M.E. Second Semester (Electrical & Electronics) (New-CGS)

13290 : Neuro Fuzzy Control : 2 EEEME 3

P. Pages : 3 | AU - 3403

Time : Three Hours | Max. Marks : 80

* 1 0 0 7 *

Notes : 1. Answer **three** question from Section A and **three** question from Section B.
2. Due credit will be given to neatness and adequate dimensions.
3. Assume suitable data wherever necessary.
4. Illustrate your answer necessary with the help of neat sketches.

SECTION – A

1. a) Explain defuzzification of fuzzy set mathematically, why can be any particular fuzzy set transformed into an infinite no. of alpha-cut sets? Justify? **7**

b) Suppose we have two fuzzy sets namely, $\underset{\sim}{A} = \left\{\frac{1}{2} + \frac{0.5}{3} + \frac{0.3}{4} + \frac{0.2}{5}\right\}$ and $\underset{\sim}{B} = \left\{\frac{0.5}{2} + \frac{0.7}{3} + \frac{0.2}{4} + \frac{0.4}{5}\right\}$ where membership for element 1 in both $\underset{\sim}{A}$ and $\underset{\sim}{B}$ is implicitly 0 (zero). Calculate: **6**

i) $\underset{\sim}{A} \cup \underset{\sim}{B}$ ii) $\underset{\sim}{A} \cap \underset{\sim}{B}$ iii) $\overline{\underset{\sim}{A} \cup \underset{\sim}{B}}$

OR

2. a) State and explain frequently used properties of fuzzy sets. **6**

b) Consider a rule: If x is A then y is B with fuzzy sets $A = \{0.1/x_1, 0.4/x_2, 1/x_3\}$ and $B = \{0/y_1, 1/y_2, 0.2/y_3\}$. Compute the fuzzy relation R that represents the truth value of this fuzzy rule. Use first the min t – norm and then the Lukasiewicz implication. Discuss the difference in the results. **7**

3. a) What are the main assumptions in a fuzzy control system design? **6**

b) Explain simple fuzzy logic controller with the aid of a neat block diagram. What are the principal design elements in a general fuzzy logic controllers? **8**

OR

4. Design and analyse a fuzzy controller for the simplified version of the inverted pendulum system shown below. **14**

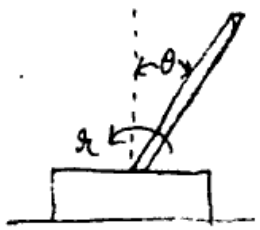

Fig. Q. 4 Inverted pendulum control

The differential equation describing the system is $-m\ell^2 \cdot \frac{d^2\theta}{dt^2} + (m\ell g)\sin(\theta) = \tau = u(t)$ where m is the mass of the pole located at the tip point of the pendulum, ℓ is the length of the pendulum, θ is the deviation angle from vertical in the clockwise direction. $\tau = u(t)$ is the torque applied to the pole in the counter clockwise direction. u(t) is the control action, t is time and g is the gravitational acceleration constant. Assume $x_1 = 0$ and $X_2 = \frac{d0}{dt}$ as the state variables. The state space representation for the nonlinear system is given by $\frac{dx_1}{dt} = x_2$ $\frac{dx_2}{dt} = \left(\frac{9}{\ell}\right) x_1 - \left(\frac{1}{m\ell^2}\right) u(t)$ as for very small rotations, or θ we have $\sin\theta \approx \theta$ where θ is measured in radians. If x_1 is measured in degrees and x_2 is measured in degrees per second and selecting $\ell = 9$ and $m = \frac{180}{(\pi - 9^2)}$ the linearized and discrete time space state equs. are

$x_1(k+1) = x_1(k) + x_2(k)$

$x_2(k+1) = x_1(k) + x_2(k) - u(k)$

Assume, the universe of discourse for the two variables to be $-2° \le x_1 \le 2°$ and $-5\,\text{dps} \le x_2 \le 5$ dps (dps – degrees per second). Construct three membership functions for x_1 and x_2 on their universe for the values positive (P), zero (Z) and negative (N). Partition the control space (output) and construct nine rules in a 3 x 3 FAM table.

5. a) Explain how a feed forward neural network is used for control with the help of a block diagram. Assume that the input layer contains situational and goal variables and the output layer contains action variables. 7

b) How learning capability of neural network is determined? Explain different data partitioning strategies for ensuring true learning and generalization. 6

OR

6. a) Derive back propagation rule for an output neuron with a sigmoidal activation function. 7

b) Explain original motivation behind ANN. Give formula and block diagram for artificial neurons. 6

SECTION – B

7. a) What is neural network identified model? Obtain control law directly from the plant dynamics by computing the inverse dynamics. 7

b) How do you simulate PI control with neural network? Explain with well labeled block diagram. 7

OR

8.	a)	Draw a general scheme of a feedforward control scheme where the controller is based on an inverse model of the dynamic process. Describe the blocks and signals in the scheme.	7
	b)	Develop an optimal neural network model for controlling temperature.	7
9.	a)	What are the basic principles of fuzzy neural systems. Define hybrid neural net.	7
	b)	Explain ANFIS learning algorithm.	6

OR

10.	a)	Explain ANFIS controller with the help of a block diagram and state its important properties.	7
	b)	Explain how fuzzy concepts are used in neural networks.	6
11.		Design and explain a neuro fuzzy control system for Integrated pest management.	13

OR

12.		Design a neuro fuzzy control system in order to identify trash in cotton. Explain various steps in the design.	13

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