Chapter 7
Optimizing Solution for Storage Space Allocation Problem in Container Terminal Using Genetic Algorithm

Gamal Abd El-Nasser A. Said
Ain Shams University, Egypt

El-Sayed M. El-Horbaty
Ain Shams University, Egypt

ABSTRACT

Seaport container terminals are essential nodes in sea cargo transportation networks. In container terminal, one of the most important performance measures in container terminals is the service time. Storage space allocation operations contribute to minimizing the vessel service time. Storage space allocation problem at container terminals is a combinatorial optimization NP-hard problem. This chapter proposes a methodology based on Genetic Algorithm (GA) to optimize the solution for storage space allocation problem. A new mathematical model that reflects reality and takes into account the workload balance among different types of storage blocks to avoid bottlenecks in container yard operations is proposed. Also the travelling distance between vessels berthing positions and storage blocks at container yard is considered in this research. The proposed methodology is applied on a real case study data of container terminal in Egypt. The computational results show the effectiveness of the proposed methodology.

INTRODUCTION

A container terminal is a zone of the port where container vessels are loaded and unloaded, and where containers are temporarily stored at container yards for variable periods. Container is a large box used for transportation of goods. Thousands of containers are handled in a container terminal everyday by different types of material handling equipment. The docking time of container ships at the port must be

as small as possible, with a minimum use of different expensive equipment, managing activities of such high intensity level in a container terminal is a challenging task.

Global containerized trade grew in 2013 taking total volumes to 160 million TEUs; up from 78 million TEUs in 2002 (Review of maritime transport, 2014). Container handling problems are NP-hard; therefore the need of optimization in container terminal operation has become more important recently. Metaheuristics algorithms are used to solve container terminal problems (Steenken, Voß, & Stahlbock, 2004).

When a ship berth is introduced in a container terminal, a number of quay cranes are assigned for the ship to handle containers. The containers are discharged from the ship by quay cranes and transported to container yards by internal trucks; and they are then stored by yard cranes at various locations in the container yard. The loading process starts in the reverse direction of the discharging process, i.e., by transferring containers from yard to quay area (Mak & sun, 2009). Figure 1 shows container handling operations in a container terminal.

Container terminals all around the world are keeping and raising their service capacity and level actively to increase their own competitive power because more ports realize the significance of raising their service level, reducing vessel turnaround time and raising the efficiency of loading and unloading of the cargoes in the container terminals. Understanding the operational processes of a container port terminal is essential to increasing efficiency. A seaport container terminal is a place where container vessels are loaded and unloaded, and where containerized cargo is temporarily stored during awaiting a future journey. One significant factor to improve a container terminal competitiveness is to raise the efficiency of loading and unloading operations and reduce vessel turnaround time.

There are different kinds of container transshipment movements: unloading, loading, receipt, delivery, and marshaling. Unloading is container movement from ship to yard. Loading is container movement from yard to ship. Receipt is container movement from the hinterland "main land" to the yard. Delivery is container movement from the yard to the hinterland. Again, it happens either by truck through a gate. Marshalling is container movement within the yard. Yard cranes store and retrieve containers within yard blocks. The containers inside the yard are divided into: import, export, hazardous, empty, and transient containers. Import containers are brought by ship, export containers are sent out by ship, and transient containers are brought by ship and also sent out by ship. In most container terminals, a large portion of

Figure 1. Container handling operations in a container terminal
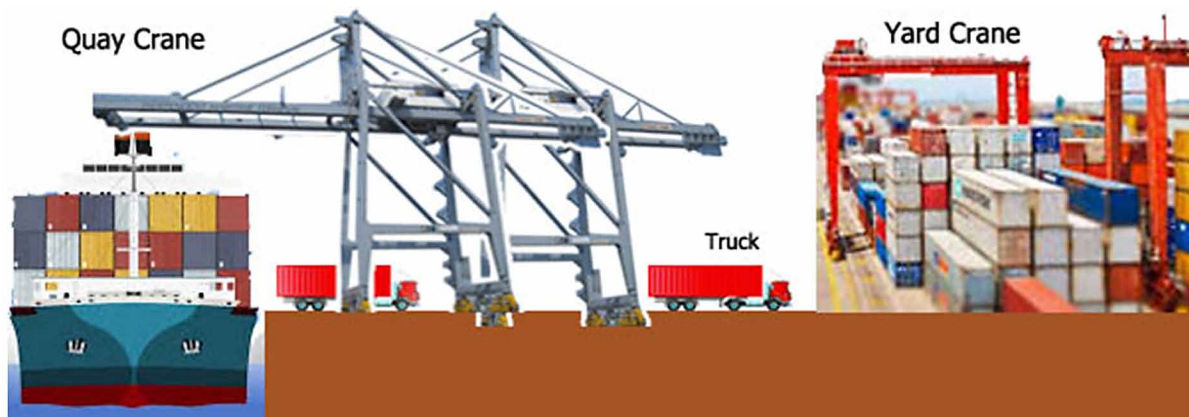
Related Content

Neural Mechanisms of Leg Motor Control in Crayfish: Insights for Neurobiologically-Inspired Autonomous Systems
Didier Le Ray, Morgane Le Bon-Jegoand Daniel Cattaert (2009). *Advancing Artificial Intelligence through Biological Process Applications (pp. 20-41).*
www.irma-international.org/chapter/neural-mechanisms-leg-motor-control/4970

Anti Fuzzy Deductive Systems of BL-Algebras
Cyrille Nganteu Tchikapa (2012). *International Journal of Artificial Life Research (pp. 32-40).*
www.irma-international.org/article/anti-fuzzy-deductive-systems-of-bl-algebras/81212

Dynamics of Neural Networks as Nonlinear Systems with Several Equilibria
Daniela Danciu (2009). *Advancing Artificial Intelligence through Biological Process Applications (pp. 331-357).*
www.irma-international.org/chapter/dynamics-neural-networks-nonlinear-systems/4986

Comparative Analysis of EMD and VMD Algorithm in Speech Enhancement
Rashmirekha Ramand Mihir Narayan Mohanty (2017). *International Journal of Natural Computing Research (pp. 17-35).*
www.irma-international.org/article/comparative-analysis-of-emd-and-vmd-algorithm-in-speech-enhancement/188780

A "Society of Mind" Cognitive Architecture Based on the Principles of Artificial Economics
Darryl N. Davisand Vijayakumar Maragal Venkatamuni (2010). *International Journal of Artificial Life Research (pp. 51-71).*
www.irma-international.org/article/society-mind-cognitive-architecture-based/38933