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Applied Evolutionary Optimization for Signal Processing in Wireless Networks

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ABSTRACT: The vast procedure of computer networks requires the enhancement in network topologies and management techniques so that user may be given high quality of service (QoS). The use of evolutionary optimization for efficient network routing is basically essential. The quantitative analysis and experimental evaluation of firefly algorithm in packet transmission with mesh topology by routing a message in hypothetical wireless computer network. Simulation was carried out in MATLAB 7.5 to demonstrate the efficiency of firefly algorithm for routing in computer network. Experimental performance was examined, by measuring the delay time in seconds and compared against packet size for quality of service.

I. INTRODUCTION

As additional persons transmit data by means of computer network, the quality of service established by user begin to degrade, due to this, a research on computer network routing is germane to improvement. Routing plays a significant part for providing a well delivering qualitative service in network, especially in wireless networks(Gihan and Wahied, 2010). Consequently, routers are free to move erratically and organize themselves indiscriminately, and thus, the network's wireless topology may change speedily and unpredictable situation could occur (Onifade et.al, 2013). Investigational work was carried out where congestion, throughput, failure rate, and distance were used as metrics for comparison with open shortest path first (OSPF) conducted in decades back (Osunade, 2012). From previous researches, message routing in a network is a 'compound concept or process' because thenetwork topology may change steadily and accessible state information for routing isfundamentally indefinite (Odekunle et.al, 2012).

Problem Statement

The use of nature-inspired or meta heuristic algorithm which may be combined with evolutionary optimization for efficient network routing; and experimental evaluation had not been previously provided for wireless network performance, hence this study

Aim and Objectives

This work aimed at stimulating hypothetical wireless network with mesh topology in MATLAB using firefly algorithm, for optimization and quality of signal in networks. The objectives are:

i. To examine the routing techniques, and optimization parameters being used to evaluate the quality of service (QoS) by users.

ii. To create and simulate hypothetical wireless network for message routing using firefly algorithm in selecting the most effective and least cost path.

II. RELATED WORKS

Firefly Algorithm (FA) with Artificial Neural Network (ANN) to predict the software cost accurately was integrated (Gihan and Wahied, 2010). Firefly Based Energy Efficient (FBEE) routing in Wireless Sensor Networks (WSN) was proposed for message routing in a switched network environment (Manshahia, 2015). A suitable model for packet routing in computer network was compared with the quality of service routing in wireless networks (Osunade, 2012).

Meta heuristic algorithms form an important part of contemporary global optimization algorithms, computational intelligence and soft computing (Xin-She andXingshi, 2013); these algorithms are usually nature-inspired with multiple interacting agents, thereby described firefly algorithm as a multimodal optimization application (Xin-She andXingshi, 2013).

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The use of neuro fuzzy system (NFS) for message routing in a computer network, which uses bandwidth and delay as input data with decision support system based on cognitive filtering in fuzzifying the routing to select the most effectiveroute/path with maximal bandwidth usage (Odekunle et.al, 2012). Recently, the use of Neuro-Fussy Model (NFM) for determining shortest routing path in a computer network was demonstrated by Adebare (2015).

Empirical knowledge of the observations and simulations of the convergence behavior of the current optimization algorithms suggests that exploitation tends to increase the speed of convergence, while exploration tends to decrease the convergence rate of the algorithm. On the other hand, too much exploration increases the likelihood of finding global optimization, while strong exploitation tends to make the algorithm trapped in a local optimum.

Nature-inspired metaheuristic algorithms, especially those based on swarm intelligence, attracted much attention about five years ago when literature developed it considerably (Xin-She and Xingshi, 2013). The genetic algorithm is a heuristic optimization algorithm that can model the routing of messages in a dynamic computer network, thus producing an optimal solution and also a firefly model (Gihan and Wahied, 2010). A subset of metaheuristics is often called swarm intelligence (SI) algorithms and has been developed by mimicking the swarm characteristics of biological agents (Xin-She and Xingshi, 2013).

III. METHODOLOGY

The goal is to determine optimal path for routing, therefore, the delay for every possible route(s) between source and destination represent the cost, the route(s) with minimum cost will be selected for transmitting the message or data packet.

The intensity of the flash light, also defined as attractive, is inversely proportional to the distance r from the light source. The intensity of the flash light is proportional to the call and is given by

$\beta = \beta_o e - yr^2$ where β_o is the attractiveness at *r* which is 0

β_o = Initial flash light intensity,

y = the light absorption coefficient

r = distance between firefly *i* and *j*

Hence, the movement of a less attractive firefly i towards a more attractive firefly j is determined by $Xi^{t+1} = X_i^t + \beta_o e - yr^2 ij\ (X_j^t - X_i^t) + \alpha_t \varepsilon_{ij}^t$

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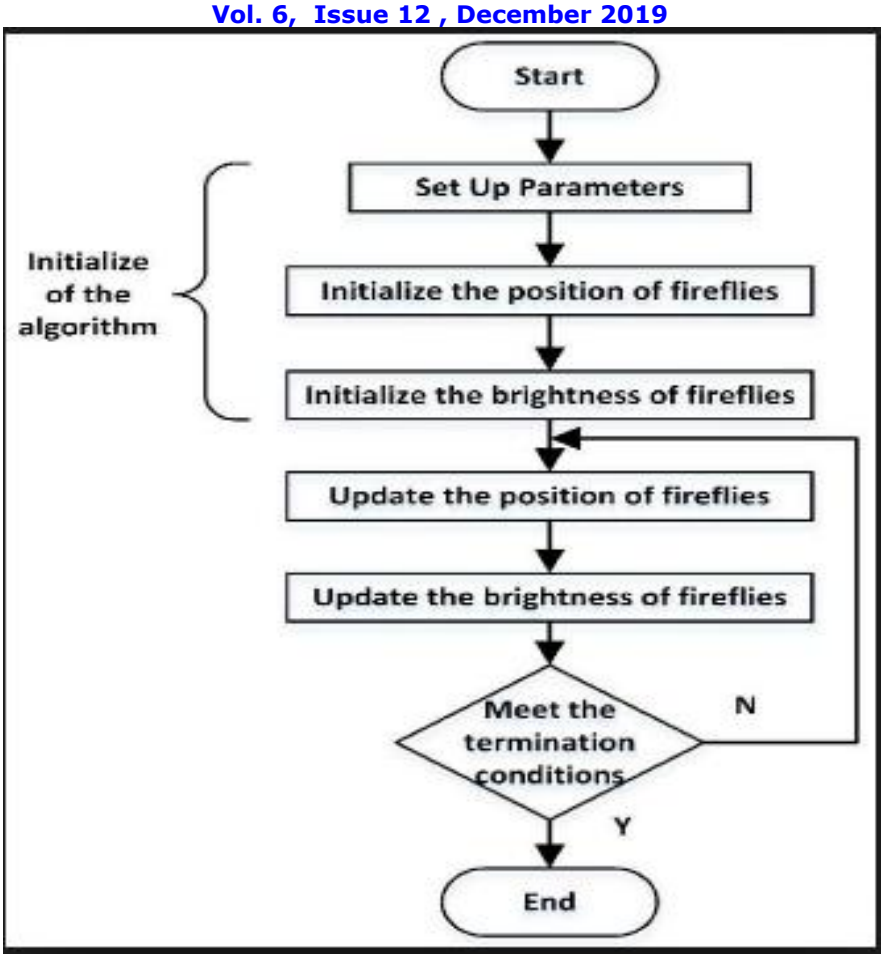

Fig. 1: Procedure Flow for Firefly Signal Optimization

In firefly algorithm, light intensity and attractiveness are the two important variables. The Firefly is attracted to the other firefly that has brighter flash than it. The attractiveness depends on the light intensity .Initial population of fireflies is generated with the objective function, thereby defining the light intensity by absorption coefficient in order to examine the attractiveness of fireflies to one another. For each of the fireflies in the given population, check the light intensity against the next if it is higher; then firefly 2 is brighter than firefly 1, therefore move firefly 2 towards firefly 1 for signal communication.

IV. SIMULATION AND RESULTS

Experimental performance was examined, by measuring the delay time in seconds and compared against packet size of the routed message unit for quality of service (QoS) in order to determine the suitability of firefly algorithm for optimizing routing signal in wireless networks.
The data packet (i.e. message) to be transmitted from source node, s to destination node, d will from through route i to route j to determine the maximum number of channels or hop count for available routes as delivery paths.
Hence, experimental evaluation is quite empirical because it inculcates performance and path determination by maximizing network throughput and minimizing delay time; being essential parameters or metrics which are rarely used in evaluating network routing for quality of service (QoS) as depicted in the following figures.

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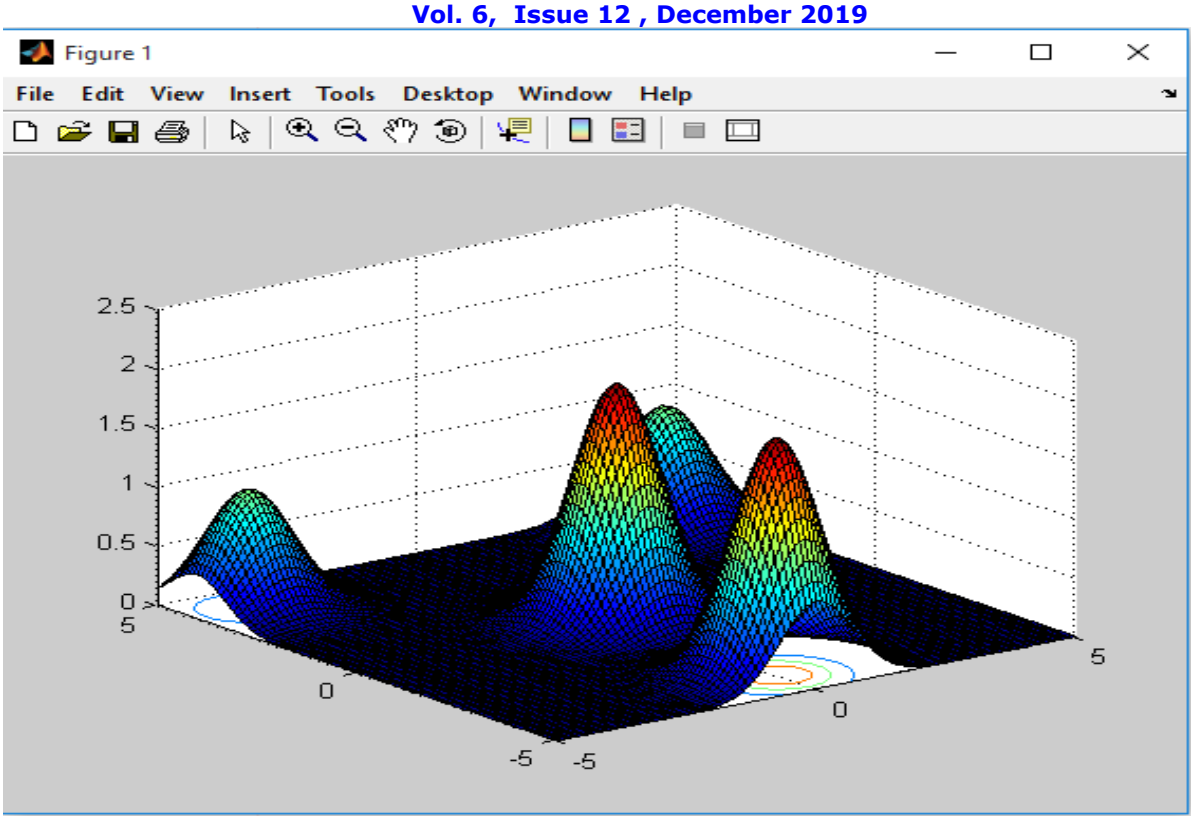

Fig. 2: Initializing the fireflies' population in MATLAB

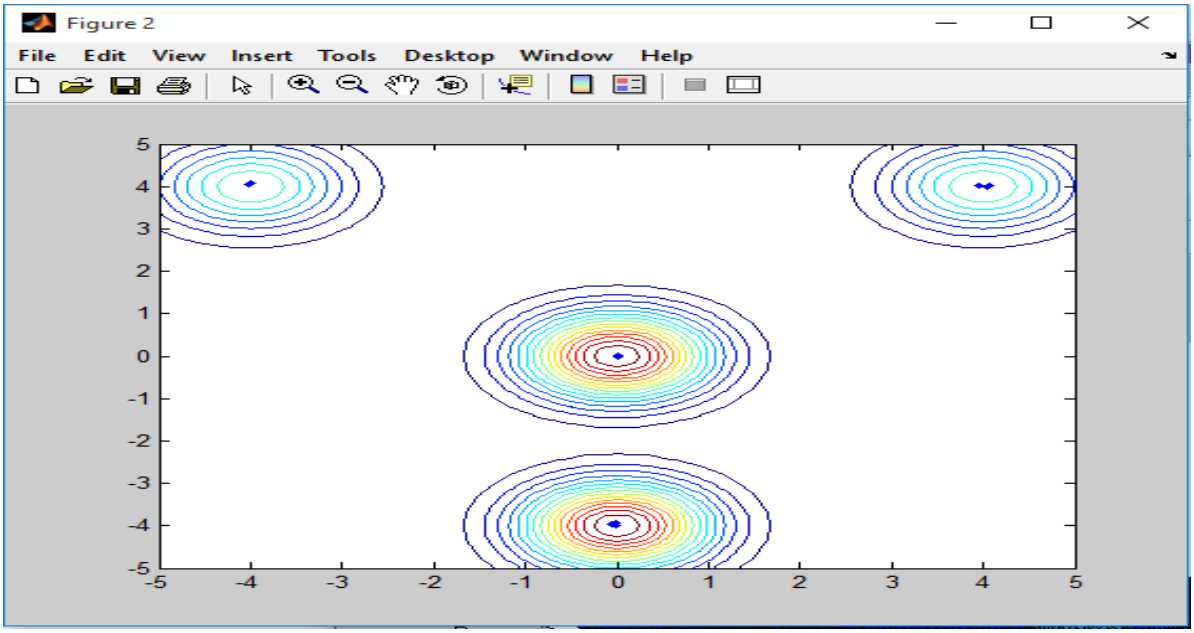

Fig. 3: Attractiveness by absorption coefficient in MATLAB

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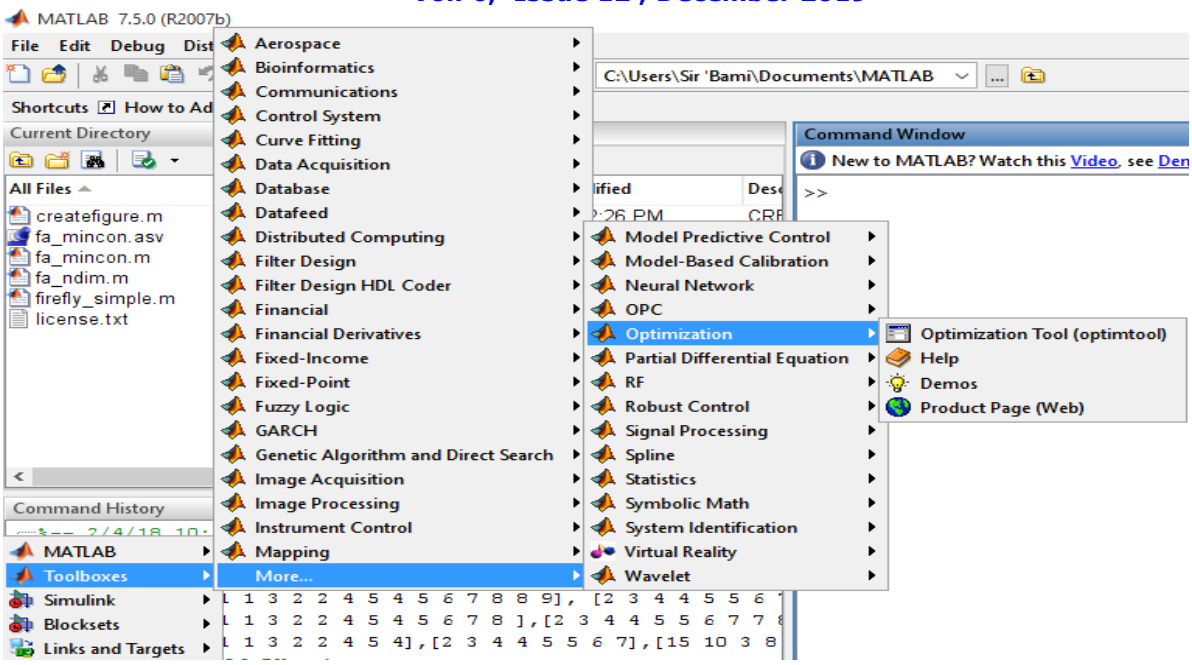

Fig. 4: Exploring optimization toolboxes in MATLAB

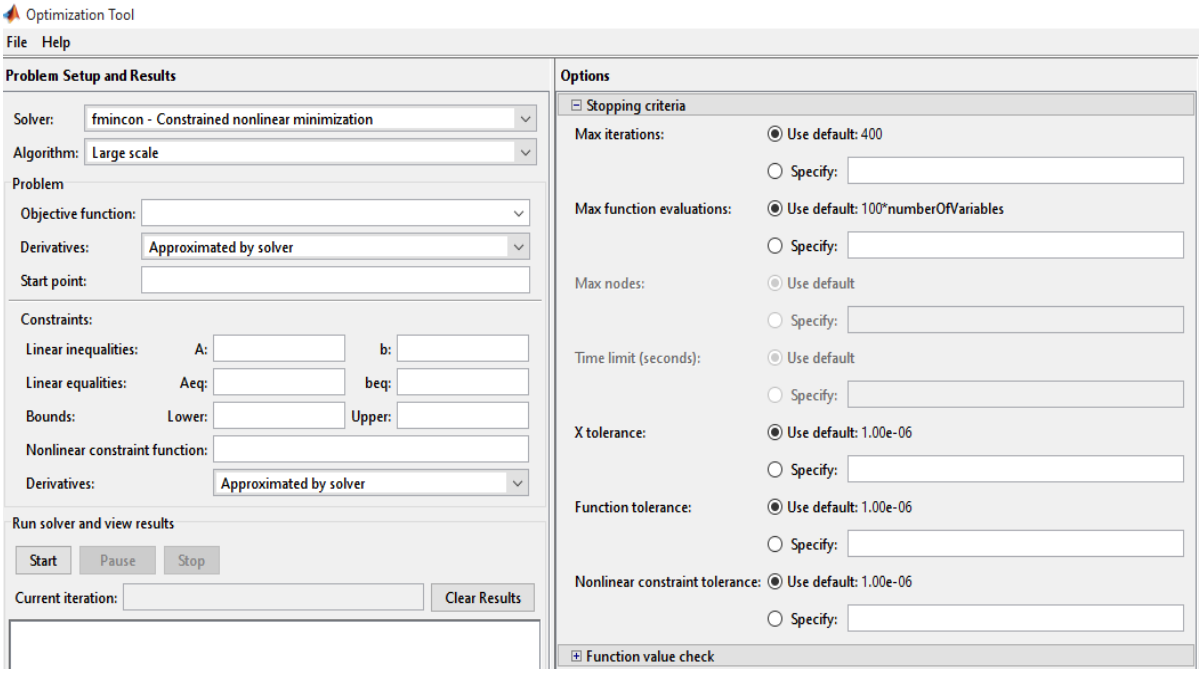

Fig. 5: Setting the parameters for non linear constraints

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Initialization: transmission throughput for message routing with host broadcast by hop-count metrics

estimated_throughput_for_every_node_as_the_QoS_parameter =

    0.7556    1.1577    1.2334    1.3388    1.0488    1.2114    1.3382    1.2746    1.0236    1.2617


maximal_light_intensity_for_signal_in_path_determination =

    0.5597


estimated_randomness_for_convergence_by_flash_attraction =

    80
```

Fig. 6: Average Throughput for Network Routing by Hop-Count

V. CONCLUSION

Computer networks are becoming more abundant in today's business environments as they play a central role in maintaining and transmitting message or information.

The growing usage of computer networks is requiring improvements in networks technologies and managements techniques so that users will be provided with high quality of service (QoS).

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