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Neural Networks for Shortest Path Computation and Routing in Computer Networks

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Abstract:

Many intellectual optimization performances like Artificial Neural Networks (ANN),Genetic Algorithms (GAs), etc., were being planned to find the stagnant shortest path. Rapid expansions in the wireless communication predominantly in the field of mobile networks havematerialized as two major fields namely Mobile Ad hoc Networks (MANETs) and Wireless Sensor Networks (WSN). Topology elusiveness is the top most challenge in the mobile wireless network field i.e., the network topology changes over time due to energy conservancy or node mobility. In order to find the shortest path (SP) with in this network becomes a dynamic optimization problem due to nodes mobility. Nodes usually die due to low energy or it may move, this scenario makes the network to be more complex for finding shortest path. In this paper we propose a novel method of using Genetic Algorithms (GAs) to solve the dynamic shortest path discovery and routing in MANETs. MANETs is one of the faster growing new-generation wireless networks. The tentative results indicate that this GA based algorithm can quick adapt to environmental change (i.e. the network topology change) and create high quality solutions after each change.

I.INTRODUCTION

Mobile *ad hoc* network (MANET) is a self-organizing and self-configuring multihop wireless network, which is collected of a set of Mobile Hosts (MHs) that can move around freely and cooperate in spreading packets on behalf of one another. MANET supports robust and proficient operations by combining the routing functionality into MHs. In MANETs, the unicast routing establishes a multihop forwarding path for two nodes beyond the direct wireless communiqué range. Routing protocols also maintain connectivity when links on these paths break due to personal property such as node movement, battery drainage, radio proliferation, and wireless interference. In multihop networks, routing is one of the most important issues that have a significant impact on the presentation of networks. So far, there are mainly two types of routing protocols in MANETs, namely, topological routing and geographic routing. In the topological routing, mobile nodes utilize the topological information to construct routing tables or search routes directly. In the geographic routing, each node knows its own position and makes routing decisions based on the position of the destination and the positions of its local neighbors. Here, I adapt and considerquite a few genetic algorithms (GAs) that are developed to deal with general DOPs to solve the DSPRP in MANETs. First, I design the constituents of the standard GA (SGA) specifically for the DSPRP. Then, I integrate several refugees and memory schemes and their combination into the GA to enhance its searching capacity for the SPs in dynamic environments. Once the topology is changed, new immigrants or the useful information stored in the memory can help guide the search of good solutions in the new environment. Our second part details about literature survey. Our third part details about system architecture. Our forth part details about critical analysis. Our fifth part details about conclusion. Our sixth part details about reference.

II.LITERATURE SURVEY:

[1]A near-optimal routing algorithm employing a modified Hopfield neural network (HNN) is presented. Since it uses every piece of information that is available at the peripheral neurons, in addition to the highly correlated information that is available at the local neuron, faster coming together and better route optimality is achieved than with existing algorithms that employ the HNN. Besides, all the results are reasonably independent of network topology for almost all source-destination pairs.

[2] This paper presents a new neural network to solve comparisons with similar techniques from literature, for static and dynamic environment, prove that mmEA technique is promising.

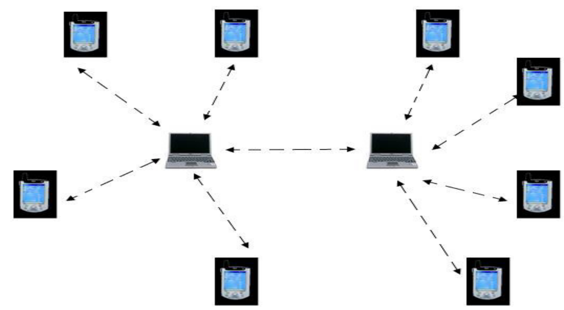
[3] Many real-world optimization problems have to be solved under the presence of uncertainties. A significant number of these uncertainty problems falls into the dynamic optimization category in which the fitness function varies through time. For this class of problems, an evolutionary algorithm is expected to perform satisfactorily in spite of different degrees and frequencies of change in the fitness landscape. In addition, the dynamic evolutionary algorithm should warrant an acceptable performance improvement to justify the additional computational cost. Effective reuse of previous evolutionary information is a must as it facilitates a faster convergence after a change has occurred. This paper proposes a new dynamic evolutionary algorithm that uses variable relocation to adapt already converged or currently evolving individuals to the new environmental condition. The proposed algorithm relocates those individuals based on their change in function value due to the change in the environment and the average sensitivities of their decision variables to the corresponding change in the objective space. The relocation occurs during the transient stage of the evolutionary process, and the algorithm reuses as much information as possible from the previous evolutionary history. As a result, the algorithm shows improved adaptation and convergence. The newly adapted population is shown to be fitter to the new environment than the original or most randomly generated population. The algorithm has been tested by several dynamic benchmark problems and has shown competitive results compared to some chosen state-of-the-art dynamic evolutionary approaches.

IV. SYSTEM ANALYSIS:

A systems analysis researches problem, plans solutions, recommends software and systems, and coordinates development to meet business or other requirements. They will be familiar with a variety of programming languages, operating systems, and computer hardware platforms. Because they often write user requests into technical specifications, the systems analysts are the liaisons between vendors and information technology professionals.[1] They may be responsible for developing cost analysis, design considerations, and implementation time-lines.

III.DESIGN:

A. ARCHITECHTURE DIAGRAM:



- Network model implementation
- Shortest path implementation
- Unicast routing
- Multicast routing
- Dynamic Environment Change

A. NETWORK MODEL:

First sample network has to be designed. Here some of the mobile nodes can be added to the particular network region. After, the creation of nodes connections will be established. Then path cost will be set for each connectivity.

B. SHORTEST PATH:

This module is used to find the shortest path from the source node to the destination node. Here shortest path is calculated for both

A. UNICAST ROUTING:

message packets are sent from source to destination by multi hop forwarding path, so the shortest path is calculated between single sources to the single destination.

B. MULTICAST ROUTING:

The single message in forwarded from the source to multiple destinations, so the shortest path is finding between single sources to the multiple selected nodes in the network.

C. DYNAMIC ENVIRONMENT CHANGE:

This module is designed to make change in the network model. Here two techniques are used to change network model.In MANET, nodes are not in fixed position; they are changing their position time to time. It affects the path cost also. So, it has to run the shortest path once again. Sometimes due to power loss, the mobile nodes on link can be failure. This also makes change in network structure.Due to the above reasons population in particular region is changed in every generation, so we have to maintain the diversity level. For that we are calling the immigrants method. Memory scheme method is used to enhance the performance of GA, by storing the old environment changes for the new generations.

1. DYNAMIC SP ROUTING PROBLEM:

In this section, I first present our network model and then formulate the DSPRP. We consider a MANET operating within a fixed geographical region. We model it by an undirected and connected topology graph *G*0 (*V*0 , *E*0), where *V*0 represents the set of wireless nodes (i.e., routers) and *E*0 represents the set of communication links connecting two neighboring routers falling into the radio transmission range. A communication link (*i*, *j*) cannot be used for packet transmission unless both node *i* and node *j* have a radio interface each with a common channel. key components: geneticrepresentation, population initialization, fitness function,selection scheme, crossover, and mutation. A routing path consistsof a sequence of adjacent nodes in the network. Hence, it is a natural choice to adopt the path-oriented encoding method.For the routing problem, the path-oriented encoding and the path-based crossover and mutation are also very popular

A.GENETIC REPRESENTATION:

A routing path is encoded by a string of positive integers that represent the IDs of nodes through which the path passes. Each locus of the string represents an order of a node (indicated by the gene of the locus). The gene of the first locus is for the source node and the gene of the last locus is for the destination node. The length of a routing path should not exceed the maximum length.

B. POPULATION INITIALIZATION:

In the GA, each chromosome corresponds to a potential solution. The initial population *Q* is composed of a certain number of, say *q*, chromosomes. To promote the genetic diversity, in our algorithm, the corresponding routing path is randomly generated for each chromosome in the initial population. We start to search a random path from *s* to *r* by randomly selecting a node *v*1 from *N (V1)*, the neighborhood of *s*. Then, we randomly select a node *v*2 from *N* (*v*1). This process is repeated until r *is* reached. Since the path should be loop-free, those nodes that are already included in the current path are excluded from being selected as the next node to be added into the path, thereby avoiding reentry of the same node into a path.

However, the channel assignment is beyond the scope of this paper. In addition, message transmission on a wireless communication link will incur remarkable delay and cost. The DSPRP can be informally described as follows. Initially, given a network of wireless routers, a delay upper bound, a source node, and a destination node, we wish to find a delay bounded least cost loop-free path on the topology graph. Then, periodically or stochastically, due to energy conservation or some other issues, some nodes are scheduled to sleep or some sleeping nodes are scheduled to wake up. Therefore, the network topology changes from time to time. The objective of the DSPRP is to quickly find the new optimal delay-constrained least cost acyclic path after each topology change.

2. SPECIALIZED GA FOR THE SP PROBLEM:

This section describes the design of the GA for the SP problem.The design of the GA involves several

C. FITNESS FUNCTION:

It is used to find the least cost path between the source and the destination. My primary criterion of solution quality is the path cost. Therefore, among a set of candidate solutions (i.e., unicast paths), we choose the one with the least path cost

D.SELECTION SCHEME:

Selection plays an important role in improving the average quality of the population by passing the high-quality chromosomes to the next generation. The selection of chromosome is based on the fitness value.

E. CROSSOVER AND MUTATION:

A GA relies on two basic genetic operators, crossover and mutation. Crossover processes the current solutions so as to find better ones. Mutation helps a GA keep away from local optima. Here chromosomes are expressed by the path structure, the single-point crossover to exchange partial chromosomes (subpaths) at positional independent crossing sites between two chromosomes.The population will undergo the mutation operation after the crossover operation is performed. Both crossover and mutation may produce new chromosomes that represent infeasible solutions. Therefore, we check if the path represented by a new chromosome is acyclic. If not, a repair function will be applied to eliminate the loops.

D. INVESTIGATED GAs FOR THE DSPRP:

A. GAS WITH IMMIGRANTS SCHEMES:

In stationary environments, convergence at a proper pace is really what we expect for GAs to locate the optimum solutions for many optimization problems. However, for DOPs, convergence usually becomes a big problem for GAs because changing environments usually require GAs to keep a certain population diversity level to maintain their adaptability. To address this problem, the random immigrants approach is a quite natural and simple way. The random immigrants maintain the diversity level of the population through replacing some individuals of the current population with random individuals, called *random immigrants*, every generation. As to which individuals in the population should be replaced, usually there are two strategies: replacing random individuals or replacing the worst ones.

B.GAS WITH MEMORY SCHEMES:

While the immigrant's schemes use random immigrants to maintain the population diversity to adapt to the changing environments, the memory scheme aims to enhance the performance of GAs for DOPs in a different way. It works by storing useful information from the current environment, either implicitly through redundant representations or explicitly by storing good (usually best) solutions of the current population in an extra memory. The stored information can be reused later in new environments. For example, for the explicit memory scheme, when the environment changes, old solutions in the memory that fit the new environment well will be reactivated, and hence, may adapt GAs to the new environment more directly than random immigrants would do. Especially, when the environment changes cyclically, memory can work very well. This is because in cyclic dynamic environments, as time passes, the environment will return to some old environment precisely, and the solution in the memory, which has been optimized with respect to the old environment, will instantaneously move the GA to the reappeared optimum of that environment.

V. CRITICAL ANALYSIS:

A.PROBLEMS FACED:

Wireless Networks growth and application is rapidly increasing. One of the problems in wireless networks is topology dynamics i.e. Network topology changes over time due to energy conservation or node mobility.Finding static shortest path (SP) is a major problem. Various methods have been proposed to find the optimal shortest path like Artificial Neural Network, Particle Swarm Optimization, and Genetic Algorithms and so on.

B.LIMITATIONS:

In this paper we propose a novel method of using Genetic Algorithms (GAs) to solve the dynamic shortest path discovery and routing in MANETs. MANETs is one of the faster growing new-generation wireless networks. The experimental results indicate that this GA based algorithm can quick adapt to environmental change (i.e. the network topology change) and produce high quality solutions after each change.

VI. CONCLUSION:

MANET is a self-organizing and self-configuring multi hop wireless network, which has a wide usage nowadays. The SP routing problem aims to establish a multihop forwarding path from a source node to a destination node and is one important issue that significantly affects the performance of MANETs. So far, most SP routing algorithms in the literature consider only the fixed network topology. It is much more challenging to deal with the SP routing problem in a continuously changing network like MANETs than to solve the static one in a fixed infrastructure. In recent years, there has been a growing interest in studying Gas for DOPs. Among approaches developed for GAs to deal with DOPs, immigrants schemes aim at maintaining the diversity of the population throughout the run via introducing random individuals into the current population, while memory schemes aim at storing useful information for possible reuse in a cyclic dynamic environment. This paper investigates the application of GAs for solving the DSPRP in MANETs. A DSPRP model is built up in this paper, specialized GA is designed for the SP problem in MANET, Immigrants and/or memory schemes that have been developed for GAs for general DOPs are adapted and integrated into - specialized GA (which gives several GA variants) to solve the DSPRP in MANETs. The experimental results indicate that both immigrants and memory schemes enhance the performance of GAs for the DSPRP in MANETs. Generally speaking, the immigrant's schemes show their power in acyclic dynamic environments, and the memory related schemes beat other schemes in cyclic dynamic environments. Finally this work investigates both the effectiveness and efficiency of GAs with immigrants and memory schemes in solving the DSPRP in the real-world networks, i.e., MANETs. There are several relevant future works. One interesting work is to further investigate other approaches developed for GAs for general DOPs to solve the DSPRP in MANETs and other relevant networks.

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