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FUZZY LOGIC COMBINED WITH NEURAL ALGORITHM TO CONTROL INDUSTRIAL ROBOT

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Abstract: The problem of finding the optimal path for the robot arm is one of the most important problems of industrial robot. Problem consists when robot looking for specific routes that require the lowest power consumption. Path that established between any two end points, can follow many paths. All these paths require different amounts of energy depending on the distance, velocity and acceleration. Path planning for robotic arms have a several degrees of freedom. This problem is solved by using neuro-fuzzy techniques. Using analytical and numerical techniques is very difficult to find a good solution. Mathematically is more difficulty to move a robotic arm in the presence of obstacles, but child instinctively moving his hand in the presence of obstacles. A way that allows us to progress is a neuro-fuzzy fusion systems. Neural networks make the ability to learn, while Fuzzy logic is based on the emulation of thinking of an expert. In addition, as hardware technology advances, more and more value will be placed on solutions that can be used in parallel processing, such as neural networks and fuzzy logic with neural networks.
Keywords: Robotic, Fuzzy Logic, Neural Network

1. INTRODUCTION

Industrial robotics are an applied science, as a combination of machine and computer applications. This includes machine design, control theory, Microelectronics, computer programming, artificial intelligence, human factors, and production theory.

Using neural network simulations have shown the improvement in the efficiency of the hybrid control, especially in slow movements end effector. Ability to move your hand around the obstacle and the find a goal is an skill for human beings. How to translating that skill into instructions for a robotic arm is basic task [1].

We have neuro-fuzzy systems involved in many science and technology applications, mainly in the last then years. It is evident that the evolution of intelligent systems is a neuro-fuzzy computing: Neural network recognize some patterns and together with fuzzy inference system, including human concepts. Neural networks and fuzzy logic systems are two of the most important directions of research in the field of artificial intelligence. Neural networks are the best learning opportunities. Fuzzy logic is a method of use of human skills and ways of thinking in the machine.

2. CONTROL OF ROBOTIC ARM

The most common industrial robot is like a an robotic arm. A typical robotic arm is made up of seven metal segments, joined by six joints. The computer controls the robot by rotating individual motors connected to each joint. The problem is that of moving a robotic arm in the presence of an obstacle. For robots to become used in a wide range of applications, they must find the ability to work in unpredictable and changing environments.

In many applications, the training of a neural network requires a millions of iterative calculations. Network cannot always adequately learning the desired function. Fuzzy logic systems, on the other hand, acquire their knowledge from encoding a knowledge in a series of IF/THEN rules. The problem grove when systems have many inputs and outputs. Forming a rule base for large systems is very difficult [2].

We use mixed techniques to controlling robotic arm:

1. Fuzzy logic
2. Neural networks
3. Neuro-fuzzy systems

Using neuro-fuzzy techniques, a robotic arm can be trained to plan its movements to avoid a collision with obstacles.

3. FUZZY LOGIC

The main part of a fuzzy expert system based on rules (FRBS) system is a set of IF-THEN rules, which are composed of stage commands and make a rule that is part of the system of decisions in the expert system. FRBS is composed of a knowledge base (KB), which include information provided by the expert in the form of the phase rule and Fazifikacijski interface, which transforms input data to the system and sets the stage for decision making, as well as defazifikacijski interface that translates the phase rule. FRBS structure of the system is as shown in Figure 1.

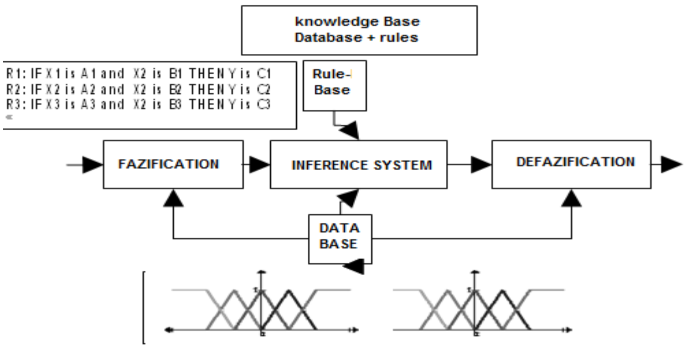

Figure 1. The generic structure of the fuzzy system

Fuzzy rules often take the place of a math model. Therefore, fuzzy logic is useful if a mathematical model of a process does not exist, is too difficult to encode, is too complex to be evaluated in real-time, or requires too much memory.

Other situations that may make fuzzy control advantageous are when there are high ambient noise levels, it is important to use inexpensive sensors, or it is important to use low precision microcontrollers [3]. They are easier to prototype and implement and simpler to describe and verify. They can be maintained and extended with greater accuracy in less time.

4. NEURAL NETWORKS

A neural network is a computational model of the brain. The most popular neural network is the multi-layer perceptron, which is a feed forward network. For artificial neural network to give any results it must be trained with series of examples and conditions. During the training neural network “learns” the governing relationships in given data sets e.g. input vectors to produce right solutions e.g. output vectors. For this purpose, back-propagation training algorithm is used. It is an iterative algorithm for minimizing the mean square error between predicted and desired output values [4].

Neural networks are composed solely of two elements – processing elements and interconnections. The processing elements are called neurons and the connections are termed synapses. A processing element generally has many inputs and a single output as shown in figure 2 [5]. There are two popular models of neural networks – the feed-forward model and the feedback model [6].

Most neural network applications involve training. Graded training provides the training input and a grade telling the network how close its output is to the desired output. The weights of the neuron inputs are adjusted during the learning process according to a learning law.

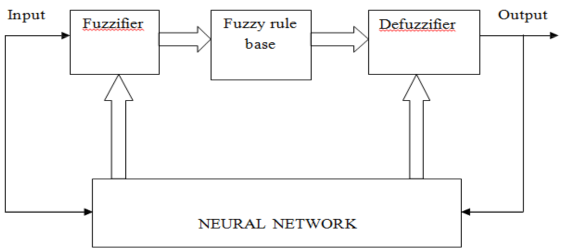

Figure 2. A fuzzy system whose membership functions is adjusted by a neural network

Assuming a certain shape and finding the beginning and endpoints for the fuzzy values in a fuzzy set is a neural network optimization problem [7].

5. NEURO FUZZY SYSTEMS

The neuro-fuzzy hybridisation represents by far the most fruitful and the most investigated strategy of integration in the context of Soft Computing. Both neural networks and fuzzy systems are dynamical, parallel processing systems that estimate input-output functions [11]. Fuzzy logic is capable of modelling vagueness, handling uncertainty and supporting human-type reasoning. Neural networks are capable of learning from scratch, without needing any a-priori intervention, provided that sufficient data are available or measurable. On the other hand, fuzzy systems make use of linguistic knowledge of the process, which can be supplied by human experts.

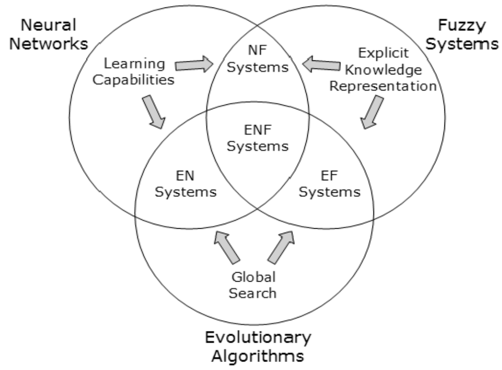

Figure 3. Evolutionary neuro-fuzzy systems and applications

Neuro-fuzzy approach combines two powerful computing disciplines: Adaptive neural networks and fuzzy set theory. Neural networks are well known for its ability to learn and adapt to unknown or changing environment to achieve better performance. The fusion of neural networks and fuzzy logic in neuro fuzzy models provide learning as well as readability. Control engineers find this useful, because the models can be interpreted and supplemented by process operators [12].

6. CONCLUSION

Neuro-fuzzy hybrid technology is becoming an important part of intelligent systems. With NFT have the opportunity to learn how to control the process with a very large part of the statement. This system is an industrial robot industry. In this paper, a neuro-fuzzy controllers are trained to look up example robot arm control human team. Membership function definitions are an important part of the neuro-fuzzy system. The final training error is reduced by 50% increase in the number of phase values in a fuzzy set.

Second, the fuzzification of a neural network's inputs and outputs allows neural networks to learn more complex functions than ever before.The performance of the neuro-fuzzy controllers in this specific application, however, is less than perfect. Programming some heuristic rules into the control of the arm could improve performance. A large percentage of the "failures" resulted from the controller attempting to move past the physical joint constraints. The control program could move the arm away from such limitations. Another situation that decreases performance occurs when the arm starts oscillating between two points.

The use of neuro-fuzzy systems for control has been examined. It is the opinion of this researcher that fuzzification of a neural network's inputs and outputs will become standard procedure in neural network applications. This work can be extended to a robot having more degrees of freedom as well as there can be more constraints i.e. while working more than one obstacle should be avoided.

In this paper we have presented the robotics kinematics manipulator problem and discussed the kinematics in the contest of soft computing techniques like fuzzy, neural network and genetic algorithms. It is concluded that in the presence of several optimization attributes for a physical system of higher order manipulator, soft computing techniques are alternatives to find the solutions of kinematics problem. Various soft computing techniques have their own advantages as neural networks required complete information of the system and required training whereas fuzzy and genetic algorithms required less information of the system and easy to implement.

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