Improving Yard Management in Container Ports using Mathematical Modelling and Systematic Optimisation Approach

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Abstract

In container terminals, yard cranes (YC) work at the interface between the storage areas and the yard trucks and quay cranes. A delay in the operations of the YCs at the yard will affect the overall operations of the container port. There is thus need for a good and reliable planning and scheduling of this scarce resource for an effective day to day operation. The co-ordination of these inter-related operations in a container terminal is complex and as such requires systematic planning. Commonly, this problem is solved in an adhoc way at ports because of its complexity. The focus of this paper is on building a model the solution of which will minimise unfinished work at the yard by allocating and changing the YCs movements between the yard zones/blocks at different times using minimal resources. The problem is formulated as a mixed integer linear programming model and solved using Gnu Linear Programming Solver(GLPSOL). Experimental tests were conducted to evaluate the performance of the model on some problem instances. Results will be discussed.

Keywords: Container terminal; Rubber-Tyred Gantry(RTG); Yard crane scheduling; GLPSOL

Some results

Table 1 shows a yard with 10 blocks varying the YCs between 6 and 9. The position of the YCs affects both the unfinished work and the processing time of the problem. We can see that while positioning the YC in either block E4 or D5 yields the same unfinished work of 23 minutes, positioning it at block C4 will result in 37 minutes of unfinished work. On the other hand, the 8th and 9th YCs yield the same unfinished work of 5 minutes and 0 minute regardless of where they are positioned.

The result shows that 9 YCs will be needed to finish the workload in the yard. However, if the yard has only 7 YCs available, we have the choice of positioning the 7th YC at either block E4 or D5.

Table 1: Computational results for a yard of 10 blocks

Problems	No of YC	Position of extra YC	Unfinished work(mins)	CPU time(secs)
1	6	-	56.001	0.2
2	7	E4	23.000	0.1
3	8	C4	5.001	0.2
4	9	D5	0.001	0.2
5	6	-	56.001	0.2
6	7	D5	23.000	0.1
7	8	E4	5.001	0.2
8	9	C4	0.001	0.3
9	6	-	56.001	0.2
10	7	C4	37.001	0.3
11	8	D5	5.001	0.1
12	9	E4	0.001	0.2

'-': This means no extra YC has been introduced yet.

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