

A COMPARITIVE STUDY OF DYNAMIC VEHICLE ROUTING PROBLEM

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Abstract: The optimization problem plays a major role in real world. Generally optimization problem are more useful for real world application and they are mostly applied to Dynamic environment. Vehicle Routing Problem is a complex combinatorial optimization problem and it is difficult to find an optimal solution consisting of a set of routes for vehicle whose total cost is minimum. The evolutionary algorithm and swarm intelligence play a vital role to solve optimization problem. The researcher usually focused on static environment but most of application deal with dynamic environment and they can be solved by using nature inspired meta heuristics algorithm. The evolutionary algorithm is a population based algorithm which is used to effectively solve optimization problem such as Vehicle Routing Problem and Dynamic Vehicle Routing Problem(DVRP). The main focus of paper is to provide study of Dynamic Vehicle Routing Problem.

Keywords: Vehicle Routing Problem, Dynamic Vehicle Routing Problem, DBGP

1. Introduction

An optimization problem can be defined as finite set of variable which is used to find best solution among all feasible solutions[5]. Optimization problem is of two types they are continuous and combinatorial optimization problem. Continuous optimization problem consist of real number of values and combinatorial optimization problem consist of finite set of distinct values. Combinatorial optimization problem is also called as discrete optimization problem and they are defined as finding an optimal solution in a finite or infinite set of solutions. In combinatorial

optimization problem, solutions are minimized or maximized. The functions which can be minimized are cost, distance, and length of traversal, weight, energy and processing time. The functions which can be maximized are profit, output, efficiency, energy and capacity. Continuous optimization problem is defined as finding minimum or maximum value of a function of one or more real variables which are subjected to constraints. The constraints in continuous optimization problem may be equality constraints or inequality constraints. The optimization problem such as Dynamic Vehicle Routing problem are powerful in solving real world application. The main challenge of optimization problem when subjected to dynamic environment(Dynamic optimization Problem) are finding the moving optimal solution and this challenge can be solved by using Ant Colony Optimization algorithm.

2. Benchmark Generator

The benchmark generator is used in optimization problem such as Dynamic Vehicle Routing Problem. The benchmark generator is used to generate dynamic environment. The dynamic environment is created by switching across various static instance of Dynamic optimization

problem. The Benchmark generator used widely for Dynamic Vehicle Routing problem are Dynamic Benchmark generator for permutation encoded problem (DBGP) and traffic factor [1][2]. The Benchmark generator properties are

- **Simplicity**
The benchmark generator should be efficient and simple enough so that user can easily adapt to it
- **Flexibility**
The benchmark generator should be flexible to user so that user can be able to access different aspect of dynamism such as frequency of change, magnitude of change and periodicity.
- **Generality**
The benchmark generator should be common enough to solve wide range of problem. It must be compatible with metaheuristic

- **Applicability**
The benchmark generator must be applicable to all real world problems.

3. Data Set

The data set of Dynamic Vehicle Routing Problem are derived from standard Vehicle Routing Problem instance. The data set of DVRP consist of number of customer to be served, maximum capacity and optimal value of data set [3]. The data set of DVRP are presented in following table 1

Table 1: Dataset of Dynamic Vehicle Routing Problem

Problem Name	Instance Name	No of Customer	No of Vehicle	Best Value	Capacity
DVRP	Fisher problem	45	4	724	2010
DVRP	Fisher Problem	72	4	238	30000
DVRP	Fisher Problem	135	7	1165	2210
DVRP	Augerat et al	32	5	784	100
DVRP	Augerat et al	36	5	799	100
DVRP	Augerat et al	45	6	944	100

4. Solution Of DVRP

In solving Dynamic Vehicle Routing Problem two important factors are considered they are event managing and resolution process [4]. The event managing task is in charge of collecting new demand and keeps trace of already served customers and position of vehicle. The event

manager also plays the role of scheduler which commits vehicles to customer according to the solution obtained. Dynamic Vehicle Routing Problem can be solved by three main methods they are strategy based, heuristic and meta heuristic

4.1 Strategy Based

The strategies are represented as simple policies which specify the action that system should bring to handle the current state and the properties of dynamic problem. Strategies have been defined for single or

multi vehicle condition. They consider the spatial and time distribution of dynamic request and enable the system to plan the service each time the problem changes. Strategies are applied repeatedly in order to dispatch the request to vehicles, and build route.

4.2 Heuristic Method

Simple strategies are related to specific condition which leads to low empirical performance in other operational condition. In these conditions heuristic could be employed to improve the performance of the algorithm[4]. These heuristics are essentially constructive and improvement procedure. Constructive heuristic create initial solution. Improvement procedure repairs the previously constructed solution by performing simple re- assignment moves. According to planning horizon these procedures re-optimize the vehicle route when new customer appears. The customers are inserted on routes following the cheapest insertion. Cheapest insertion is used to determine overall best insertion for location of request before its insertion. The improvement procedure is based on tabu search. It is applied after re-insertion procedure and it runs while new request are being received. Adaptive granular local search heuristic has reduced neighborhood based on candidate list strategy such neighborhood discard long tour segment which represent high cost arc and focuses on promising short tour segment.

4.3 Metaheuristic Method

Meta heuristic design a computational method that optimize the problem by iteratively trying to improve the candidate solution with regard to a given measure of quality[4]. They make few or no assumption about the problem being optimized and can search very large space of candidate solution. They provide acceptable solution in a reasonable time for solving hard and complex problem. Their main exploring characteristic is based on balance between intensification and diversification. The term diversification generally refers to exploration of search space where intensification refers to exploitation of search space. The balance between intensification and diversification is used to identify region in search space with high quality of solution. Meta heuristic can be classified into two group of algorithm they are single solution based and population based meta heuristic.

Single solution based meta heuristic could be viewed as search trajectories over search space of problem. These trajectories are performed by iterative procedure that moves from current solution to another one in search space. They incorporate technique that allows the algorithm to escape from local optima. Population based meta heuristic start from initial population of solution and iteratively apply the generation of new population and replacement of current one. They regroup algorithm such as evolutionary algorithm, swarm intelligence based method, scatter search, bee colony and artificial immune system.

Table 2: survey of Dynamic Vehicle Routing Problem

Referenc e and Year	Title of The Paper	Techniques used	Data set used	Type of Dynami sm used	Limitations
Referenc e [1] (2015)	Ant colony algorithms with immigrants schemes for	-Random immigrant(RI) -Elitism based immigrant(EI) -Memory based	DVRP- Fisher problem instance -Instance 1-45 nodes -Instance 2-72	Dynami c Bench mark Generat	-RI is used to maintain diversity -EI is used for

	the dynamic vehicle routing problem	immigrant(MI)	nodes -Instance 3- 135 node	or for permutation problem	knowledge transfer -MI is used for knowledge transfer
Reference [2] (2013)	Ant colony optimization with immigrants schemes for the dynamic travelling salesman problem with traffic factors	-Random immigrant(RI) -Elitism based immigrant(EI) -Memory based immigrant(MI)	DVRP- KroA -Instance1-100 -Instance2-150 -Instance3-200	Traffic factor	1)RI- used to maintain diversity -EI- used for knowledge transfer -MI used for knowledge transfer
Reference [3] (2013)	Dynamic Vehicle Routing: A Memetic Ant Colony Optimization Approach	Local search operator(LS) Random immigrant(RI)	DVRP- Fisher problem instance Instance 1-45 nodes Instance 2-72 nodes Instance 3- 135 node	Traffic factor	1)LS is used for exploitation property 2)RI is used to maintain diversity

5. Conclusion

Recently Dynamic Vehicle Routing Problem have been applied to many Real world problems. The Dynamic Vehicle Routing is used to provide optimal solution and optimal distance. The researcher focuses on balancing the optimization property. The future work is to hybridize the technique or algorithm and to obtain better optimal result in less time.

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