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The convergence of budding reckoning Soft computing technologies

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Abstract: **- Soft Computing methodologies represents the amalgamation of promising problem-solving technologies such as Neural Networks (NNs), Fuzzy Logic (FL), Probabilistic Reasoning (PR) and Genetic Algorithms (GAs) . We present a collection of tools and methods that can be used to perform diagnostics, estimation, and control. These tools are an enormous match for real-world applications that are characterized by imprecise, uncertain data and incomplete domain knowledge. Each of these technologies offer us with complementary reasoning and searching methods to solve complex problems. In this paper after a brief description of each of these technologies, we will analyze some of their most useful combinations, such as the use of FL to control GAs and NNs parameters; the application of GAs to evolve NNs or to tune FL controllers; and the implementation of FL controllers as NNs tuned by back propagation-type algorithms .We summarize the recompense of SC techniques and in particular the synergy derived from the use of hybrid SC systems.**

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1. INTRODUCTION

Soft Computing is a coined term describing the unification of various methods which are designed for modelling and for enabling solutions in real problems, that are not actually modeled, or which are very difficult to model, in mathematical terms. According to Zadeh (1994):[3] ‘‘2in contrast to traditional,hard computing, soft computing is tolerant of imprecision, uncertainty, and partial truth.’ Such problems have been associated with fuzzy, complex, and various dynamical systems, with various uncertain parameters. Such systems are the ones which can model the real world. Non linear problems can be easily which are not defined in terms of mathematical models.[4] Fuzzy Logic, introduced by Zadeh (1965), gives us a language, with syntax and local semantics, in which we can translate our qualitative knowledge about the problem to be solved. FL’s main characteristic is the robustness of its interpolative reasoning mechanism. Among all these methods related to soft computing, two of them are considered as the alternatives, which are Fuzzy Computing and Probabilistic Computing. Here we are explaining following methods to solve the problems Fuzzy Computing and Probabilistic Computing, Artificial Neural Network, Evolutionary Computing .[7] If we go towards Fuzzy Computing side, this defines the Law of Excluded Middle by Fuzzy Set Theory as one of the non-natural feature of the theory . This also identifies the various computations which may result by applying the crisp techniques of Probability Theory to fuzzy and other complex systems. We will explain different methods in detail.

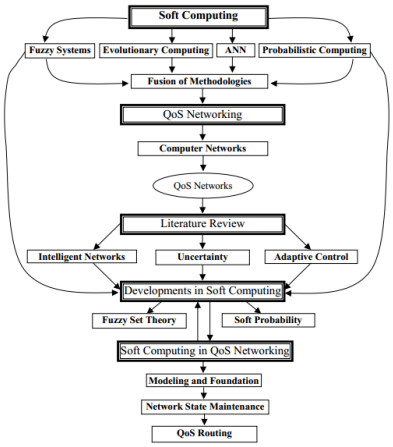

Fig 1 : Soft Computing

2.1 ARTIFICIAL NEURAL NETWORK

This is also known as neural network (NN), which is one of the mathematical modelling or computational modelling which are inspired by the structural / functional aspects of various biological neural networks. Such network has an interconnection of artificial neurons, that will process information using computational approach .[6] It is one of the adaptive system which changes structure depending on external or internal information which will flow via the network during one of the learning phase. They model various complex relationships between inputs

and outputs or to find patterns in data.[4] It is an interconnection of nodes, which is just like a network of neurons .

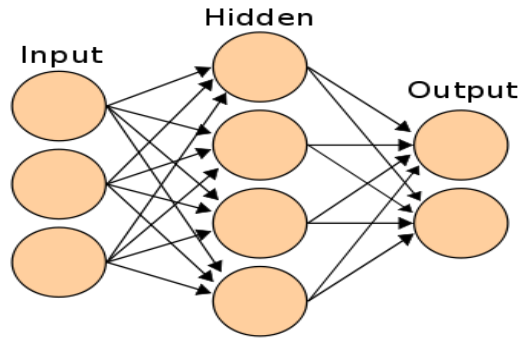

Fig 2 : Networking

2.2Fuzzy Computing

This is a logical system whose main motive is to formalize approximate reasoning. This is almost same s fuzzy logic theory which is basically theory of classes having unsharp boundaries. Linguistic variable plays one the important role in fuzzy logic . For example, we consider age as one of the linguistic variable whose linguistic values are young ,middle-aged and old , linguistic variable can be viewed in form of data compression which is known as granulation .[5] The same effect can be checked using quantization but in this case values are intervals whereas in case of granulation values are overlapping fuzzy sets. Granulation is better than Quantization in many respects such as it defines no of ways by which humans can interpret linguistic values.

2.2.1 FUZZY SETS AND THEIR OPERATIONS

They are defined by membership functions which can be assigned to each element x in a set of numbers, A(x) in an interval from [0,1].Operations possible are complement and union .

2.2.2 PROPERTIES OF FUZZY RELATIONS:

Fuzzy Relations actually describe the degree of association rather than describing the full presence or full absence of association of elements of different sets in the case of crisp relations . It provides fuzzy relations the capability for capturing the uncertainty and vagueness in relations between sets and elements of a set. This also enables fuzzy relations in order to capture broader concepts that are expressed in fuzzy linguistic terms when we describe the relation between two or more sets.[3] For example, when classical sets are used in order to describe the equality relation, this can only describe the concept "*x* is equal to *y*" with absolute certainty, i.e., if *x* is equal to *y* with unlimited precision, then *x* is related to *y*, otherwise *x* is not related to *y*, even if it was slightly different.[10] Thus, it is not possible to describe the concept "*x* is approximately equal to *y*".

2.2.3FUZZY COTROL

Here process can be very easily controlled by using human knowledge which made possible to find control solutions for which mathematical model is unavailable. Steps for fuzzy control algorithm are obtaining information , fuzzification , running of interference engine and defuzzification.

3.1 PROBABILISTIC COMPUTING

Paradigms on which probabilistic reasoning is based are Bayesian Belief Network and Dempster Shafer's Theory of Belief /Mathematical Theory of Evidence.

3.1.1BAYESIAN BELIEF NETWORK

It is the network which is defined by Thomas Bayes where first belief propagation was defined in 1980 by Pearl where scheme for trees and poly-trees has been defined in series of research publications .In order to decrease technical complexity we can use techniques like moralization so inorder to decrease value of n , dividing problem in sub problems .

3.1.2 DEMPSTER SHAFER'S THEORY OF BELIEF/ MATHEMATICAL THEORY OF EVIDENCE

This is generalized view of Bayesian Theory which defines mechanism for evaluating outcome of systems alongwith randomness and probabilistic uncertainities. This method is basically used as alongwith its unique features it can be used with classical Probability Theory and Boolean logic.

Graph Type	Complexity	Variables
Tree	$O(n^2)$	*n* is the number of values per node.
Poly-tree	$O(K^m)$	K is the number of values per parent node, *m* is the number of parents per child.
Multi-connected graphs	$O(K^n)$	K is the number of values per node, *n* is the size of the largest non-decomposable sub-graph.

Table 1 : Increasing complexity based on Bayesian Network

4. EVOLUTIONARY COMPUTING

This covers Evolutionary Strategies (ES) , Evolutionary Programs(EP) , Genetic Algorithms (GA) and Genetic Programming(GP) where ES is used for function optimization , EP is used for generating strategies with the help of finite state automata, GA are used for processes in biological systems , GP is used to generate approximate solution to problems .

5. FUSION METHODS

Modeling Techniques	Algebraic Expressions	Dynamical Systems (Linear Differential Equations)	Bayesian Belief Networks	Neural Networks	Fuzzy Systems TSK/ ANFIS	Fuzzy Instance Based Reasoning
Model Structure	Expression	Order	Topology	Topology	Rule Set	Attribute Space
Model Parameters	Weights	Coefficients	Prior Prob. Conditional Prob.	Biases Weights	Term sets Scaling Factors Coefficients	Attribute weights Similarity parameters
Reasoning Mechanism	Evaluate expression	Solve equations - Closed form - Approximation	Propagation	Propagation	Node evaluation & Propagation	Local Model evaluation & Output combination
Design Search Method	Manual Gradient EA	First principle Energy balance methods (Bond Graphs)	Manual EM EA ...	Manual EA Backpropagation Conjugate gradient, ...	Manual EA Backpropagation ...	Manual EA ...

Table 2 : FUSION METHODOLOGY

CONCLUSION

Applications has been increasing day by day in field of soft computing techniques and there relation in fuzzy logic ,neural network and probability reasoning whose main aim is to achieve robustness, low solution cost and uncertainity . Its main aim is to define granulation , linguistic variable and fuzzy graphs Role model for this is human mind . Its use has been increased in the field of chemistry, medicine, information engineering, networking .

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