www.ijecs.in
International Journal Of Engineering And Computer Science ISSN:2319-7242
Volume 6 Issue 5 May 2017, Page No. 21343-21349
Index Copernicus value (2015): 58.10 DOI: 10.18535/ijecs/v6i5.26

A review on Neural Network and Ant Colony Optimization for Vehicle Traffic Analysis and Routing

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Abstract: This paper contains study regarding artificial neural network and ant colony optimization. An artificial neural network is used for traffic analysis and ant colony optimization is used for finding shortest path. All the previous work regarding the topic did not used the combination of these two techniques. Traffic analysis is very important topic because traffic is increasing on the roads day by day.
Keyword: Artificial neural network, Ant colony optimization, Neural Network, Vehicle Routing Problem.

I. Introduction

With the development of the countries, roads are the common way for communication. Each person uses the road for their work. So as a result traffic on the roads increasing day by day. So it is necessary to maintain traffic on the roads. For maintaining traffic, some traffic analysis method will be needed. This will be done by artificial neural network. After analyzing the traffic, an alternative path will provide to the vehicles which has less traffic and this is done with the help of ant colony optimization.

Artificial Neural Network: A network inspired by biological neural networks is known as **artificial neural network** (**ANN**). Its structure is based on the structure of neurons of human brain. Neural Network helps in analysis of the traffic.

An artificial neural network is the mathematical models depend upon some particular learning algorithm and rule. An artificial neural network contains a set of nodes, layers and set of weighted links that connected these layers. Here we use the word network which implies that there is an interconnection between various layers with the help of the links. An artificial network neural contains mainly three layers. These are:

1. Input Layer: It is the first layer which is used to take input and send data from synapse to neurons.
2. Hidden Layer: The second layer in artificial neural network is Hidden Layer. It takes input from input layer and then process this input and sends the result to output layer which is the third layer.
3. Output Layer: The third layer in artificial neural network is output layer. The synapse calculates the weights and then sends the result to the output layer.

An artificial neural network works with the help of these three layers and calculates the result using these three layers.
An artificial neural network (ANN) is typically uses the three types of parameters. These are:

1. Interconnection Pattern: The different layers of neurons formed interconnection patterns.
2. Weights: Another type of parameter is weights. These are the mathematical values which are given to the various links of the interconnections.
3. Activation Function: With the help of activation function an input is converted into output. An input may be a neuron's weights.

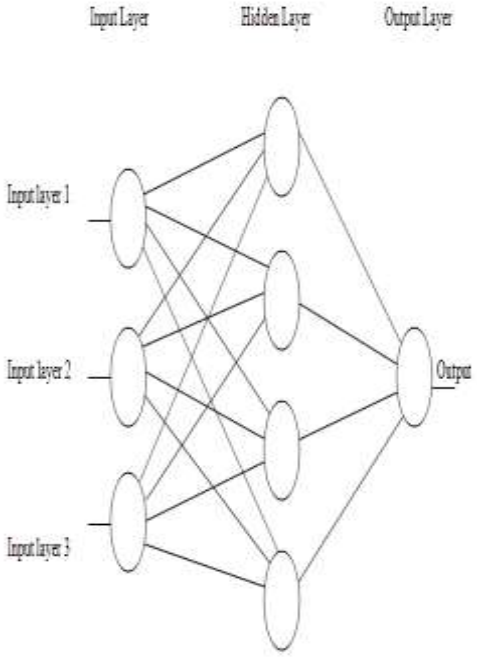

Fig.2. Artificial Neural Network

Ant Colony Optimization: Today the traffic on connection path is increasing day by day. For solving this problem, ant colony optimization algorithm (**ACO**) is used which helps in finding alternative shortest path for sending data. An ant colony optimization is a technique for solving various computational problems by using probabilistic technique. It finds the good path with the help of graphs.

Ant colony optimization helps in searching for optimal path with the help of the graph which is based on the behavior of ants that are seeking for a path between their colonies and the source of the food. Ants move from their nest to the food source. As the ants are blind and they did not know the path from nest to the food source. They have trails known as pheromone trails which will help them to discover the shortest path.

All the ants navigate randomly and start depositing pheromone trails on their path. The path on which more pheromone is deposit increases the probability of the path that being followed by other ants. Hence ant colony optimization helps in discovering the shortest path.

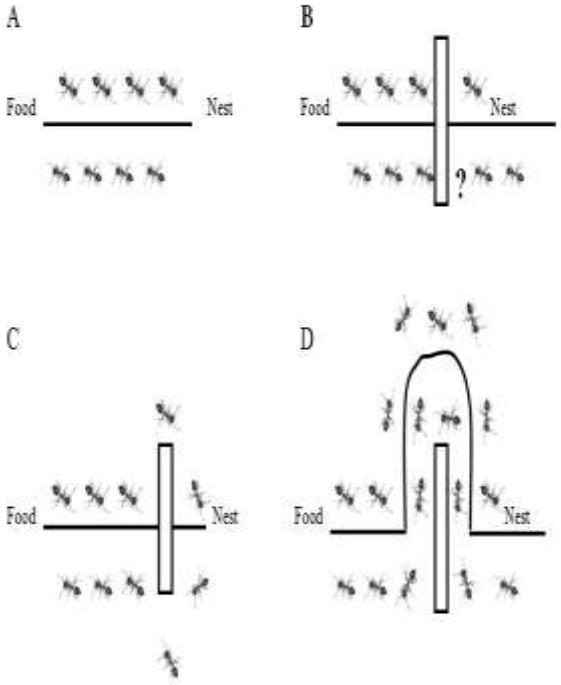

Fig: 3. Ant Colony Finding the Shortest Path

II. Literature Survey

Xu Yan, Et.al.(2016) [1] in this paper propose the GAPSPAC algorithm. The algorithm combines the advantages of the genetic algorithm and the ant colony algorithm. This paper introduces the research status of the ant colony algorithm. Secondly, this paper introduces the basic steps of ant colony algorithm, genetic algorithm and PSO algorithm. Thirdly, aiming at the shortcomings, we combine the genetic algorithm and the ant colony algorithm and propose GAPSOAC algorithm. The last experiment verifies the algorithm has higher solution efficiency and the stability.

Eneko Osaba, et.al.(2016) [2] this paper has been modeled as a rich vehicle routing problem, which can be more specially considered as an asymmetric and clustered vehicle routing problem with simultaneous pickup and deliveries, variable costs and forbidden paths (AC-VRP-SPDVCFP). The proper treatment of this AC-VRP-SPDVCFP, a discrete firefly algorithm (DFA) has been developed. This application is the firefly application of the firefly algorithm to any rich vehicle routing problem. To prove that the proposed DFA is a promising technique, its performance has been compared with two other well-known techniques an evolutionary algorithm and an evolutionary simulated annealing. Our results have shown that the DFA has outperformed these two classic meta-heuristics.

Oshin,et,al.(2016)[3] in this paper uses different parameters to provide analytical study of variants of Ant Colony Optimization for scheduling sequential jobs in grid systems. Based on the literature analysis, one can summarize that ACO is the most convincing technique for scheduling problems. However, incapacitation of ACO to fix up a systematized startup and poor scattering capability cast down its efficiency .To overpower these constraints researchers have proposed different hybridizations of ACO that manages to sustain more effective results than standalone ACO.

Amin Ahmadi ,et.al,(2015)[4] In this paper we want by use of ant Colony Optimization (ACO) that is one of the meta-heuristic methods that constructs solutions of hard combinatorial optimization problems. In this desertion, a suitable algorithm is presented to minimize logistic costs in supply chain downstream and in distribution network's chain. Suggested algorithm is based on Ant Colony System and searched two goals with finding paths with the minimum number of vehicles and minimum time of costumers, service. Initially vehicle routing problem of this company has been solved with used nearest neighborhood heuristic algorithm. Its result is compared with the proposed algorithm. The results show that the response of proposed algorithm is more efficient from the response of nearest neighborhood algorithm.

R. Yesodh ,et.al(2015)[5] in this paper a brief survey on Vehicle Routing Problem (VRP) and its variants with different Bio-inspired meta heuristics. Meta heuristics is a high-level technique that coordinates simple heuristics and rules to find good approximate solutions and Bio-inspired meta heuristics which helps to solve challenging combinatorial optimization problems in an adaptable and distributed fashion. Vehicle routing problem is one of the Nondeterministic Polynomial – Hard combinatorial optimization problem which aims to optimize the routes and reduce the overall cost of the routes with minimum distance. Recent years, combinatorial optimization problems are gaining more awareness of the researchers both in scientific as well as industrial world. Biologically-inspired methods are becoming more progressively important in the face of complexity in today's demanding applications. Researchers are continuously applying their best efforts to design new techniques to provide better solution as related to previously existing procedures.

Tuomas Pellonpera,(2014)[6] In this paper they are well suited to solving computational problem which involve traversing graphs. The Vehicle Routing Problem is combinatorial optimization problem which is studied in the field of operations research. Its numerous variants have several real-life applications. It is used to solve a particular variant of the Vehicle Routing Problem the Vehicle Routing Problem with Time Window.

Chun Ying Liu, et.al(2013)[9] In this paper puts forward a fusion algorithm on multiple depots vehicle routing based on the ant colony algorithm with genetic algorithm. Design/methodology/approach: to achieve this objective, the genetic algorithm optimizes the parameters of the ant colony algorithm. Findings:

simulation experiment indicates that the result of the fusion algorithm is more excellent than the other algorithm, and the improved algorithm has better convergence effective and global ability. Research limitations/implications: in this research, there are some assumption that might affect the accuracy of the model such as the pheromone volatile factor, heuristic factor in each period and the selected multiple depots. These assumptions can be relaxed in future work .The fusion algorithm eliminate the influence of the selected parameter by optimizing the heuristic factor, evaporation factor, initial pheromone distribute, and have the strong global searching ability.

Chenqi Wang, et.al (2013)[8] In this paper Traffic congestion in urban areas is a severe problem in many cities around the world. these solutions, sensor data is collected by mobile devices onboard the vehicles, sent to a central server via vehicle-to-infrastructure (V2I) or cellular communications, and used collectively to determine the traffic states of the roads. the system can function properly even if there is only a smaller number of vehicles equipped with the system, which is usually the case at the early stage of the deployment of a vehicle-to-vehicle (V2V)network or a large scale intelligent transportation system. the system can function properly even if there is only a smaller number of vehicles equipped with the system, which is usually the case at the early stage of the deployment of a vehicle-to-vehicle (V2V) network or a large scale intelligent transportation system. GPS data will be collected from mobile devices onboard vehicles on the road, in order to validate that with GPS data our proposed method and developed model can still yield high accuracy.

Amin Ahmadi, et.al(2012)[4] In this paper we want by use of ant Colony Optimization (ACO) that is one of the meta-heuristic methods that constructs solutions of hard combinatorial optimization problems. In the ant colony based algorithms to VRP, initial pheromone trails is calculated based on the best known route distances found for the particular problem. In this study it is calculated based on the feasible solution found. The visibility of an arc is calculated as a function of distance between two customers, customers' distance to the depot and the time window associated with the customer to whom the ant is considered to move.

Suresh Nanda Kumar, et.al(2012)[11] In this paper, we have conducted a literature review on the recent developments and publications involving the vehicle routing problem and its variants, namely vehicle routing problem with time windows (VRPTW) and the capacitated vehicle routing problem (CVRP) and also their variants. The VRP is classified as an NP-hard problem the use of exact optimization methods may be difficult to solve these problems in acceptable CPU times, when the problem involves real-world data sets that are very large. The vehicle routing problem comes under combinatorial problem. Hence, to get solutions in determining routes which are realistic and very close to the optimal solution, we use heuristics and meta-heuristics. Under meta-heuristic, the contributions of the researchers on simulated annealing algorithms, tabu search, genetic algorithm, ant-colony optimization and GRASP applied to vehicle routing problems are presented.

Anuja Nagare, et.al (2012)[10] in this paper Intelligent Transportation Systems (ITS) are used to avoid these problems and improve efficiency, safety and service. Traffic Flow Forecasting is an important part of (ITS). Traffic Flow Forecasting (TFF) is for Controlling Traffic and Intelligent Traffic Guidance. TFF is the study of interactions between vehicles, drivers, and infrastructure (which includes highways and traffic control devices), with the aim of understanding and developing an optimal road network with efficient movement of traffic and minimal traffic congestion problems. Back Propagation Neural Network is widely used for short term Traffic

Flow Forecasting. To enhance the performance of BPNN, Adaptive Learning Rate and Additional Momentum Methods can be used.

Ivan Brezina Jr.Zuzana Čičková, et.al(2011)[12] In this paper Travelling salesman problem (TSP) consists of finding the shortest route in complete weighted graph *G* with *n* nodes and *n(n-1)* edges, so that the start node and the end node are identical and all other nodes in this tour are visited exactly once. They are shortest path of costumer servicing route planning bus lines. The higher number of ants in population causes the higher accumulation of pheromone on edges, and thus an individual keeps the path with higher concentration of pheromone with a high probability. it is useable for solving problems occurring in practical applications

A.E. Rizzoli, et.al (2006)[15] In this paper we report on its successful application to the vehicle routing problem(VRP). First, we introduce the VRP and some of its variants, such as the VRP with time windows, the time dependent VRP, the VRP with pickup and delivery, and the dynamic VRP. These variants have been formulated in order to bring the VRP closer to the kind of situations encountered in the real-world. We presented two industrial-scale applications of ACO for the solution of static VRP problems a VRP with time windows and a VRP with pickup and delivery. ACO has been shown to be one of the most successful meta heuristics for the VRP and its application to real-world problems demonstrates that it has now become a fundamental tool in applied operations research.

Alberto V. Donati ,et.al(2005)[17] In this paper Time Dependent Vehicle Routing Problem (TDVRP) consists in optimally routing a fleet of vehicles of fixed capacity When a travel times are time dependent, The optimization method consists in finding solutions that minimize two hierarchical objectives: the number of tours and the total travel time. Optimization of total travel time is a continuous optimization problem that in our approach is solved by discretizing the time space in a suitable number of subspaces. New time dependent local search procedures are also introduced, as well as conditions that guarantee that feasible moves are sought for in constant time. The model is integrated with a robust shortest path algorithm to compute time dependent paths between each customer pairs of the time dependent model. Time dependent models can provide a better description in those cases when variable traffic conditions have a considerable influence.

John Bell, (2004)[21] In this paper research applies the meta-heuristic method of ant colony optimization (ACO) to an established set of vehicle routing problems (VRP). The procedure simulates the decision-making processes of ant colonies as they forage for food and is similar to other adaptive learning and artificial intelligence techniques such as Tabu Search, Simulated Annealing and Genetic Algorithms. Modifications are made to the ACO algorithm used to solve the traditional traveling salesman problem in order to allow the search of the multiple routes of the VRP.

Nicola Secomandi,(2000)[24] In this paper considers a version of the vehicle routing problem where customers' demands are uncertain. The focus is on dynamically routing a single vehicle to serve the demands of a known set of geographically dispersed customers during real-time operations. The emerging field of (NDP) in providing approximate solutions to the different stochastic combinatorial optimization problem. The paper compares the performance of two NDP algorithms: optimistic approximate policy iteration and a rollout policy. Two such algorithms are analyzed: optimistic approximate policy iteration and a rollout policy. The computational experiment shows that the rollout policy outperforms optimistic approximate policy iteration.

III. Conclusion

This is the review paper on artificial neural network and ant colony optimization. It contains the various techniques which are used for finding shortest path and analysing traffic. Artificial Neural Network uses the concept of biological neural network of human brain. And the ant colony optimization helps in finding optimal path for sending the traffic

References

[1] Xu Yan,"Research on the Hybrid ant Colony Algorithm based on Genetic Algorithm", International Journal of Signal Processing, Image Processing and Pattern Recognition Vol.9, No.3 (2016)

[2] Eneko Osaba, Xin-She Yang1, F. Diaz, E. Onieva, A. D. Masegosa , A. Perallos," A Discrete Firey Algorithm to Solve a Rich Vehicle Routing Problem Modelling a Newspaper Distribution System with Recycling Policy", Published First Online 18 March 2016.DOI 10.1007/s00500-016-2114.

[3] shin, "Job Scheduling using Ant Colony Optimization inGrid environment", International Conference on Electrical, Electronics, and Optimization Techniques (ICEEOT) – 2016

[4] Amin Ahmadi, Ahmad Foroozantabar," ant colony system method to vehicle routing problems", International Journal of Engineering and Applied Sciences, March.2015.

[5] R. Yesodha and T. Amudha," A Study on Bio-Inspired Metaheuristics for Solving Vehicle Routing Problem", Indian Journal of Science and Technology, *Vol 8(25), DOI:* 10.17485/ijst/2015/v8i25/80042, October 2015.

[6] Tuomas Pellonpera," Ant colony optimization and the vehicle routing problem," University of Tampere School of Information Sciences Computer Science, M.Sc. Thesis, May 2014.

[7] Er. Gurpreet Singh, Dr. Vijay Dhir," Open Vehicle Routing Problem by Ant Colony Optimization", *(IJACSA)* International Journal of Advanced Computer Science and Applications, *Vol. 5, No. 3, 2014*.

[8] Chenqi Wang and Hsin-Mu Tsai," Detecting Urban Traffic Congestion with Single Vehicle," (2013) International Conference on Connected Vehicles and Expo (ICCVE).

[9] ChunYing Liu, Jijiang Yu," Multiple depots vehicle routing based on the ant colony with the genetic algorithm", Journal of Industrial Engineering and Management, Received: March(2013).

[10] Anuja Nagare, Shalini Bhatia," Traffic Flow Control using Neural Network", International Journal of Applied Information Systems (IJAIS) – ISSN : 2249-0868 Foundation of Computer Science FCS, New York, USA Volume 1– No.2, January 2012.

[11] Suresh Nanda Kumar, Ramasamy Panneerselvam,"A Survey on the Vehicle Routing Problem and Its Variants", Published Online May 2012 , Intelligent Information Management, 2012.

[12] Ivan Brezina Jr.Zuzana Čičková," Solving the Travelling Salesman Problem Using the Ant Colony Optimization", Management Information Systems,Vol. 6 (2011).

[13] P. Zhang, J. Lin and L. Xue, "An Adaptive Heterogeneous Multiple Ant Colonies Algorithm", Journal of Intelligent Systems, vol. 194, (2010), pp. 301-314.

[14] Y. Gajpal and P. L., "Abad Multi-ant colony system (MACS) for a vehicle routing problem with backhauls", European Journal of Operational Research, vol. 196, no. 1, (2009), pp. 102-117.

[15] A.E. Rizzoli, · R. Montemanni · E. Lucibello," Ant colony optimization for real-world vehicle routing problems", Received: 6 December 2006 / Accepted: 10 May 2007 / Published online: 13 September 2007© Springer Science + Business Media, LLC 2007.

[16] Crevier. B, Cordeau , J.F., & Laporte, G. (2007)," The multi-depot vehicle routing

problem with inter-depot routes," European Journal of Operational Research, 176(2), 756-773.
http://dx.doi.org/10.1016/j.ejor.2005.08.015.

[17] Alberto V. Donati , Roberto Montemanni, Norman Casagrande,Andrea E. Rizzoli," Time dependent vehicle routing problem with a multi ant colony system", European Journal of Operational Research (2006), Received 1 June 2005; accepted 1 June 2006.

[18] Marco Dorigo, Christian Blum "Ant colony optimization theory: A survey", Theoretical Computer Science 344 (2005) 243 – 278,Science Direct and Elsevier.

[19] Christian Blum," Ant colony optimization: Introduction and recent trends", ALBCOM, LSI, Universitat Politècnica de Catalunya, Jordi Girona 1-3, Campus Nord, 08034 Barcelona, Spain Accepted 11 October(2005).

[20] Tolga Bektas," The multiple traveling salesman problem: an overview of formulations and solution procedures", Received 2 December 2003; accepted 11 October 2004 Available online 8 January 2005

[21] John E. Bella, Patrick R. McMullen," Ant colony optimization techniques for the vehicle routing problem", Advanced Engineering Informatics 18 (2004) Received 9 July 2004; accepted 9 July 2004.

[22] Bell, J.E., McMullen, "Ant colony optimization techniques for the vehicle routing problem", Adv. Eng. Inform. 18, 41–48, P.R. (2004)

[23] Gökçe , Elif İlke," A revised ant colony system approach to vehicle routing problems", Diss. Sabanci University, (2004)

[24] Nicola Secomandi*,"* Comparing neuro-dynamic programming algorithms for the vehicle routing problem with stochastic demands", N. Secomandi / Computers & Operations Research 27 (2000).