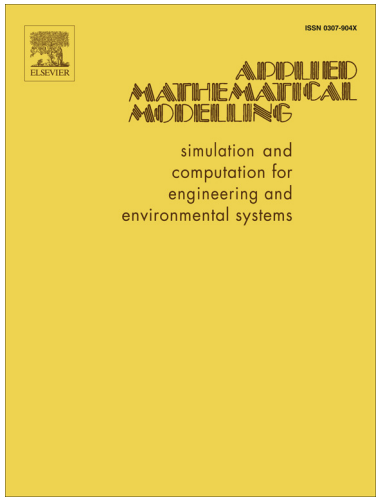

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A Lagrangian Relaxation Approach for Solving the Integrated Quay Crane Assignment and Scheduling Problem

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Abstract— Decisions on the quay crane assignment problem and the quay crane scheduling problem are typically made independently. However, the efficiency of container terminals can be increased when these decisions are made simultaneously due to the interrelation between quay crane assignment and scheduling. A mathematical formulation for the integrated quay crane assignment and scheduling problem (QCASP) is developed in this paper. Practical considerations are incorporated in the model, such as quay crane (QC) interference. A Lagrangian relaxation is proposed for the model. Feasible solutions are then obtained from the proposed heuristic. Computational results are provided for the proposed Lagrangian relaxation.

Keywords: Quay crane assignment; quay crane scheduling; Lagrangian relaxation; Integrated models; integer programming.

1. Introduction

Today's global economic activities and industry globalization have led to a rapid increase in the exchange of products and materials between nations. Transport is an integral part of the entire supply chain; therefore, ports play an important role in the management of material. Ports are the sites connecting countries and provide the link between maritime and inland transport.

Fig. 1 shows the sub-systems of sea port container terminals. These systems are the same for ports with different sizes, functions, and geometrical layouts. Starting from the lower part of Fig. 1, the relevant areas include the ship operation area, yard area, and the truck and train operation area, respectively. The ship operation area is used for loading and unloading vessels. The yard area, which may be divided into many blocks, is the place for storing inbound and outbound containers. Some of the block areas are reserved for containers with special requirements, such as those that may need electricity for cooling.