Application of Soft Computing Techniques in Water Resources Engineering

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Abstract

In the present paper it has been concluded that the importance of various soft computing techniques in water resources problems. In this study, it presents that the four major techniques applicable to solve complex water resources problems like Fuzzy Logic, Artificial Neural Network, Genetic Algorithms and ant colony optimization. This review paper may consider as a valuable guide for a research in the area of Soft Computing Techniques.

1. INTRODUCTION

Soft computing techniques will refer to a collection of computational methods that may be inspired by inherent ambiguity and wisdom of human beings and real life probabilistic problems. In knowledge of present data driven and soft computing techniques to conventional computing techniques approach is quite long and non efficient. The use of soft computing is to determine the logical algorithms based on the present data or problem. The main aim of using Fuzzy Logic, Artificial Neural Network, Genetic Algorithms and ant colony optimization to solve the problem in context with Surface hydrology, subsurface hydrology and water resources engineering problems. Soft computing techniques being a multi-disciplinary field uses a variety of statistical, probabilistic and optimization tools which complement each other to evolve distinct computational methodologies namely, Neural Networks, Fuzzy Systems, Machine Learning and Probabilistic Reasoning. Among the various sub-sets of Soft Computing, Neural Networks, Genetic Algorithms and Fuzzy Logic are the major players and are commonly used for problems related to real life applications. Artificial Neural Networks implies that the using the machine learning techniques ability of the human brain, are able to implies that the relationships

between independent and dependent variable of the techniques whose interactions are unknown, non-linear or too complex to represent. Genetic Algorithms represents a stochastic search and optimization computational tool that revolves around the evolutionary theories of natural genetics and natural selection. Fuzzy Logic helps in solving real life problems which are always in some way or the other prone to ambiguity and uncertainty.

2. REVIEW OF LITERATURE

2.1 Fuzzy Logic

Fuzzy Logic models helps to solve the real life problems which are always in some way or the other way in a probabilistic in nature. This techniques help in to solve the problem related to water science or hydrology as water is a complex in nature and study of water is itself challenging in nature as it is dynamic in nature. With the help of Fuzzy Logic sets information as a multiple inputs variable will combine to form a precise result as an output for a selected model study. Although Fuzzy logic techniques is in quantitative in nature to describing an observed values as an output.

Fuzzy Logic (FL) suggested that the computational methodology of thinking and solving various problems inherent in human beings. This approach provides a simple method to draw finite conclusions from vague, ambiguous, or imprecise information (Klir et al. 1988). Built on linguistic principles, modelling using fuzzy logic involves fuzzification of various variables, defining rule base, selecting inference method and finally applying defuzzification method for predicting responses. The fuzzy of variables is accomplished by defining the membership function, which represents the degree of belongingness of the element to the set. Its mathematical formulation is synonymous to fuzzy set theory dealing with classes without crisp boundaries. In Fuzzy logic Fuzzy Logic theory and fuzzy set theory provide an excellent means for representing imprecision and uncertainty in the decision-making process and for defining the reasoning in such processes (Zadeh, 1983).
In terms of mathematical modelling, the fuzzy logic rule that deals with either of the one may applicable as "True" or "False" logic or "0" or "1" logic, the use of fuzzy logic rule is to determine the fuzzy set theory is able to deal with many valued logic that has prevailed due to probabilistic and vagueness inherent in real life problem in a particular phenomenon, allowing generalization of a characteristic function to a straight linear membership function. The Fuzzy logic sets rule may also used to calculate the operation of Reservoir gated structure. The diagrammatic representation of Fuzzy Logic as given below fig.1
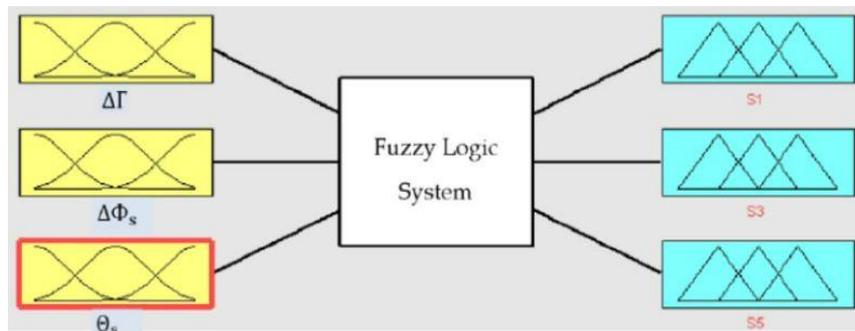
Fig.1 Diagrammatic representation of the Fuzzy Logic

2.2 Artificial Neural Network

It is a very popular and reliable method for prediction of rainfall runoff modelling. The artificial neural techniques basically made-up of each interconnected nodes or neuron specify simply and result orientated configuration the neuron of the particular model collects input information from both a single and multiple types of sources and produces output in terms of various model factors. An Artificial Neural Network technique is created by interconnection of many of the neurons in a sequential configuration. Artificial neural network is an element of neuron characterising the neural network are the distributed representation of information, local operations and non-linear processing.

The theory of Artificial Neural Network has been concluded by various researchers using MATLAB tools box and by developing the algorithms in conceptual and efficient way. The main principle of neural computing is the development of black box modelling with a set of training data and output as the result using various types of Artificial Neural Network tools present in the black box model. The diagrammatic representation of Artificial Neural Network as
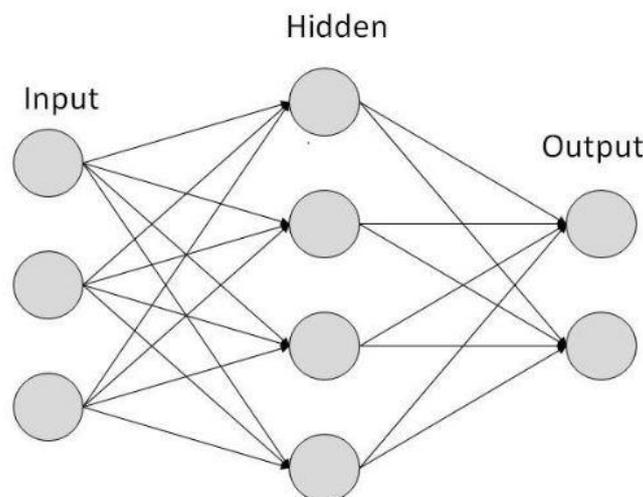

Fig.2 Shows that the Artificial Neural Network Architecture

2.3 Genetic Algorithms

Genetic Programming is a part of the evolutionary algorithms. In Genetic Algorithms the evolutionary changes may be directed towards the creation of various models that make a very simple and conceptual flow model. In this evolutionary algorithm, evolving entities are presented with a collection of definite sets of data and the evolutionary process is directed towards the final development of the algorithms based on various input data. The preciseness of data and development of model based on our complex problem can easily available functional nodes. In the Genetic Algorithms, the selections is quite natural process of development of mathematical models along the basic observation based on selected problem related to water resources as the behaviour of water is itself a complex way. Genetic Algorithms is an ac as a very efficient search algorithm that need not assume the functional form of the underlying relationship. The genetic algorithm is a Pool of solutions rather than once in a single (Vladan Babovic et al. 2002). The application of Genetic Algorithms may also applicable to design and implication of problem related to water resources Engineering and System Engineering Problems.
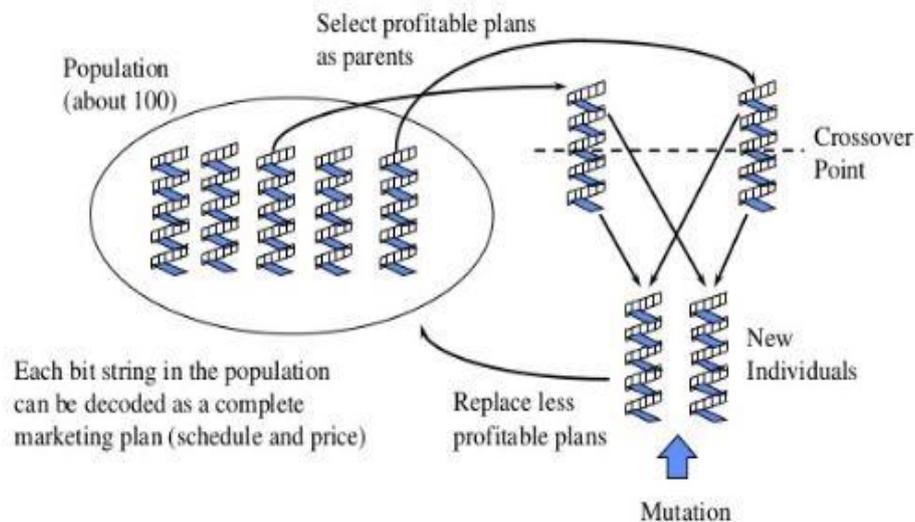

Fig.3 Model of Genetic Algorithms

2.4 Ant colony optimization

Ant colony optimization is a technique used for solving problem using optimization that was introduced in the early 1990's. This optimization techniques will inspiring source of ant colony optimization is the foraging behaviour of real ant colonies. This technique is a swarn optimization method based on prediction of Pre and post

monsoon effects also simulates the decision-making processes of ant colony similar to other adaptive learning techniques. The first Ant Colony Optimization algorithm was called the ant system basically this techniques involves that the solving the problem to find out the short way for design the pipe network system in urban planning of water distribution system to link the various activities. The use of Optimization problems are of high importance for both the Engineering as well as for the applied Engineering
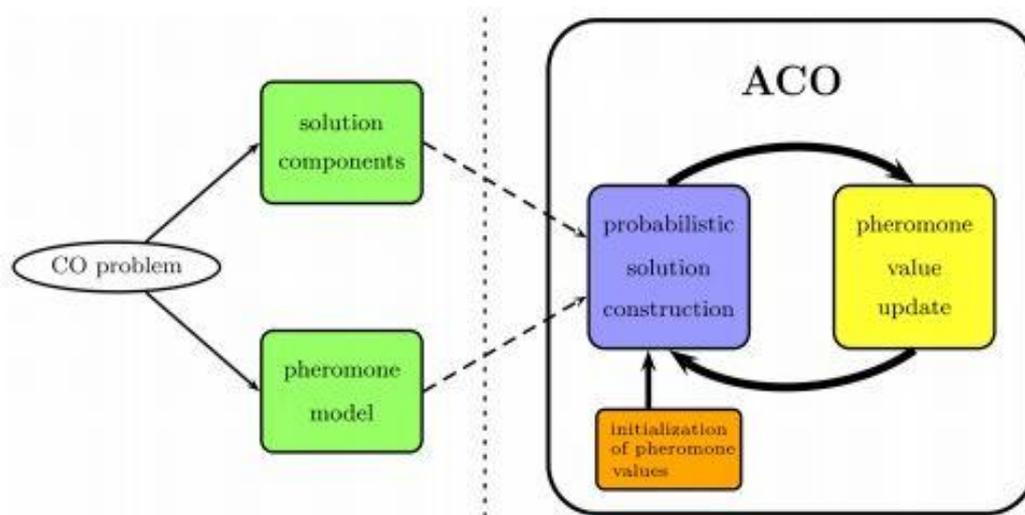

Fig: 4 Flow of Ant Colony Optimization (Blum C (2005))

3. CONCLUSIONS
The following conclusions were made from this study as given below:
1. The use of Artificial Neural Network involves predication of model using input data
2. The Genetic Algorithms is widely used in the areas of water resources engineering Problem related to reservoir operation problems
3. The Ant colony optimization also gives the complex analytical problem in to simple solver manner.
4. Fuzzy Logic is also help to analysis and solves the problem frequently and easily.

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