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A Review on Berth Allocation Problem and Crane Allocation Problem with Assignment Optimizing Technique

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Abstract: ***Berth spaces and quay cranes are the most important assets in container terminals, to improve the utilization. In this paper we reviewed the idea of allocation of berth and quay crane by investigating the various optimizing technique which is further used in improving the time and cost value. In the benefit of doubt we covered systematic survey on different algorithms, technique and optimization.***

Keywords: PSO, GA, BAP, CAP, FCFS

1. Introduction

In multi – user container terminal, berth and quay cranes are the most important resources. An effective planning of all the outcomes can perform and make a successful operation, which can further satisfies the costumer and throughout leads to higher revenue for the port. Initially berth and quay problem deals respectively, which can arrange the berthing positions, the berthing time and the quay cranes for the arriving ships simultaneously, are a new tendency in container terminal operation research.

Several studies have been conducted to improve the efficiency of ship operation in container terminal .Christian in [1]. As similar a simulation method to achieve the optimized allocation plan by means of rehearsal. Ning Meng, Yan Chen, Lin He [2] presented a simulation optimization method for scheduling loading operations in container terminals and used Genetic Algorithm to get the best operations. Wang F in [3] designed a random beam search algorithm to resolve berth allocation problems. Etsuko Nishimura in [4] used Genetic Algorithm for berth allocation planning in the public berth system. Kap Hwan Kim in [5] discussed the problem of scheduling query cranes and proposed a branch and bound (B&B) method and greedy randomized adaptive search. Several application of assignment problem based on parameter and the restrictions we are dealing with as first come first serve (FCFS), unloading of vessels and managing the port useful equipments.

2. Literature Review

There are a lot of algorithm used for optimization and methods further to implementation as per.

2.1 Particle Swarm Optimization

Particle Swarm Optimization is a swarm intelligence-based optimization algorithm [6], which proposed by Dr. Kennedy and Dr. Eberhart [7] of the United States. It's a random searching algorithm by simulating birds foraging behavior. The algorithm has a good application for the port berth scheduling. Particle swarm optimization as developed by the authors comprises a very simple concept, and paradigms can be implemented in a few lines of computer code. It requires only primitive mathematical operators, and is computationally inexpensive in terms of both memory requirements and speed. (27)

Figure 1: Swarm Optimization

2.2 Simulated Annealing

Simulation annealing is another method used in berth scheduling. The application of this algorithm leads us to understand an efficient scheduling can be done however it lacks of experience.

Simulated annealing [8] is a random combination optimization method developed in the early 1980s. The core is that accepting the poor solution in a certain probability, then the algorithm has the ability to jump out of the local optimal solution. The simulated annealing algorithm has been widely used in combinatorial optimization problems. The process is like this, first of all, given an initial temperature; then randomly select an initial state and calculate the objective function value; as the temperature decreases attach a small perturbation continuously to the current state, and calculate the target function value of the new state; if there is a good point, accept it, if there is a poor point, accept the poor solution to a certain probability. This process is accompanied by the temperature gradually reduced until the temperature drops a certain value, the loop ends.

There have been a growing number of studies that deal with the berth allocation problem (BAP) as well as the quay crane allocation problem (CAP) although very few of them have examined the issues simultaneously [13]. The BAP has been studied widely. The discrete BAPs were studied deeply by Imai [9, 10, 11, and 12]. The continuous BAPs were studied by Park and Kim [14] with an objective that minimizes the additional costs of ships. Kim and Moon [15] proposed a new heuristics of simulated annealing method to solve the same problem. As to the CAP, many papers [16, 17] were about particular allocation on one ship's different holds, bays, or tasks, which is not the exact problem considered in this paper. Some of them [18, 20, 19, 21] combined the crane operation with yard trailer or yard crane. There are also a few papers about the berth and quay crane allocation problem (B&CAP) from different aspects. Some of them are discrete ones [22, 23] and it is proved that the combination optimization is superior to optimize separately [22]. The chromosomes defined in the Genetic Algorithms [22, 23] represented berth-ship-order assignment, while the fitness value of a chromosome was obtained by combined allocation of berth and crane. For the continuous case, Park and Kim [24] firstly gave out the problem of berth and quay crane allocation, but it was dealt as two phase problems. Han and Ding [25] dealt with the BAP and CAP in container terminal, which was abstracted as package problem. A trace method was applied to obtain the near-optimal solution. While it was assumed that the berth and quay cranes were vacant at the beginning of operation, with no consideration of any work in progress. A recent paper by Meisel and Birwirth [26] provided a linear formulation of the continuous B&CAP, which incorporated the productivity effects of crane resources. The objective of the formulation was the cost minimization of quayside operation. But the crossover of QCs and the space between the adjacent ships both in time and berth axes were not considered.

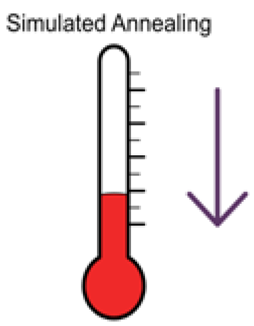
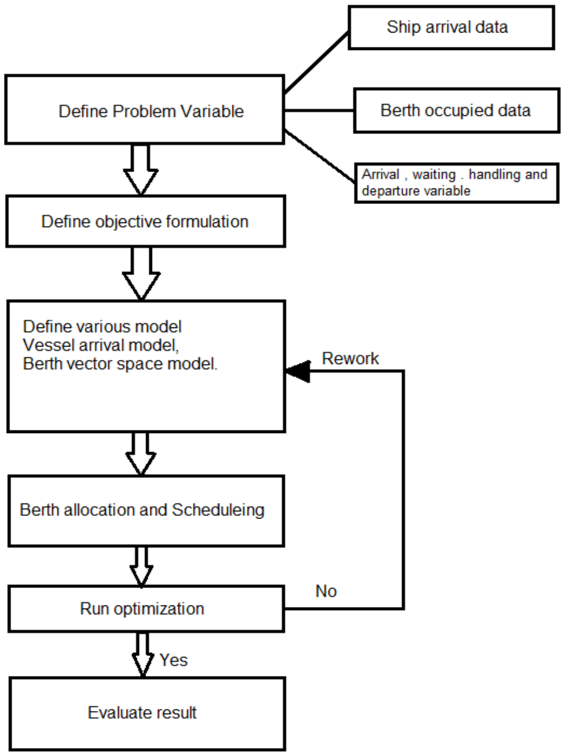


Figure 2: Simulation Annealing

3. Methodology

Most of the researcher used the data collecting procedure and methodology. Where we are taking help of genetic typical methodology.



4. Conclusion

In this review paper ,we have done a systematic survey of the algorithms/methods/techniques for solving assignment and layout problems like shipyard berth allocation and scheduling, and it has been seen that there are plethora of bio inspired optimization algorithms like PSO ,GA and many combinatorial methods that can be used for the solving linear and non-linear problems , however , the real question is does, these methods lead to finding solutions that can be solved with in stipulated polynomial-time , does the algorithm strictly complementary solution and justify the real need for optimization of the problem which is already solved but need optimization, hence looking at the Complexity of the algorithms and the accuracy of these solutions, for future work we suggest that berth problem for ship yard management must be solved by those methods that regard , there variables involved represented as quantities that can only be integer. For example, it is not possible to build 3.7 ships and hence the variable represent decisions which can take value either 0 or 1, example whether the berth is occupied or not moreover, for future scope would suggest that problems that involves ship vehicle scheduling in transportation networks must be addressed with mimic possible complexity, a problem defined as assignment of ships to individual berth so that a timetable of occupancy can be met without congestion and conflict of interests. This may be achieved by usage of binary integer programming which would involve the binary decision variables indicating whether a ship is assigned to a berth with maximum possible equality and non equality variables.

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