LOADING AND UNLOADING TRAINS AND TRUCKS AT CONTAINER TERMINALS

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New container terminals are designed to handle large vessels, with large call sizes within the shortest time possible, and at competitive rates. In response, terminal operators, shipping lines and port authorities are investing in new technologies and smart decision rules to improve container handling and operational efficiency. While there are some analytical studies on improving operational performance at the seaside, very limited studies are done on performance modelling of landside operations at a terminal. The landside operations include train handling process using gantry cranes, container transport between train and automated stacking cranes using automated guided vehicles (or multi-trailer trucks), and managing interactions between the containers arriving in a train and trucks at the automated stacking cranes.

We first develop a closed queuing network with a fixed number of Automated Guided Vehicles that continuously circulate in the network during train loading or unloading process and interact with truck arrivals at the stacking cranes. We develop exact solutions for the case with one automated stacking crane by using a standard inbedded Markov chain approach. We then use these results to develop a semi-open queuing network model to analyse and approximate the expected throughput times for handling containers that arrive via trains (bulk arrivals) and trucks (single arrivals). To handle the batch arrivals, we have to adapt the Approximate Mean Value Algorithm. Finally, we compare our approximations with simulation results.