International Journal of Psychosocial Rehabilitation, Vol. 23, Issue 05,
2019 ISSN: 1475-7192

Implementation of Techniques of Soft Computing on Bio Medical Image Processing

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Abstract--- *this paper proposes a solution to those real world problems that cannot be solved mathematically by soft computing. It enables solution to ambiguous problems by a fusion of methodologies. Soft computing comprise of complementary elements of fuzzy logic, evolutionary computation and neural computing. Applications of soft computing are found in various areas, most importantly image processing. Applications of different methods of soft computing are found in biological and industrial processes, financial and investment trading and engineering design. The literature is analysed based on the style of method of soft computing, the discipline of investment used, and demonstration of success and application of research in real world problems.*

Index Terms--- *fuzzy logic, soft computing, genetic algorithm, optimization algorithms.*

I. INTRODUCTION

Uncertainty, approximation, imprecision and partial truth are dealt in soft computing. Human brain inspires soft computing. The soft computing works on the principle of "to exploit the tolerance for imprecision, uncertainty, partial truth, and approximation achieve tractability, robustness and low solution cost and solve the fundamental problem associated with the current technological development, the lack of the required intelligence of the recent information technology that enables human brain functionality"[1]. The soft computing have fundamental ideas that are linked to several previous influences. The recognition of techniques of soft computing is done as alternatives to well established and standard hard computing paradigms [2]. When soft computing techniques are compared with hard computing methodologies, then it has been concluded that soft computing has different methods of representing uncertain, vague and imprecise concepts. Soft computing offers simplicity of computation and it is able to handle non-linearity [2]. The genetic computing and neural were included in soft computing at a later stage. The major components of a Soft Computing (SC) includes: "Fuzzy systems (FS)"[3] which includes "Fuzzy Logic (FL)"; "Evolutionary Computation (EC)", techniques of optimization using "Genetic Algorithms (GA)", "Particle Swarm Optimization (PSO)", "Neural Networks (NN)" having "Neural Computing (NC)"[14]; "Machine Learning (ML)" and "Probabilistic Reasoning (PR)".

II. RELATED WORK

The algorithms which are inspired by nature and based on population and are meta heuristic in nature are known as "Particle swarm optimization (PSO)" algorithms. The social behaviour of schooling fishes and blocking birds are

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Received: 10 Nov 2018 | Revised: 20 Dec 2018 | Accepted: 02 Jan 2019

mimicked by PSO algorithms. The solutions are improved based on a quality measure when starting from random distribution of set of particles or potential solutions.

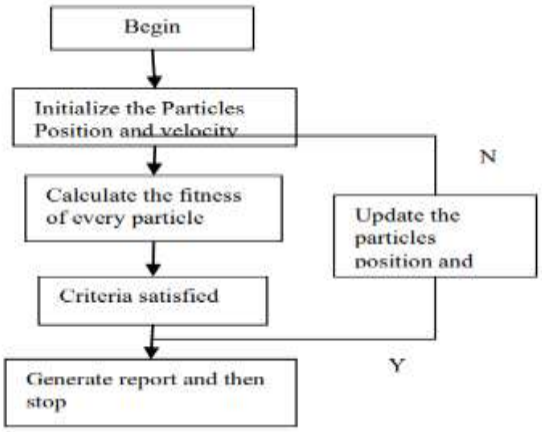

Fig. 1 PSO flow chart

The particles move around search space for improving the performance by a set of mathematical expressions that model inter particle communications. The movement of each particle is suggested towards its best position based on experience. The steps of PSO are illustrated in figure 1. Though generally being utilized and known as a technique of optimization, PSO finds its roots in "computer animation technology" and "image rendering" in which particle system is defined as "a set of autonomous individuals working together to form the appearance of a fuzzy object like a cloud or an explosion". This led to the generation of set of points and assignment to each one of them an initial velocity vector. This leads to iterative change in position of each particles by using velocity vectors while adjusting velocity vectors using some random factors. Generally, a PSO algorithm is stated as follows:

Procedure:

```
Particle Swarm Optimization begin
Initialize xi, vi and xbesti for each particle i; while (not
termination condition) d
        begin
        foreach particle i
           Evaluate objective function;
           Update xbesti
        end
        foreach i
           Set g equal to index of neighbor with best
xbesti;
           Use g to calculate vi; Update
           xi ¼ xi + vi; Evaluate
           objective function; Update
           xbesti
         end
     end
end
```


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III. PROPOSED SYSTEM

III.I. Fuzzy Genetic Algorithms

Genetic Algorithm:

Darwin's theory of evolution inspired basic philosophy of genetic algorithm established by Goldberg. Darwin's theory of evolution stated that the survival of an organisms depends on its strength [8]. The process of crossover, mutation and reproduction are responsible for maintaining an organism's survival. The computational algorithm for solving a problem by making use of an objective function is based upon Darwin's theory. Chromosome is a solution created by genetic algorithm. A chromosome comprises of genes and it may have binary, numerical, characters or symbolic value based upon the problem.

The suitability which is created by genetic algorithm, is measured by fitness function of chromosomes. A process known as crossover is used to mate chromosomes in population. The composition of genes of parents gives rise to the newly produces chromosomes known as offspring. Mutation is genes is gone through a few chromosomes. The mutation rate value controls the number of chromosomes that go through mutation and crossover rate decides the quantity of chromosomes that undergo crossover[4-7]. The 'Darwinian evolution rule' is used to select the chromosome for maintaining next generation. The chromosomes will be more probable in being selected for next generation that has higher value of fitness. The convergence of value of chromosome will be to towards a certain value.

Working of GA*:*

There are following stages in the working of GA:

- The initial population is generated randomly.
- The chromosome having best fitness value is selected.
- The selected chromosomes are recombined by using operators of mutation and crossover.
- Offspring is inserted into population.
- The chromosome having best fitness value is returned else step 2 is repeated.

A group of individuals collected together forms population in GA. A generation that produce new generation after undergoing changes is known as population. Population is made healthy by several members in GAs. The problem is optimized by a possible solution represented by each individual. The number of genes is equal to each chromosome in dimension of GA, which is a search space's dimension.

Applications of Genetic Algorithm:

The problems of real world are solved by the processes of evolving natural selection and it inspires genetic algorithms. The problems of optimization having objective function are solved by genetic algorithms such as non-differentiable, discontinuous, higher order, stochastic and nonlinear. The problems of 'mixed integer programming' are addressed by genetic algorithm where components are integer valued. The complex search problems are solved by genetic algorithms (GA). The designing of computer algorithms for task scheduling and optimizing problems is done by Genetic Algorithm [3].

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III.II. Optimization of fuzzy genetic algorithms

The purpose of measuring index of fitness is not served by an optimization model having single objective because of the reason of stringing of multiple data items into clusters [9-10]. The combination of fuzzy logic with genetic algorithm is shown in figure.

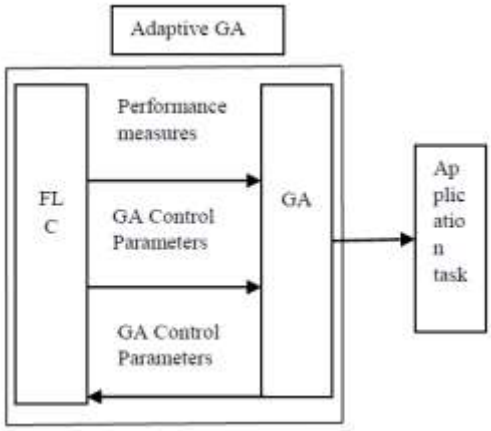

Fig. 2 Block diagram of fuzzy genetic

There are two elements of computation that work together in this algorithm: "Genetic Algorithm (GA)" and "Fuzzy Fitness Finder (FFF)". The profit or cost can be maximized or minimized for optimization. Survival of fittest is used for optimizing multiple objectives in decision taking problems in this real world applications. The parallel nature of evolution programs is an important aspect of computer science. The solutions of evaluation function is rated in terms of their fitness. GA is successfully run after altering composition of children by genetic operators. The survival of fittest is used for evaluating the terminating condition and genetic operator's parameters defined as a size of population by the parameter values of GA. Genetic algorithms based programming techniques of evolution programming are applied to many optimization problems such as "function optimization by linear/nonlinear constraints, the traveling salesman problem, and problems of scheduling, partitioning, and control". The problems of optimization are solved by fuzzy genetic algorithms in the best way as compared to standard genetic algorithms.

IV. ANALYSIS OF RESULT

IV.I. Artificial Neural Network

Millions of neurons in human brain are processing elements that are connected to each other in parallel [14-15]. The human's power of discriminating and intelligence is dependent on these neurons. A complex interconnection of processing elements similar to biological neurons replicates the performance of a biological system forms a neural networks. Instead of being data driven, ANNs are information driven. It is formed up of two

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layers, namely an input and an output layer. A common network called back propagation network (BPN) comprise of an input, an output and one or more intermediate layers called hidden layers. The values of weights are adjusted by training ANNs for performing a specific function. Neural networks are trained, adjusted to lead a particular input to a particular target output. The examples are generated for training the network and the performance of neural network is widely effected by the training algorithm. The "Back Propagation (BP) algorithm" is one of the used training algorithms. The deviation between "desired and actual objective function value" is reduced by this algorithm[11-13].

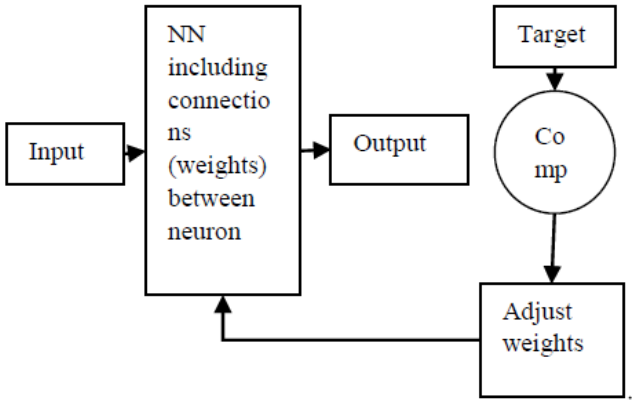

Fig. 3 Flow diagram of ANN

The neurons and weights included in artificial neural network and its flow diagram is shown in figure 1. An input is applied by specific mathematical operations and an output is generated. The patterns are recognized by training these neurons and incomplete patterns are also identified according to processes of human brain for recognition of information, retrieval of information and burying noise. The ANN have been widely improved by remarkable progress. Neurons have a simple behaviour and they are interconnected strongly, forming a network of ANN. They are capable of solving complicated problems.

V. CONCLUSION

The efficiency of 'image processing' is seen after implying 'soft computing', 'fuzzy algorithm', 'genetic algorithm' and 'neural network' based approaches on real time images. Complementary elements of 'fuzzy logic, neural computing and evolutionary computation' are comprised in the field of soft computing. This paper witnesses the wide applications of techniques of soft computing. This paper provides an expert to choose from wide variety of applications.

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