International Journal of Electronics Communication and Computer Engineering
Volume 4, Issue 2, ISSN (Online): 2249–071X, ISSN (Print): 2278–4209

A New Approach for Minimizing the Routing and Wavelength Assignment Problem

Malothu Amru
Associate Professor
Samskruti College of Engineering & Technology, AP, India

Subrahmanya Sastry.S
Associate Professor
Tirumala College of Engineering, AP, India

P. Satyanarayana
Associate Professor
Samskruti college of Engineering & Technology, AP, India

Abstract - **The RWA problem is a crucial and complicated designing issue in optical networks which is known to be an NP-hard problem. In this paper, modeling for Routing and Wavelength Assignment (RWA) problem in DWDM optical networks is proposed. In this technique is introduced for solving RWA problem which is known to be an NP-hard problem. In this technique every food source contains one of the K possible paths between each node pair in optical network. The artificial bees modify the positions of food sources and evaluated by the fitness function. The simulation results shows different population sizes on speed convergency and link state variables after routing and wavelength assignment. It ink state variables after routing and wavelength assignment.**

Keywords - **Transparent Optical Networks, Intelligent Systems, Routing and Wavelength Assignment, Artificial Bee Colony Algorithm, Optimization.**

I. Introduction

Numerous research studies have been conducted on the RWA problem. Several RWA schemes have been proposed that differ in the assumptions on the traffic pattern, availability of the wavelength converters, and desired objectives. The traffic assumptions generally fall into one of two categories: static or dynamic. In static RWA models we assume that the demand is fixed and known, i.e., all the lightpaths that are to be set up in the network are known beforehand. The objective is typically to accommodate the demand while minimizing the number of wavelengths used on all links[1] .Wavelength-Division Multiplexing (WDM) in optical fiber networks has been rapidly gaining acceptance as a means to handle the ever-increasing bandwidth demands of network users [2]. In a wavelength-routed WDM network, end users communicate with one another via all-optical WDM channels, which are referred to as lightpaths [3].

The integer linear programming (ILP) models have been successfully employed for solving RAW problem for small size optical networks. Therefore, different heuristic and intelligent algorithms [4, 5] have been developed for solving RWA problem for large scale networks. The aim of this paper is to introduce an Artificial Bee Colony (ABC) algorithm for solving RWA problem. In this paper providing a compatible and practical model of ABC algorithm for RWA in optical networks is the main concern which could be extended and improved more in future for different applications. Given a set of connections, the problem of setting up light paths by routing and assigning a wavelength to each connection is called the Routing and Wavelength-Assignment (RWA) problem. Typically, connection requests may be of three types: static, incremental, and dynamic [4]. For the routing sub problem, there are three basic approaches that can be found in the literature: fixed routing, fixed-alternate routing, and adaptive routing [6], [7], [8], [9], [10]. Among these approaches, fixed routing is the simplest while adaptive routing yields the best performance. For the wavelength-assignment sub problem, a number of heuristics have been proposed [11], [12], [13], [14], [15], [16], [17]. In this paper introduce an artificial bee colony (ABC) algorithm to solving the RWA problem and which is more efficient in a distributed environment.

In this paper is organized as follows. The ARTIFICIAL BEE COLONY algorithm is presented in Section II. The simulation results are presented in Sectional. Concluding remarks are made in Section IV.

II. Artificial Bee Colony Algorithm

In ABC algorithm, the colony of artificial bees contains three groups of bees: employed bees, onlookers and scouts. First half of the colony consists of the employed artificial bees and the second half includes the onlookers. For every food source, there is only one employed bee. In other words, the number of employed bees is equal to the number of food sources. The employed bee of an abandoned food source becomes a scout. The search carried out by the artificial bees can be summarized as follows:

- Employed bees determine a food source within the neighbourhood of the food source in their memory.
- Employed bees share their information with onlookers within the hive and then the onlookers select one of the food sources.
- Onlookers select a food source within the neighbourhood of the food sources chosen by themselves.
- An employed bee of which the source has been abandoned becomes a scout and starts to search a new food source randomly.

In the ABC algorithm the position of food source represents a possible solution to the optimization problem, and the nectar amount of a food source corresponds to the profitability (fitness) of associated solution.The basic steps are used in ABC algorithm as shown details.

2.1. Initialization of the parameters

In this algorithm, The number of food sources (SN) which is equal to the number of the employed bees or onlooker bees i.e every food source is consider on bee.

2.2. Initial food source

Initial food sources are generating randomly within the range of the parameters defined by:

$$X_{ij} = X_j^{min} + rand(0,1)(X_j^{max} - X_j^{min})$$

Where
i=1…SN,
j=1…D,
SN is the number of food sources and D is the number of optimization parameters.

2.3. Sending employed bees to the food sources sites

After producing initial source site then to sending employed bees to the food sources. In this step, the employed bee produces a modification on the position of the food source (solution) in her memory depending upon local information (visual information) and finds neighboring food source, and then evaluates its quality. In ABC, finding a neighboring food source is defined by:

$$V_{ij} = X_{ij} + \Phi_{ij}(X_{ij} - X_{kj})$$

After producing Vi and the calculate the fitness function as shown below

$$Fitness_i = \begin{cases} 1/(1+f_i) & \text{if } f_i \geq 0 \\ 1+abs(f_i) & \text{if } f_i < 0 \end{cases}$$

2.4. Calculating probability value

The probability value depends up on fitness value in the population as shown below.

$$P_i = \frac{Fitness_i}{\sum_{i=1}^{N} Fitness_i}$$

In above equation, pi is the probalitiy value and N is the number of food source. The pi is the promotional in to the fitness value.

The algorithm for ABC algoritm as shown below
The initialization of parameters
Construct initial food source
Sending employees bee to the food source using ABC algorithm
Calculate fitness value of each bee
For m=1:I
For k=1:N
Apply Shift and doubleshift neighbourhood
c. Calculate probabilities value from fitness values by using equation (4)
d. Assign Onlooker Bees to Employed Bees from probabilitie values
f. Find best Onlooker, replace with respective Employed Bee
if fitness(Best Onlooker)<fitness(Employed)
Best solution= best onlooker
end
if fit (BestFeas Onlooker)<fit(Best)
N=N+1
end
If (N=Employed Bee)
Stop
End
end
I=I+1
If (I=MaxIteration)
Stop
End
End

III. Experimental Results

In order to analyses the behavior of the ABC algorithm; it has been run with different population sizes (colony sizes) and limited values. As shown in fig.2. The cases of using bigger population sizes have better convergence speeds. In Fig. 3 the link state variables after routing and wavelength assignment for proposed demand matrix are presented. The wavelengths of the links belong to some shortest paths are most used. The link number 6 is most used and links number 1 and 7 are least used and links number 3 and 4 are not used at all.

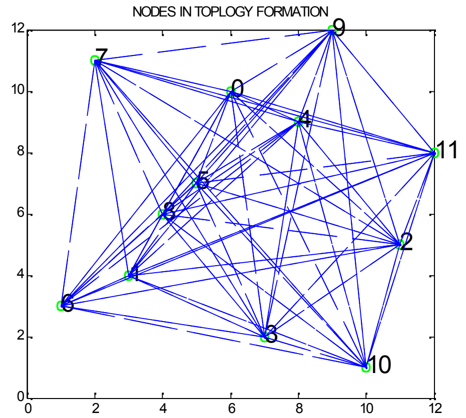

Fig.1. Network topology

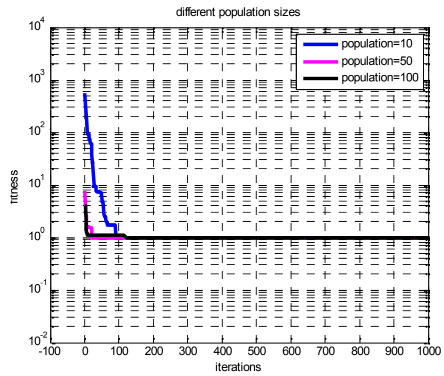

Fig.2.Different population sizes on speed convergence

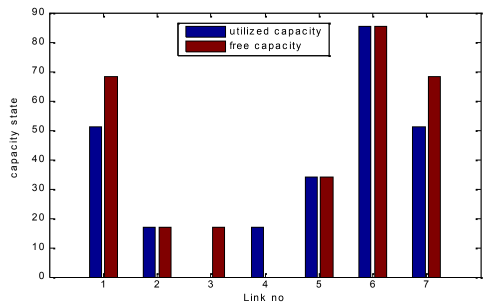

Fig.3. Link state variables after RWA

IV. Conclusion

This paper has presented an algorithm ABC for solving routing and wavelength assignment problem. ABC has effectively provided the best solution satisfying both equality and inequality constraints. This algorithm is found very effective in solving small to medium sized generalized assignment problems. The proposed approach could be extended for dynamic RWA schemes in real-time applications and employed by network resilience architectures.

Reference

[1] Asuman E. Ozdaglar and Dimitri P. Bertsekas. "Routing and Wavelength Assignment in Optical Networks"

[2] B. Mukherjee, Optical Communication Networks,McGraw-Hill, New York, 1997.

[3] I. Chlamtac, A. Ganz, and G. Karmi. "Lightpath Communications: An Approach to High-Bandwidth Optical WAN's," IEEE Transactions onCommunications, vol. 40, no. 7, pp. 1171-1182, July1992.

[4] R. Ramaswami and K. N. Sivarajan, "Routing andWavelength Assignment in All-Optical Networks,"IEEE/ACM Transactions on Networking, vol. 3, no. 5,pp. 489-500, Oct. 1995.

[5] K. Chan and T. P. Yum, "Analysis of Least CongestedPath Routing in WDM Lightwave Networks," Proc.,IEEE INFOCOM '94,Toronto, Canada, vol. 2, pp. 962-969, April 1994.

[6] H.Harai,M.Murata, and H.Miyahara, "Performance of Alternate Routing Methods in All-Optical Switching Networks," Proc., IEEE INFOCOM '97, Kobe, Japan, vol. 2, pp. 516-524, April 1997.

[7] L. Li and A. K. Somani, "Dynamic Wavelength Routing Using Congestion and Neighborhood Information," IEEE/ACM Transactions on Networking, to appear, 1999.

[8] S. Ramamurthy and B. Mukherjee,"Fixed-Alternate Routing and Wavelength Conversion in Wavelength- Routed Optical Networks," Proc., IEEE GLOBECOM '98, vol. 4, pp. 2295-2302, Nov. 1998.

[9] S. Ramamurthy, Optical Design of WDM Network Architectures, Ph.D. Dissertation, University of California, Davis, 1998.

[10] I. Chlamtac, A. Ganz, and G. Karmi,"Purely Optical Networks for Terabit Communication," Proc., IEEE INFOCOM '89, Washington, DC, vol. 3, pp. 887-896, April 1989.

[11] R. A. Barry and S. Subramaniam. "The MAX-SUM Wavelength Assignment Algorithm for WDM Ring Networks," Proc., OFC '97, Feb. 1997.

[12] A. Birman and A. Kershenbaum, "Routing and Wavelength Assignment Methods in Single-Hop All- Optical Networks with Blocking," Proc., IEEE INFO-COM '95, Boston, MA, vol. 2, pp. 431-438, April 1995.

[13] G. Jeong and E. Ayanoglu,"Comparison of Wavelength-Interchanging and Wavelength-Selective Cross-Connects in Multiwavelength All-Optical Networks," Proc., IEEE INFOCOM '96, San Francisco, CA, vol. 1, pp. 156-163, March 1996.

[14] E. Karasan and E. Ayanoglu,"Effects of Wavelength Routing and Selection Algorithms on Wavelength Conversion Gain in WDM Optical Networks," IEEE/ACM Transactions on Networking, vol. 6, no. 2, pp. 186-196, April 1998.

[15] S. Subramaniam and R.A. Barry,"Wavelength Assignment in Fixed Routing WDM Networks, Proc., ICC '97, Montreal, Canada, vol. 1, pp. 406-410, June 1997.

[16] X. Zhang and C. Qiao,"Wavelength Assignment for Dynamic Traffic in Multi-fiber WDM Networks,"Proc., 7th International Conference on Computer Communications and Networks, Lafayette, LA, pp. 479- 485, Oct. 1998.

Author's Profile

Malothu Amru

was born in 1980. He obtained B.Tech from Sri Venkateshwara Engineering College, Suryapet, M.tech from NIT Calicut. Presently he is working as Associate Professor in the ECE department of Samskruti College of Engineering & Technology, Hyderabad. His areas of interest are Communications and Networks.

Mr. Subrahmanya Sastry S

is presently working as associate professor in dept of ECE of Tirumala engineering college. He completed B.tech & M.Tech from JNTU University. Presently he is doing PHD in the area of communication systems. He had two international and one national journal. He is a life member in ISTE, ISECE, IAENG, IETE..His area of interest is communication systems

Pulime Satyanarayana

M.Tech currently he is the Head of Department for Master of Computer Applications at Samskruti College of Engineering & Technology. His research areas include Network Security, Mobile Communications, and Data Base Management systems