Bandwidth Optimization through Dynamic Routing

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ABSTRACT
In emerging network technologies intended to help a variety of services, it is usually to find that the packet switching service is implemented on top of a facility network. Asynchronous Transfer Mode (ATM) is a standout amongst most promising networking technologies. In this paper parallel genetic algorithm are implemented for dynamic routing networks for optimizing band width as far as limiting the delay between source and destination nodes and results are contrasted with Genetic Algorithm, Dijkstra's Algorithm (DA). Simulation results are performed for algorithms on MATLAB. The results affirmed the potential of Parallel Genetic Algorithm.

Keywords— **Dijkstra's Algorithm, Genetic Algorithm, Parrallel Genetic Algorithm**

1. Introduction

There is a rapidly demand for telecommunication networks to work practically in spite of deterrents, such as disabling portions of the network, limiting the links capacities, high cabling expenses, and so on. In this manner, a network should be constantly capable to sustain an acceptable point of performance. In spite of this prerequisite, the issue of dynamic rebuild of operational networks still got a little consideration. Today, with the fortifying obligation of utilizing the Internet and networking technologies, there has been enormous advancement in via the telecommunications services in the present information society. Asynchronous Transfer Mode (ATM) is one of the most promising networking technologies. ATM was rated to reduce the complexity of the network and improve the flexibility of traffic performance which has good ability for transmitting many kinds of information, and convey traffic over all kinds of networks. Using ATM it can be flexibly reconfigure the network and re-assign the bandwidth to meet the requirements of all types of services. Hence bandwidth optimization is a critical task for ATM.

2. Literature Review

The main objective of ATM network planning is to plan the network structure to convey the evaluated traffic and furthermore to limit the expense of network [2]. GA is a non-traditional based optimizing procedure which can be utilized to enhance the ATM network. GA steps [1] can be quickly depicted as Coding, Initialization, Evaluation, Reproduction, Crossover, Mutation and Terminating condition.GA has been utilized in past examinations to enhance the ATM network and furthermore in the structure of ATM network contemplated in [3].In [5] utilizes GA for apportioning bandwidth in the ATM network however the constraining component of their work is the encoding method that is difficult for some complex networks.ATM network configuration utilizing HGA creates good quality designs as far as system throughput and GA is utilized, yet the restricting factor is dynamic capacity[4].

3. Parallel Genetic Algorithm

The basic idea behind most parallel programs is to divide a task into chunks and to solve the chunks simultaneously using multiple processors. This partition-and-conquer approach can be applied to GAs in many different ways, and the literature contains numerous instances of fruitful parallel usage. Some parallelization techniques utilize a single population, while others separate the population into a few moderately segregated subpopulations. Some methods can exploit massively parallel computer architectures, while others are better appropriate to multicomputer with fewer and more powerful processing elements.
Parallel Genetic Algorithms (PGAs) are parallel stochastic algorithms. Like sequential genetic algorithms (GAs), they are based on the natural evolutionary principle. Better individuals survive and reproduce

themselves more often than the worse ones. To get a move on the processing of generations of populations, the population can be come apart into several subpopulations and run them in the parallel way. PGAs have often been applied to various hard optimization problems, machine learning, and prediction problems [6].
There are three different types of PGA
i) Global single-population Master slave GAs(Micro-grained model)
ii) Single-population fine grained (Cellular model)
iii) Multiple-Population coarse grained GAs (Island Model)

A. Master- Slave Scheme

In the master –slave method, as the name designate one node becomes toward becoming master and alternate nodes turn into the slaves. The master node keeps up the number of population of GA. The master node assigns individuals to slave nodes to parallelize the result of the fitness. The slave nodes determine the fitness of each one individual and sent it backside to the master node and then the master nodes does the selection, crossover and mutation.

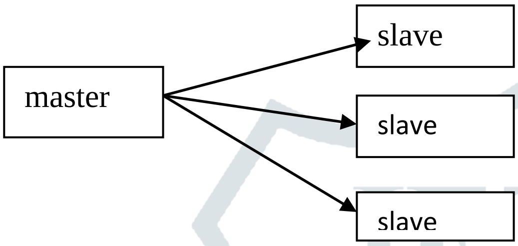

Figure1: Master Slave method

B. Cellular Scheme

In this scheme every individual is executed by a processing device independently. Individuals only mate with their connected neighbours during crossover and mutation. The neighbours of individuals are chosen by the connection topology. The Cellular scheme is a fine grained parallel scheme.

C .Island Scheme

In the Island scheme, the population of GA is partitioned into a few sub-population called islands. The sub-population works in separation from one another. Island communicate trade a portion of their best individuals, this procedure is called migration. The migration helps to spread spreads the nearby best arrangements in islands to other islands, with this the population can evolve to better solutions. The island method is perfectly appropriate for the parallel and distributed environments. With this plan, the calculation burden can be conveyed to various computing devices without enormous overheads brought about by the to convey the message between islands. Islands are connected by migration in a ring topology. Each island keeps up a migration data structure to support the migration. When an island does a migration it puts a fixed number of individuals into its neighbour's migration data structure. Every Island gets individuals from its migration data structure and afterward the relocation step is finished. There are two types of islands scheme Synchronous Island and asynchronous.

4. Methodology

PGA requires number of steps for the problem formulation as shown below:

Encoding Method:

This step is used to encode the variables of the optimization problem in terms of genes. In this work, a table was created for all pairs of links combination. The links in the table correspond to the virtual paths included between pair of nodes. In the proposed algorithm each link is identified by an ID number which is in accordance to the row number in the table. The proposed GAs will have 14 genes. Each gene corresponds to a link and each link has an identified (*Ci*).

Initialization: This stage brings into plays the encoding technique to generate a random initial population by at random generating a suitable number of chromosomes. In this paper, the chromosome length equals to the number of links in the original network.

Number of Populations: Different kinds of population sizes were used while running GA in every level.

Selection Mechanism: Selection methods help in deciding the convergence properties of GAs. A selection method is the procedure which constructively chooses better individuals in the current population for the mating pool [19], [20]. The selection strategy decides how individuals are picked for mating. The first step in the selection method is the fitness assignment. Every individual in the selection pool gets a reproduction probability based on its objective value. This fitness is utilized for the selection advance a short time later. Rank selection method is considered in this work.

Crossover: This process interchanges genes between the parents. Two chromosomes are randomly chosen from the population as parent chromosomes. Two new chromosomes with the genes from both the parent chromosomes are obtained. A two point crossover is considered in this work.

Mutation: This step is used to have a new chromosome which differs from the chromosomes in the population. A chromosome is randomly selected as the mutated chromosome. In this paper Gaussian mutation is used. in this mutation method, the mutation operator adds a unit Gaussian distributed random value to chosen gene. For newly created gene is clipped if it falls outside of user specified lower and upper bounds for that gene.

Fitness Evaluation: The fitness function is computed by using the mean time delay as given in Equation 1. This fitness is based on a minimum time delay over the evolved network. Each chromosome in the population is assigned a specific value associated with the gene arrangement in order to select the best individuals. Finally, the effectiveness of the proposed algorithm was tested based on the GA utilization.

$$Q = \begin{cases} \frac{1}{\sum_{i=0}^{n-1} wi(pi,pi+1)} & ; \text{feasible path} \\ 0 & ; \text{infeasible path} \end{cases} \qquad \text{Equation--1}$$

Where w (i)[p (i)p(i+1)]=cost between node p(i) and adjacent node p(i+1) If the path in not feasible, its fitness value is equal to zero.

Terminating condition

Starting with initial population, the evolution process is repeated until the satisfaction of the end condition. Various methods are considered for stopping criteria are Generations, Time limit, Fitness limit, Function tolerance.

5. Problem statement

Efficient data transmission designation and transfer speed streamlining calculations are required to guarantee QOS prerequisites for each kind of traffic in ATM networks. Bandwidth optimization is achieved in terms minimizing the delay function. Parallel genetic algorithm is optimizes to find the best values of fi such that the overall delay is minimized. In this paper, consider fitness function is the time delay from source node to destination node, Consider ATM network model [6]

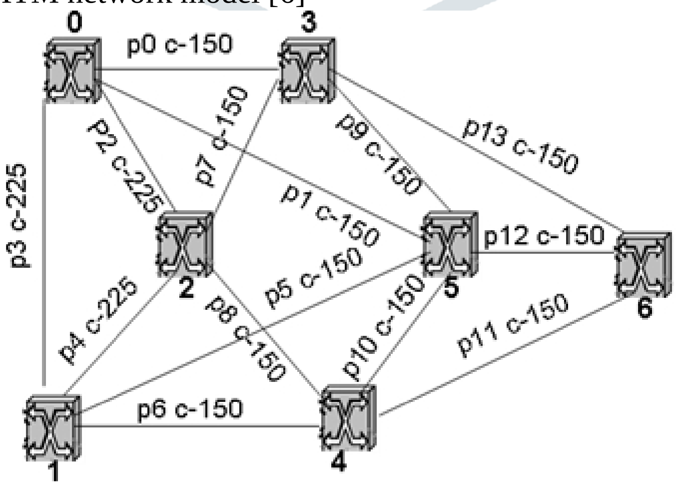

Figure2: ATM network model

6. Design Steps & Results Discussions

In this paper master slave method in parallel genetic algorithm is used.

Description of the parallel genetic algorithm

The master-node reads the input parameters and forwards them to all slave nodes generates a start-population

Applies the rank selection method for selection

Applies TWO -point crossovers

Applies mutations

Evaluates the fitness of the population

Every each node sends elements to its neighbours according to the chosen

and sends the best individual back to the master-node

the master node evaluates all the individuals and again chooses the best.

Table1 gives the different parameters are considered for the implementation of the algorithm.

Table1: Parameters for proposed algorithm

Genetic operator	Type
Initial Population	randint function
Crossover	Two point
Mutation	Interchange
Selection	Ranking
No.of Iterations	100

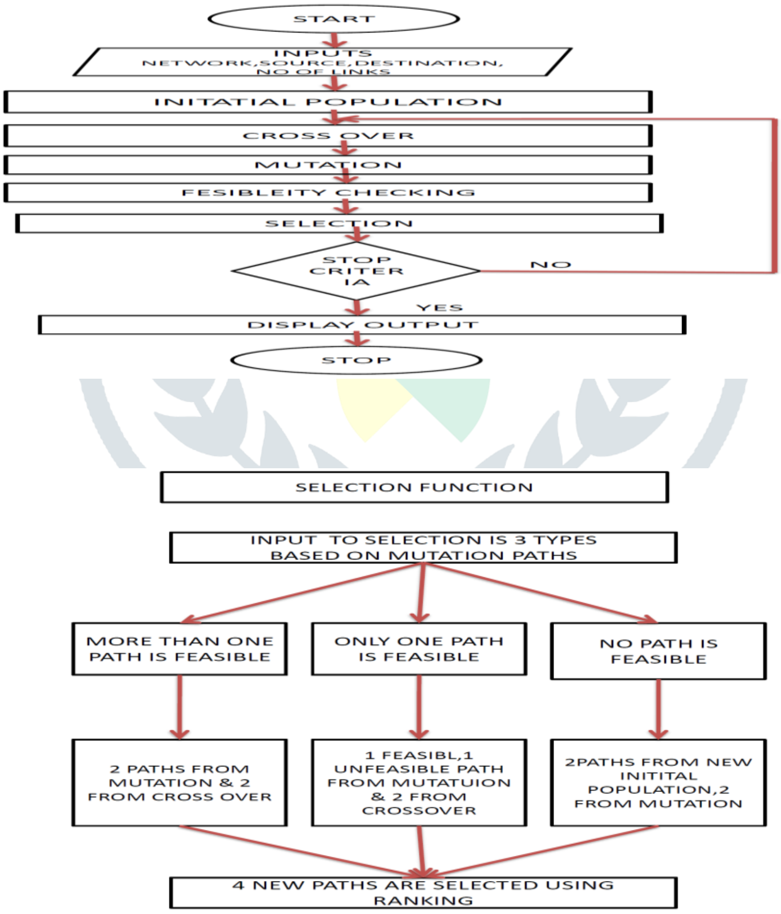

Figure3: Flowchart for proposed algorithm

Table2 gives the traffic specifications consider as the input for algorithm.

Table 2: Traffic Specification

ATM nodes	0	1	2	3	4	5	6	7
0	0	2	10000	10000	10000	10000	6	10000
1	2	0	7	10000	2	10000	10000	10000
2	10000	7	0	3	10000	3	10000	10000
3	10000	10000	3	0	10000	10000	10000	2
4	10000	2	10000	10000	0	2	1	10000
5	10000	10000	3	10000	2	0	10000	2
6	6	10000	10000	10000	1	10000	0	4
7	10000	10000	10000	2	10000	2	4	0

Table 3: Delay Time for Dynamic Routing in Matlab

Algorithm	Delay time
Dijkstra's Algorithm	0.877171 sec
Genetic algorithm	0.230088 sec
Parallel Genetic algorithm	0.217801 sec

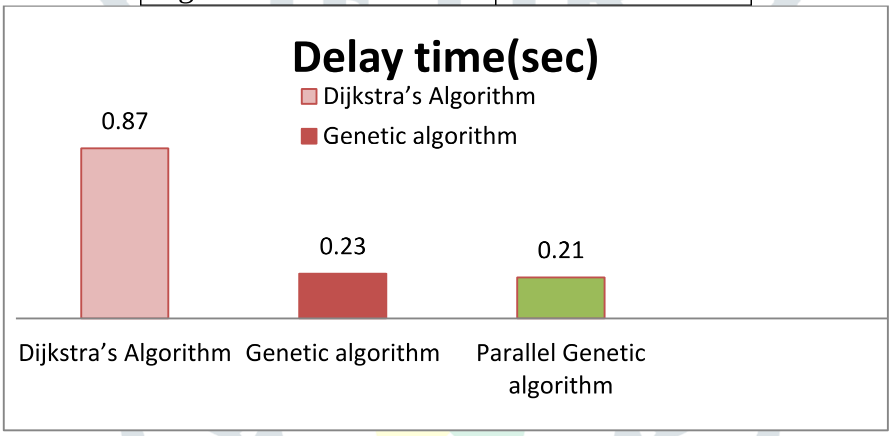

Figure 4: Comparisons between algorithms based on delay time

From figure4 shows that more delay variation observed between Dijkstra's Algorithm and Genetic algorithm. Considerable amount of delay variation is observed between Genetic algorithm and Parallel Genetic Algorithm. Bandwidth is optimized through by minimizing the delay.

Conclusion

In this paper discussed and implemented parallel genetic algorithm and also compared results with Dijkstra's Algorithm, Genetic algorithm based on execution time for dynamic routing networks in matlab. This analysis is useful for achieving bandwidth optimization in ATM networks. bandwidth is optimized in terms of minimizing delay for finding the shortest path between source and destination node in given network. We plan to extend our work to consider the design of a ATM networks which not only minimizes the delay time but also the Bandwidth utilization, packet loss over the ATM network at the same time. It is suggested to improve the current work by adding new issues related to dynamic capacity allocation within the network. Additionally, improvement can be achieved if using particle swarm optimization Algorithms (PSO).

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