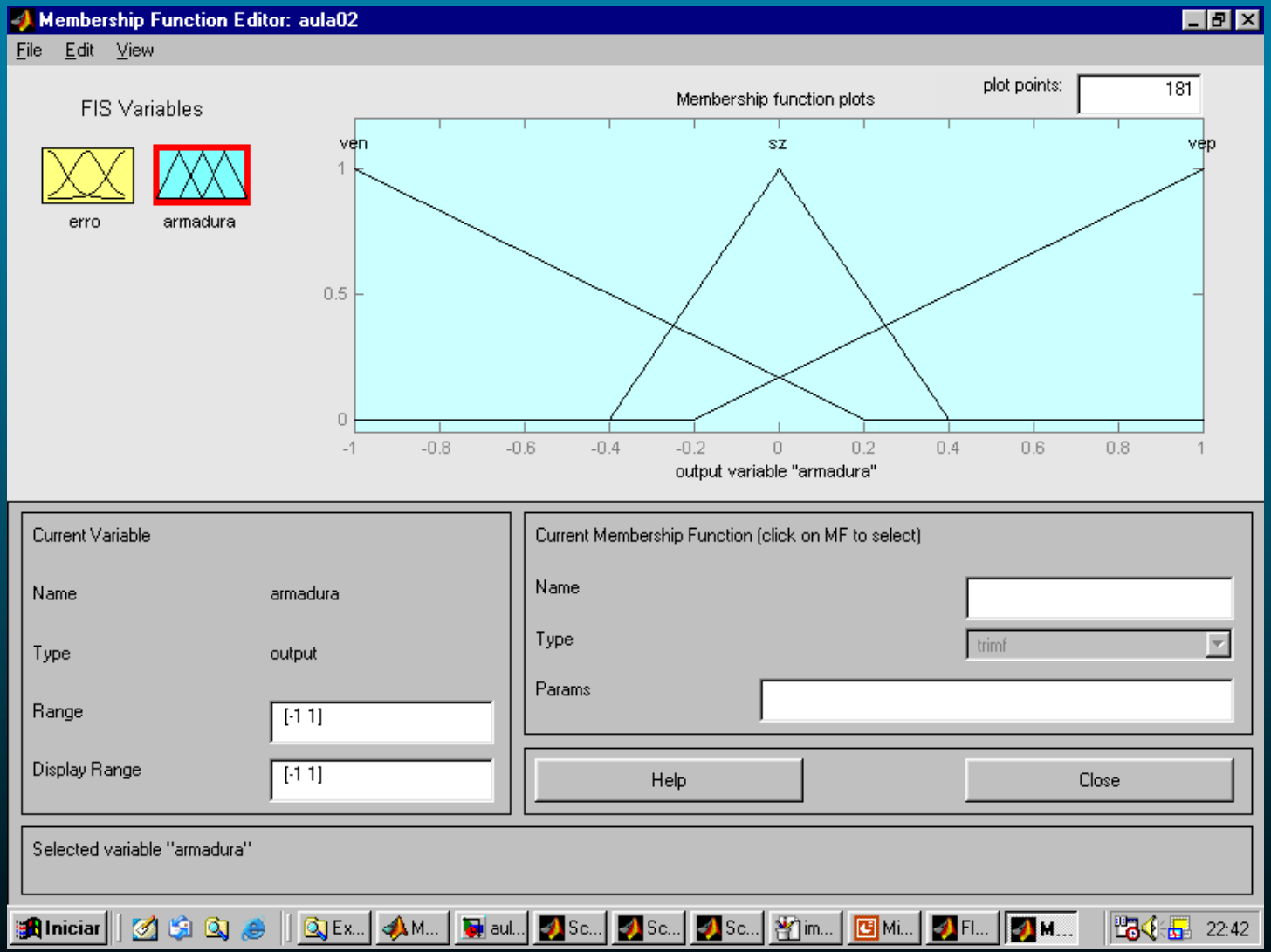
Definindo os Conjuntos *Fuzzy* da Saída



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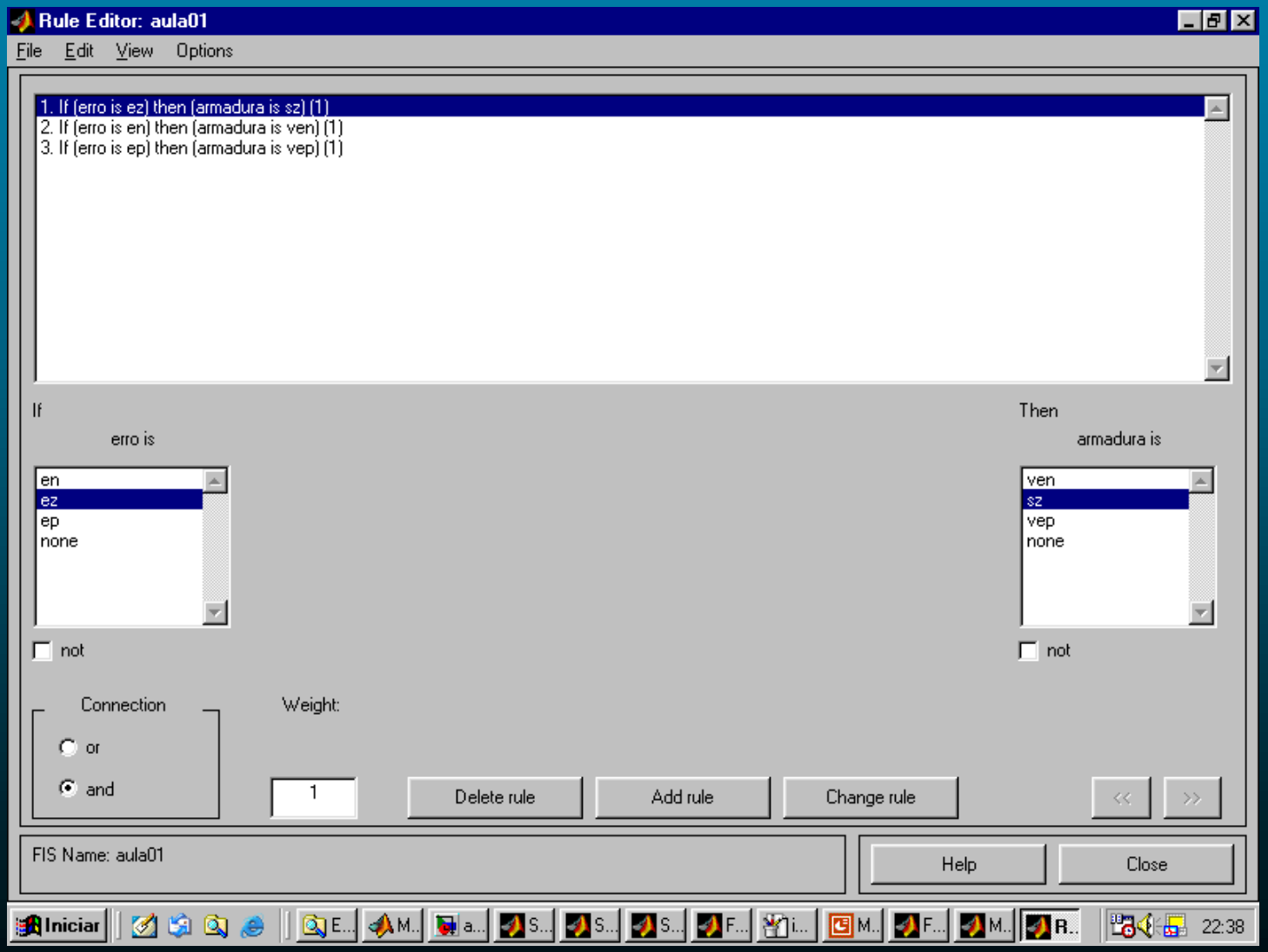
Editando as Regras do Controlador



Função Entrada ➔ Saída

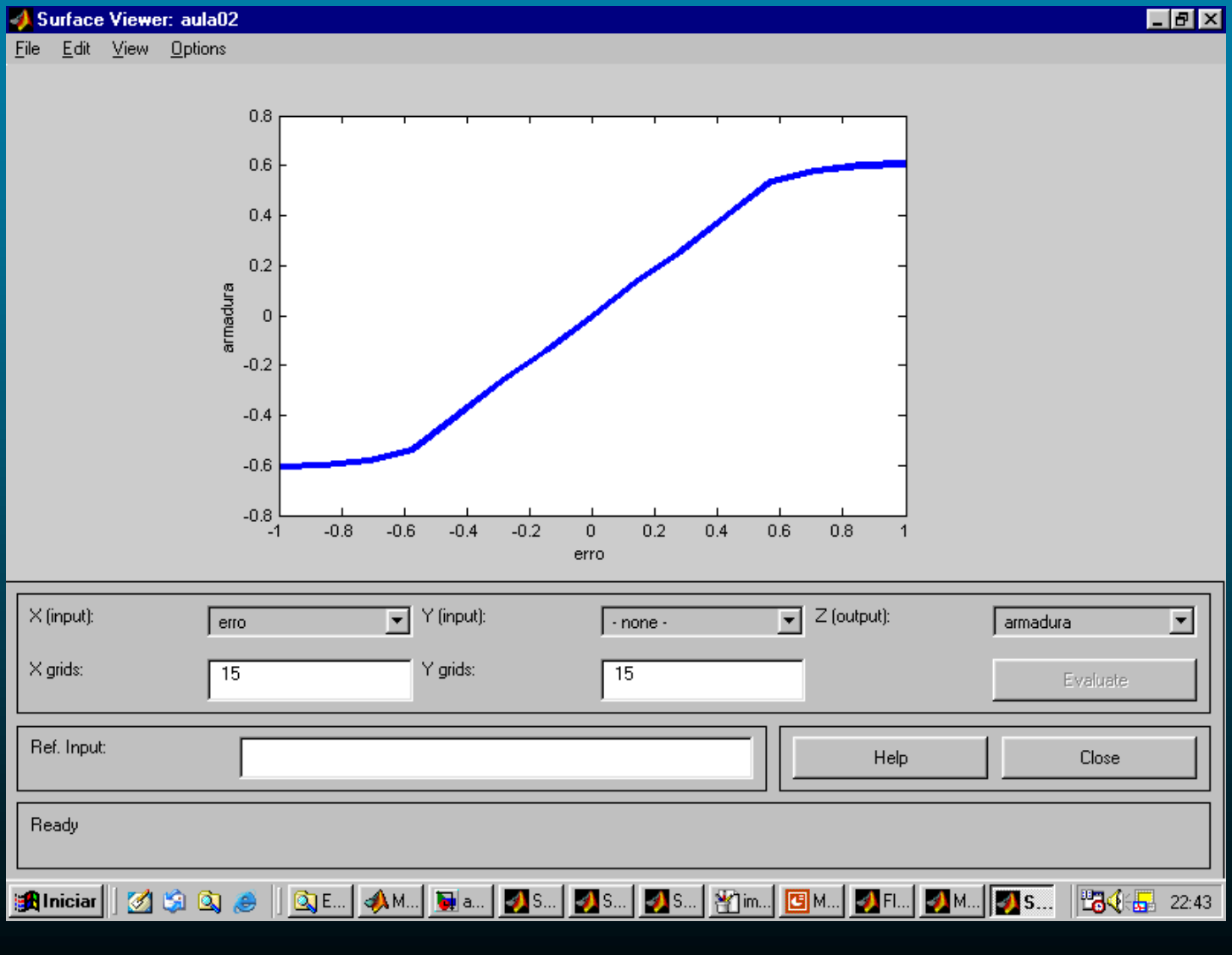
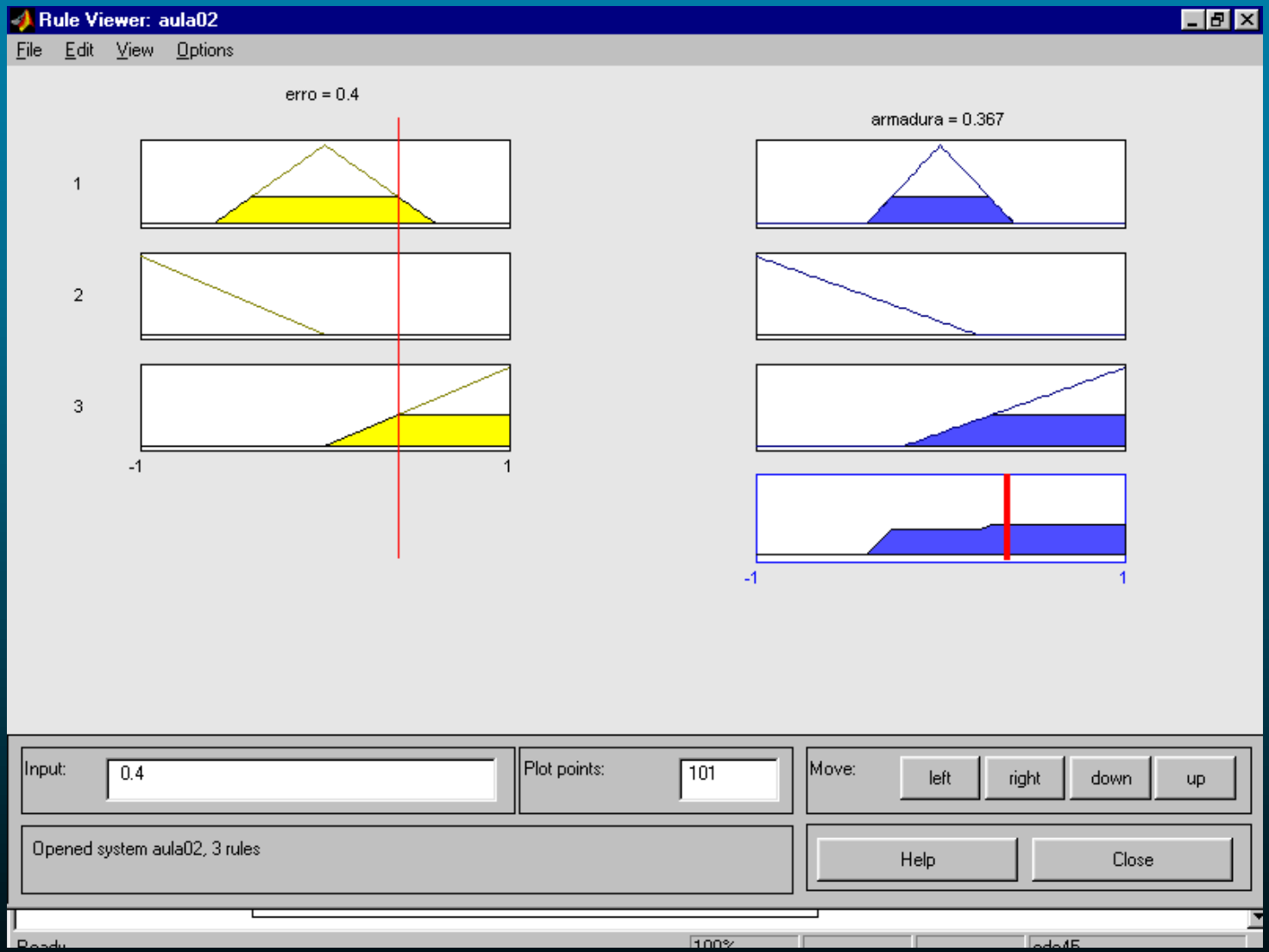
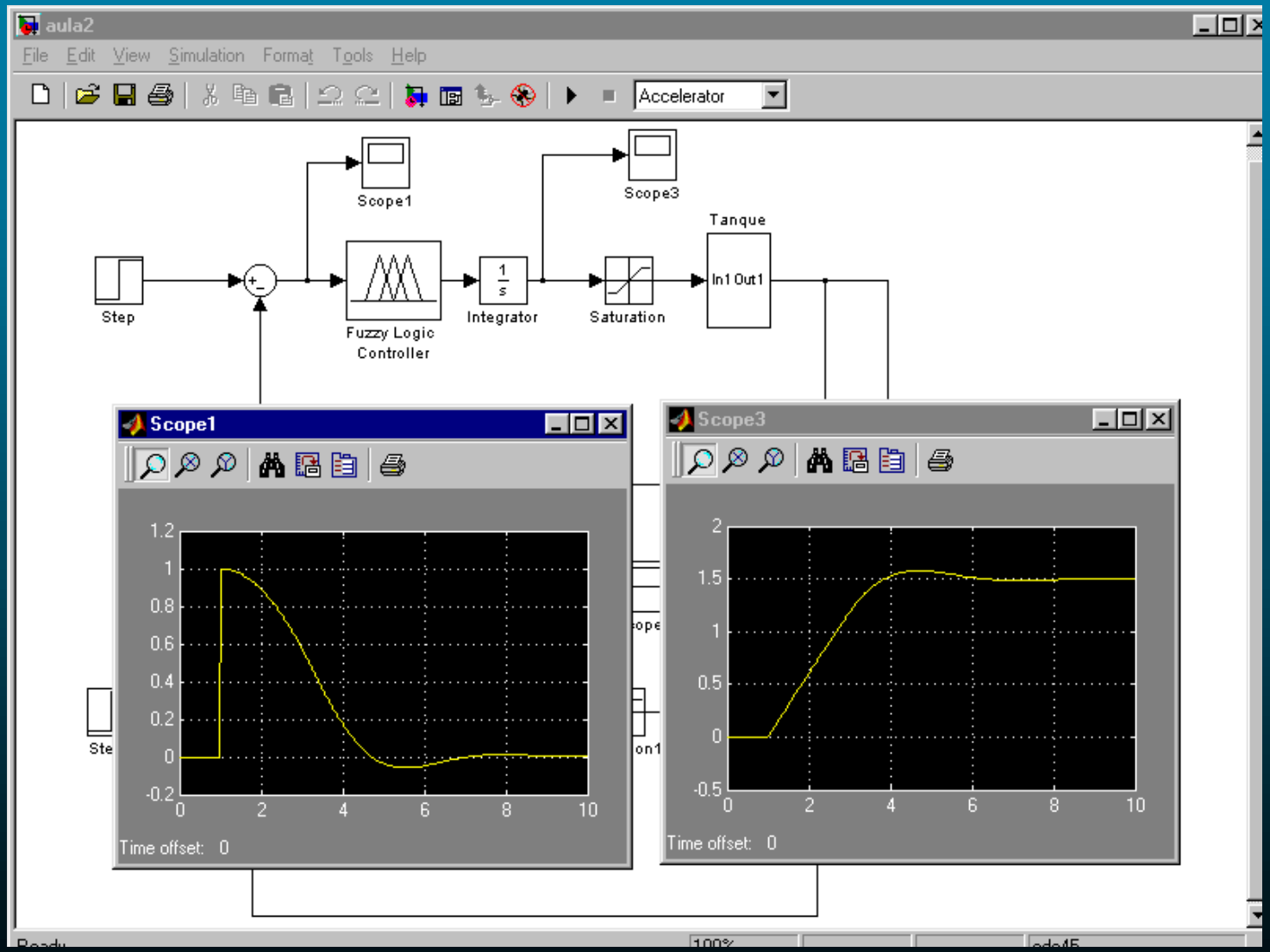


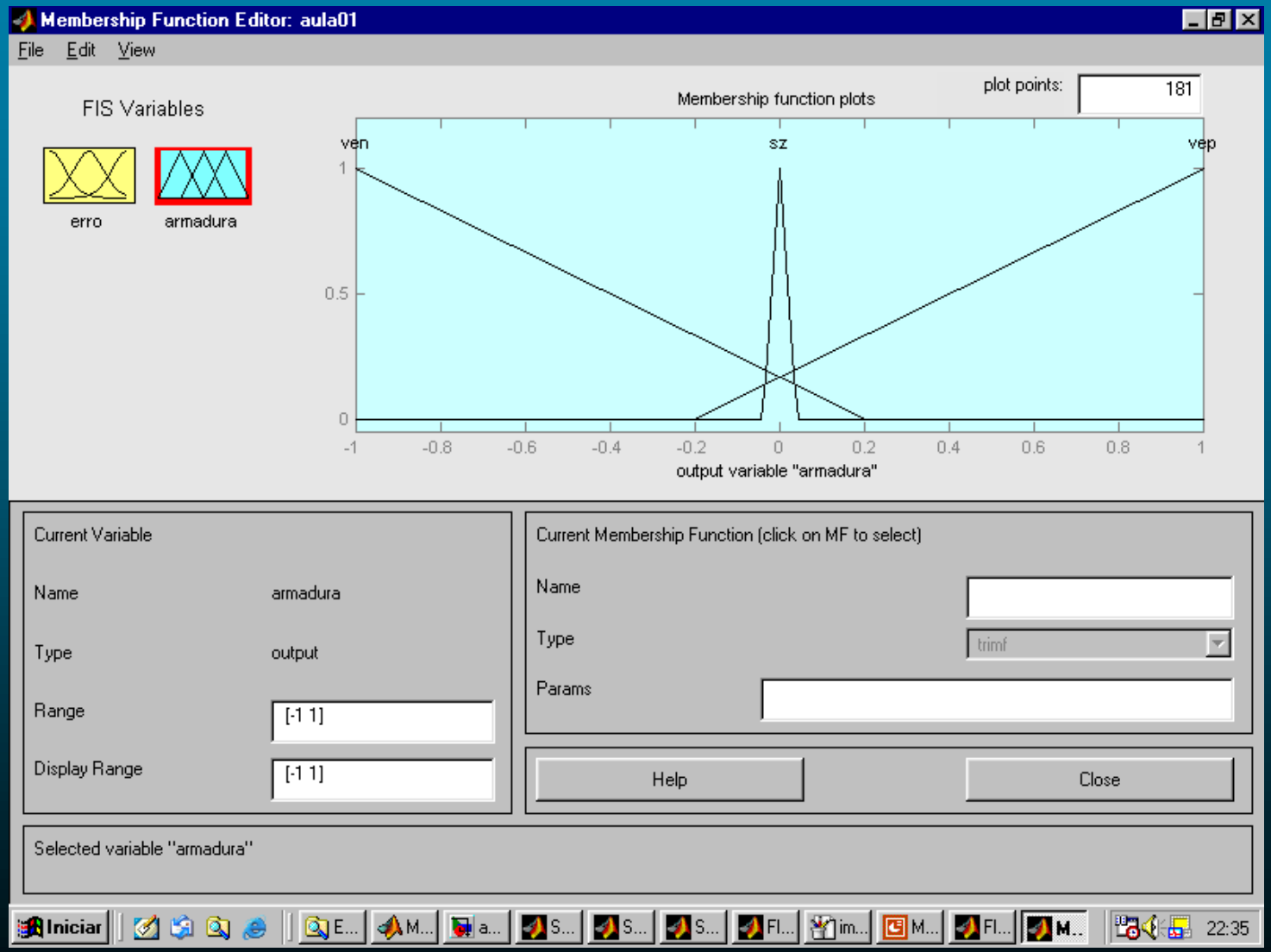
Diagrama de Inferência *Fuzzy*



Resultados


aula2
File Edit View Simulation Format Tools Help
Accelerator
Scope1
Scope3
Tanque
Step
Fuzzy Logic Controller
Integrator
Saturation
In1 Out1
Scope1
Time offset: 0
Scope3
Time offset: 0

Modificando o Conjunto Fuzzy de Saída



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Função Entrada ➔ Saída

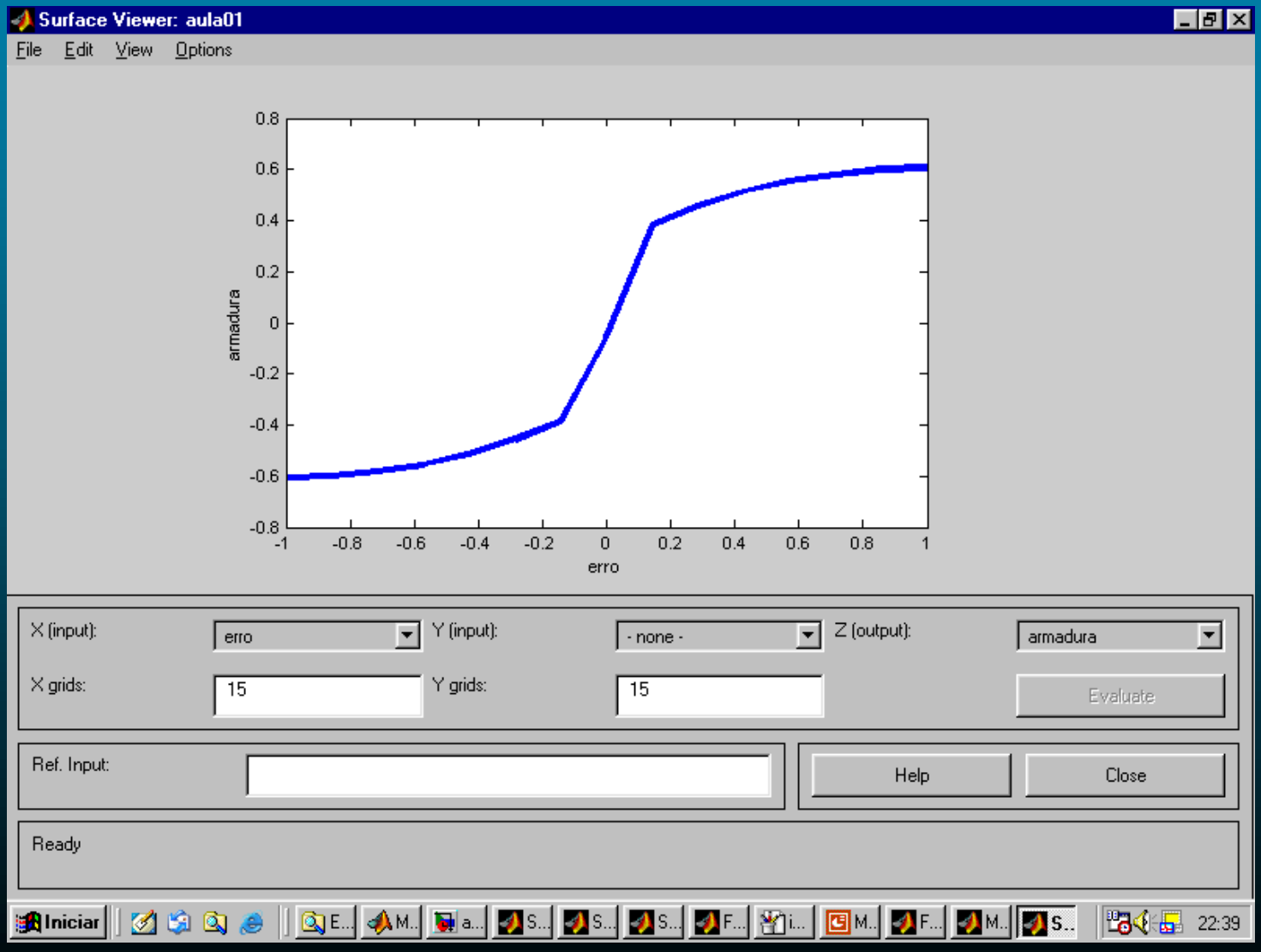
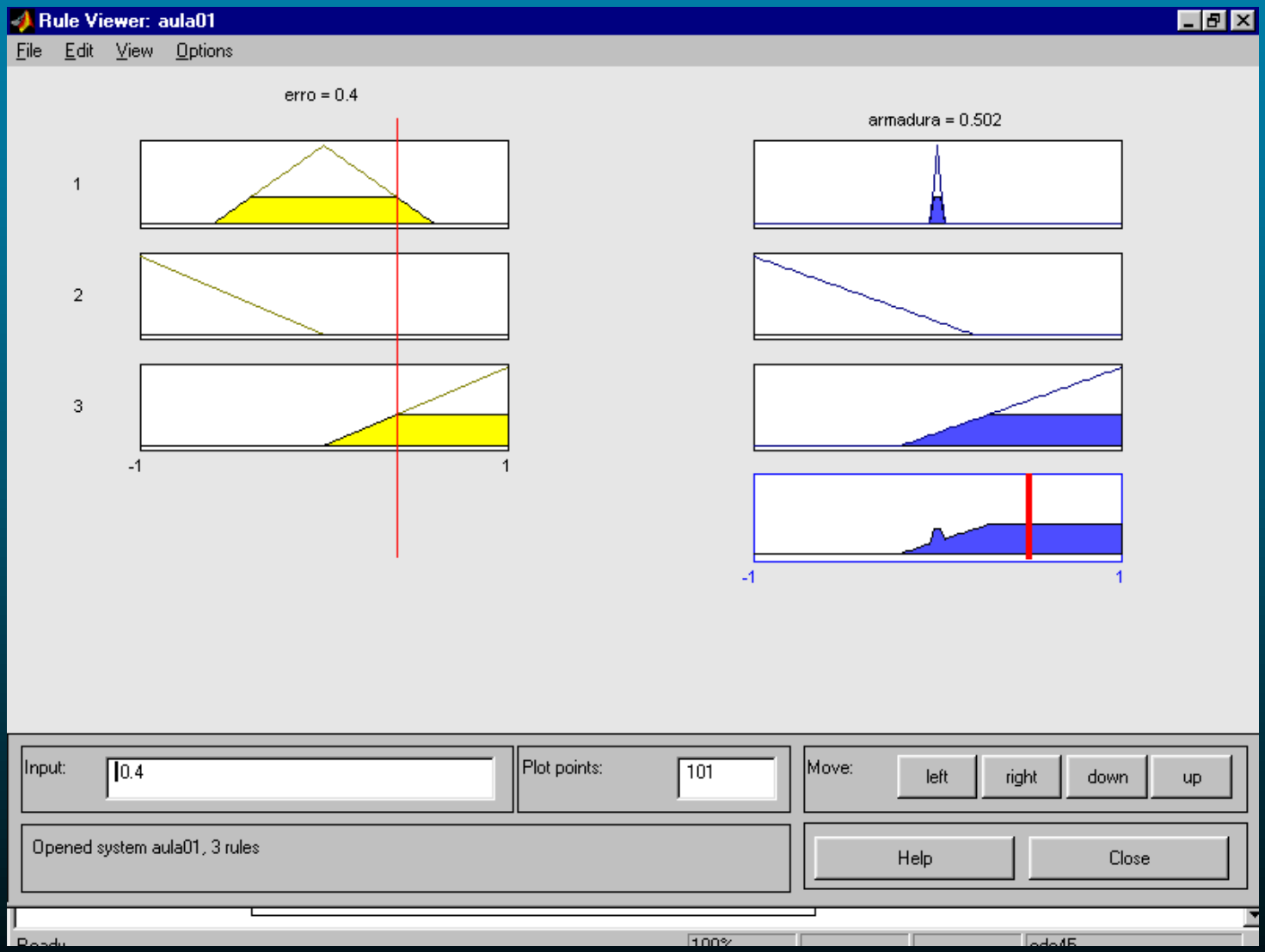
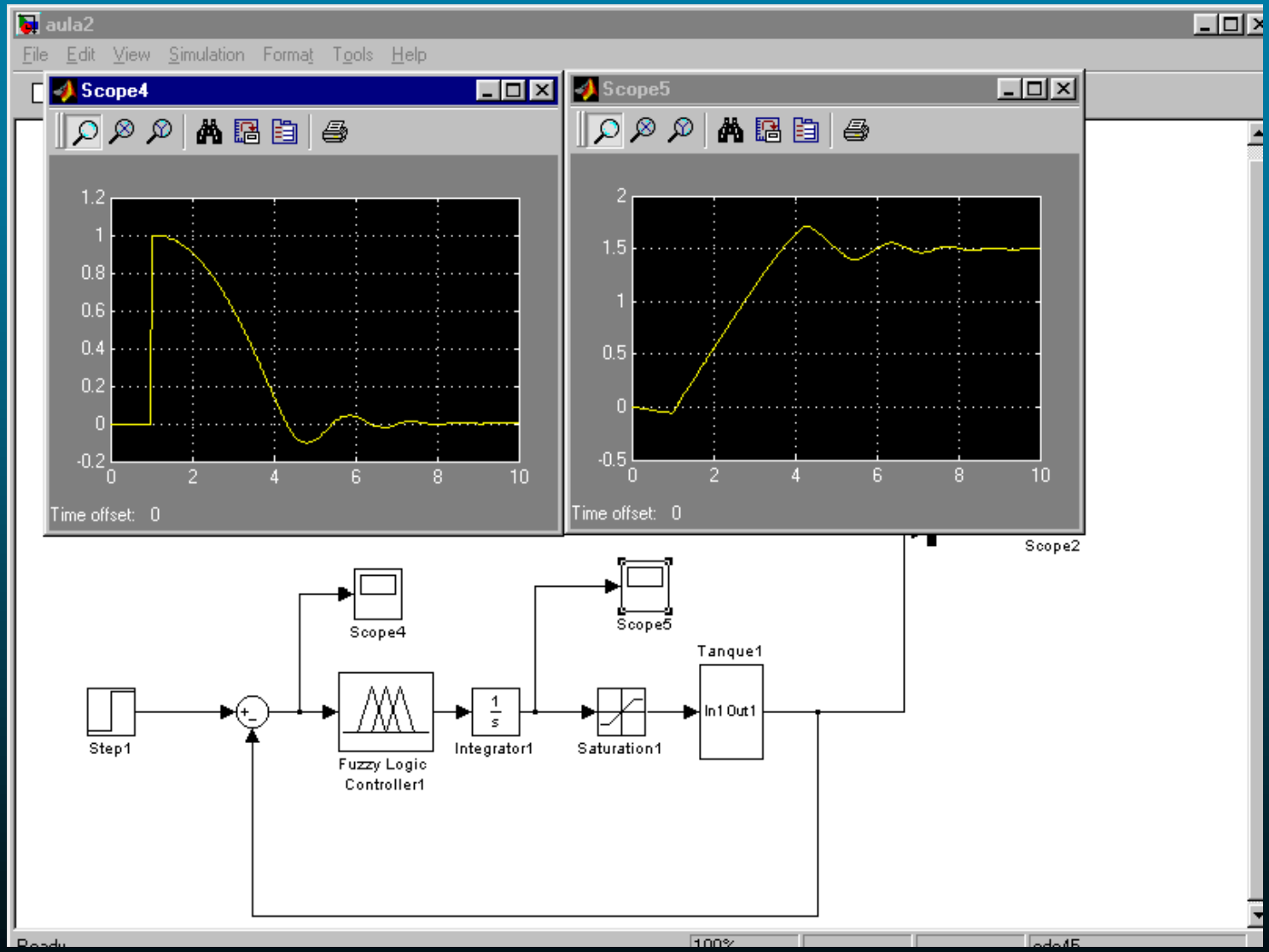


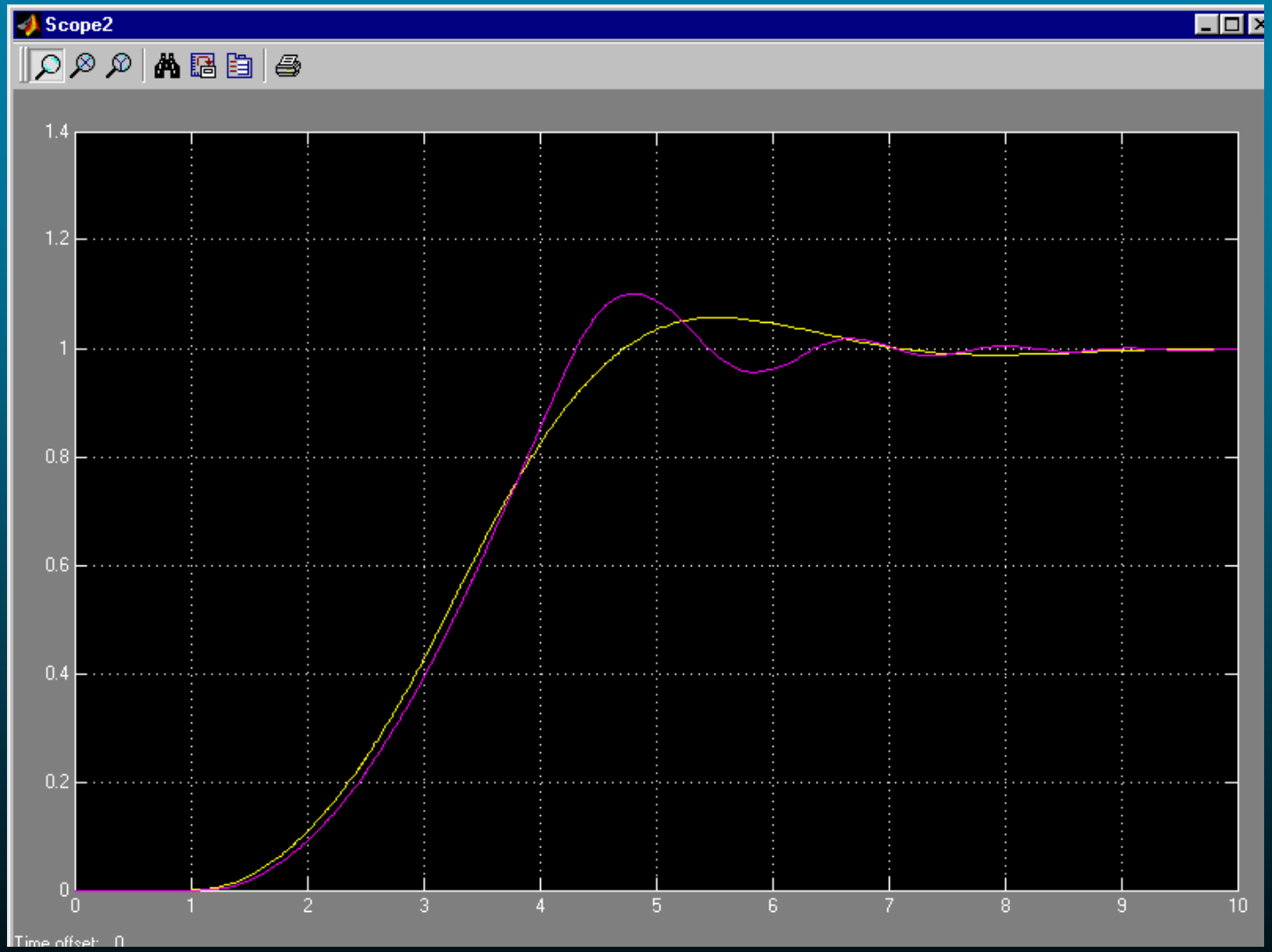
Diagrama de Inferência *Fuzzy*



Resultados


aula2
File Edit View Simulation Format Tools Help
Scope4
Time offset: 0
Scope5
Time offset: 0
Scope2
Scope4
Scope5
Tanque1
In1 Out1
Step1
Fuzzy Logic Controller1
Integrator1
Saturation1

Comparando as Respostas Obtidas



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