Chapter 4

Neuro–Fuzzy Models and Applications

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ABSTRACT

The modern techniques of artificial intelligence have found application in almost all the fields of human knowledge. Among them, two important techniques of artificial intelligence, fuzzy systems (FS) and artificial neural networks (ANNs), have found many applications in various fields such as production, control systems, diagnostic, supervision, etc. They evolved and improved throughout the years to adapt arising needs and technological advancements. However, a great emphasis is given in the engineering field. The techniques of artificial intelligence based on fuzzy logic and neural networks are frequently applied together for solving engineering problems where the classic techniques do not supply an easy and accurate solution. Separately, each one of these techniques possesses advantages and disadvantages that, when mixed together, provide better results than the ones achieved with the use of each isolated technique. As ANNs and fuzzy systems have often been applied together, the concept of a fusion between them started to take shape. Neuro-fuzzy systems were born which utilize the advantages of both techniques. Such systems show two distinct ways of behavior. In a first phase, called learning phase, it behaves like neural networks that learn internal parameters off-line. Later, in the execution phase, it behaves like a fuzzy logic system. A neuro-fuzzy system is a fuzzy system that uses a...
learning algorithm derived from or inspired by neural network theory to determine its parameters (fuzzy sets and fuzzy rules) by processing data samples. Neural networks and fuzzy systems can be combined to join its advantages and to cure its individual illness. Neural networks introduce its computational characteristics of learning in the fuzzy systems and receive from them the interpretation and clarity of systems representation. Thus, the disadvantages of the fuzzy systems are compensated by the capacities of the neural networks. These techniques are complementary, which justifies its use together. This chapter deals with an analysis of neuro-fuzzy systems. Benefits of these systems are studied with its limitations too. Comparative analyses of various categories of neuro-fuzzy systems are discussed in detail. Apart from these, real-time applications of such systems are also presented.

INTRODUCTION

The modern techniques of artificial intelligence have found application in almost all the fields of the human knowledge. However, a great emphasis is given to the accurate sciences areas; perhaps the biggest expression of the success of these techniques is in engineering field. These two techniques neural networks and fuzzy logic are many times applied together for solving engineering problems where the classic techniques do not supply an easy and accurate solution. The Neuro fuzzy term was born by the fusing of these two techniques. As each researcher combines these two tools in different way, then, some confusion was created on the exact meaning of this term. Still there is no absolute consensus but in general, the Neuro fuzzy term means a type of system characterized for a similar structure of a fuzzy controller where the fuzzy sets and rules are adjusted using neural networks tuning techniques in an iterative way with data vectors (input and output system data). Such systems show two distinct ways of behavior. In a first phase, called learning phase, it behaves like neural networks that learns its internal parameters off-line. Later, in the execution phase, it behaves like a fuzzy logic system. Separately, each one of these techniques possess advantages and disadvantages that, when mixed together, theirs cooperage provides better results than the ones achieved with the use of each isolated technique.

BACKGROUND

Fuzzy systems propose a mathematic calculus to translate the subjective human knowledge of the real processes. This is a way to manipulate practical knowledge with some level of uncertainty. The fuzzy sets theory was initiated by the authors
Enhancement of Turbo-Generators Phase Backup Protection Using Adaptive Neuro Fuzzy Inference System

Intuitionistic Group Decision Making to Identify the Status of Student's Knowledge Acquisition in E-Learning Systems
[www.igi-global.com/article/intuitionistic-group-decision-making-to-identify-the-status-of-students-knowledge-acquisition-in-e-learning-systems/162663?camid=4v1a](www.igi-global.com/article/intuitionistic-group-decision-making-to-identify-the-status-of-students-knowledge-acquisition-in-e-learning-systems/162663?camid=4v1a)