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PORTMOD - a Simulation Tool to Improve Container Terminal Operation

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Abstract

PORTMOD is a new simulation tool that aims to facilitate Container Terminal (CT) operation improvements. Some of the main tasks of a Terminal Operating System (TOS) is to determine container allocations on the container yard and schedule container moves performed by cranes and machines, e.g. Ship-To-Shore cranes and Straddle Carriers. Currently, no TOS provider provide what-if analyses. PORTMOD aims to fill this gap by simulating CT operation, which can be used to improve CT efficiency by adjusting CT operation or analysing investment decisions. Furthermore, PORTMOD enables analyzation of container flows in order to identify improvements. PORTMOD is built on open source DESMO-J framework, where the acronym stands for Discrete-Event Simulation and MOdelling in Java. PORTMOD differs from many other CT simulators by retaining the programming language possibility to build up customized simulations. Therefore, it is well suited for CT simulations with customizations; expansion of new simulation modules; and research purposes.

Keywords: Container Terminal, Discrete Event Simulation, Simulator, PORTMOD, Optimisation, Terminal Operating System.

1. Introduction

The significance of ports for the European Union is irrefutably high: 75% of all international goods traffic is handled via ports. In 2011, the EU ports handled about 3.7 billion tons of goods whereof 70% were bulk, 18% container, 7% Ro-Ro (roll-on-roll-off) and 5% break bulk traffic [1]. Taking 2011 as year of reference, the total goods volume is forecasted to rise by 50% until the year 2030 [2]. Port automation level will increase gradually in many ports, because full automation may be a too expensive solution for many cases [3]. Generally, ports use some Terminal Operations Systems (TOS) to manage port and harbour facilities and services. A TOS is composed of sub-systems for administration, planning, scheduling, executing and reporting parts. During CT operation, TOS constructs an optimal schedule to be performed by Quay cranes (QC's), Yard Cranes (YC's) and vehicles in order to perform various handling tasks on time [4]. Currently, no TOS provider provide what-if analyses, however, simulation and emulation provides a way to analyse CT efficiency and investment alternatives. The investment may consider, for example, increasing capacity and automation level.

2. Research scope and methodology

The scope is this paper is to introduce a new simulation tool called PORTMOD. PORTMOD is developed in the EU funded project COREALIS (grant agreement 768994) [5]. The tool is done in close co-operation with Steveco Oy, who operates Kotka Container Terminal in Finland. Kotka Container Terminal is the largest container port in Finland and handled about 650 000 TEUs in year 2018. PORTMOD differs from many other CT simulators by retaining the programming language possibility to build up customized simulations. It is built on DESMO-J framework, where the acronym stands for Discrete-Event Simulation and MOdelling in Java. DESMO-J is a product of the University of Hamburg and licensed under Apache Software License 2.0, i.e. a permissive free software license. DESMO-J has been successfully used in several harbour related studies; see [6], [7] and [8]. For more information on DESMO-J, see [9], [10] and [11]. PORTMOD is built on top of this framework with the primary aim to enable CT simulation. In this paper the capability to analyse container flows in order to identify improvements is presented. Furthermore the CT simulation capability is presented, which includes the movements of Straddle Carriers (SC) and Ship-To-Shore (STS) cranes on the container yard for different scenarios, as well as, the key performance indicators that can be obtained from the simulation results.

3. Results and discussion

The results and discussion will be completed for the revised paper.

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