THE NEED FOR LANDSIDE AUTOMATION

IN AUTOMATED TERMINALS

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The container shipping industry is one of the most competitive industries in today's marketplace. The dual force of globalization and the consolidation of shipping lines has forced terminals to move more containers in a shorter amount of time with lower costs. Because of this, terminal operators are constantly seeking ways to become more productive and cost effective. Additionally, environmental impact is a growing concern all over the world, with increasing regulations empowering the drive to lower emissions. If container terminals want to become more profitable and maintain their competitive edge, they must improve terminal throughput and efficiency while reducing their carbon footprints. Landside automation provides a tangible solution for achieving these goals.

Automation has been evolving in the container industry over the last 20 years. Automatic Stacking Cranes (ASC) began appearing in the early 2000s and revolutionized container yard layout and operations. Ideally, ASC yards are oriented perpendicular to the quay with a Waterside Transfer Zone (WSTZ), a stacking area, and a Landside Transfer Zone (LSTZ). The WSTZ serves as the exchange area between the quay and the stacking area, and is typically serviced by either straddle carriers or Automatic Guided Vehicles (AGV). These vehicles drop-off the container in the WSTZ. The ASC can automatically pick-up and drop-off containers in these areas once the vehicles have left. The stacking area is an unmanned area where the ASCs operate in full automatic mode. The LSTZ is where containers are loaded onto road trucks for transport; Figure 1 shows a typical ASC yard's LSTZ. Traditionally, these ASCs only allow full automatic operation inside of unmanned areas (WSTZ and stacking area) and rely on remote operators to complete all moves in the LSTZ. While this method offers many improvements over a purely manual operation, its reliance on remote operators for all moves in the LSTZ introduces delays in the transfer process.

TERMINAL SPEEDS

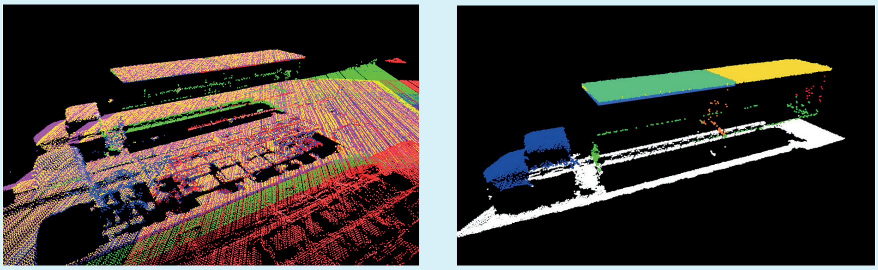
Operators rely on various camera views in order to accurately position and land a container on a road chassis from a remote location. These remote operators bring human variability to the landing process. Some operators are very efficient, while others require more time or multiple attempts to achieve a successful container pick-up or landing. Another delay is introduced from waiting for a remote operator to become available to perform the move. In one of the world's most advanced container terminals, the average wait time for a remote operator to connect to a waiting crane is approximately 33 seconds. This connection time seems very impressive when evaluated for a single container move. However, over the course of a 24-hour period, the 33-second delay is a significant loss of productivity. This wait time adds up to 2.1 hours per crane and over 50 hours a day of wasted productivity (depending on the size of the yard).

Wait time is dependent on remote operator availability, as well as any truck management systems in place, and other terminal operating procedures. These wait times only include the time waiting for an operator to become available and do not include any time the operator takes to perform the move once they are connected. Implementing a successful automation solution in the LSTZ greatly improves terminal productivity.

A SOLUTION

TMEIC now offers a new system providing fully autonomous landing on any top loaded container handling equipment, including road chassis. This system utilizes the same sensors required for a traditional ASC and usually does not require any additional infrastructure. Furthermore, it provides an economical solution either

Figure 1: Typical Land Side Transfer Zone



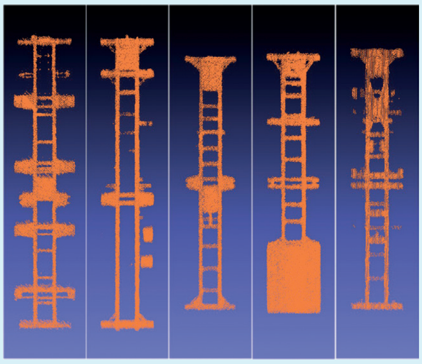


Figure 2 (Top left and middle): Raw and filtered data for a chassis loaded with twin twenties; Figure 3 (Top right): Filtered scans for several chassis types

for new ASCs or to retrofit existing ASCs. The system uses crane-mounted laser scanners (LIDAR) to create a model of the area under the spreader. As the ASC enters the LSTZ, it begins a scan of the area underneath the crane generating a set of Cartesian coordinates in the crane's frame of reference. Collecting these points over time creates a point cloud representing the area of interest. Filtering the raw point cloud provides a clear view of the target. Figure 2 shows both raw and filtered point cloud data of a loaded chassis. The filtered data provides a precise location of the container that the crane will use to autonomously remove the container from the chassis and transport the container to the stacking area.

Automating the process of landing containers on road chassis presents significantly more challenges than the pickups discussed above. The inherent variability between different chassis types, the required 25mm combined accuracy for the twistlocks, and the resolution capabilities of crane-mounted scanners are the main obstacles. TMEIC's new LSTZ automation solution addresses these issues by analyzing chassis geometry and shape instead of attempting to "see" twistlocks to determine an appropriate landing solution. Point cloud data for the empty chassis is constructed as previously described, and the system then evaluates key geometric features to determine the correct loading position of the container and deposits the container on the empty chassis. Figure 3 shows scan data from several different chassis types.

This system has achieved great success in the locations where it is currently in operation. It has an average success rate of 99% for automated pickups from the chassis, a 70% success rate for automated landing on chassis, for a combined success rate of 84.5% for landside-automated operations. This system offers significant improvements in efficiency and success rates. The system generates a solution in approximately 3 seconds following scan completion. The total time required to land on a road chassis is 66 seconds from the time the crane enters the LSTZ to the time when the spreader is completely disengaged from the container.

A landside automation system such as this one reduces the average wait time in the LSTZ from 33 seconds waiting for a remote operator to 3 seconds for the system to generate an appropriate solution in 84.5% of all operations. This is an extra 1.66 hours of production per crane every day without considering any improvements in the active landing time. Additionally, in the instances where an operator must intervene, that involvement usually consists of a simple adjustment in the landing position which takes significantly less time to complete than a fully remote move.

Another benefit of autonomous landings in the LSTZ is the near elimination of hard landings. The auto landing system will accurately detect the height of the chassis and slow down appropriately prior to landing. This reduces damage and maintenance of the spreader and increases overall crane up time.

Finally, an effective landside automation system reduces the overall emissions of the terminal. The average truck uses approximately 3.1L (0.82 gal) of fuel for every hour spent idling. An extra 30 seconds of wait time is not significant to an individual truck driver and it does not provide a practical incentive for turning the truck off while waiting. However, on the terminal level, these extra waits can add up to an extra 50 hours of truck idling emissions per day. With the described LSTZ automation system, idling time is reduced by 38 hours/day eliminating up to 312kg of CO_2 and 5.47kg of NO_x emissions, every day. Automating the LSTZ is an essential step in improving environmental factors as well as helping container terminals keep up with the ever-increasing vessel size, meeting increased throughput requirements, and to remaining competitive in the global marketplace.

ABOUT THE AUTHOR

Maggie Richardson joined TMEIC Corp. in 2015 as a Sales Application Engineer specializing in Crane Systems for port applications. Prior to joining TMEIC, Maggie spent 5 years as a United States Naval Officer instructing at the Navy's Nuclear Power School. She holds a BS in Electrical Engineering and a Master's in Business Administration.

ABOUT THE ORGANIZATION

TMEIC Corporation a Globally recognized leader in Drives and Automation Systems with manufacturing, engineering, sales, support and service facilities around the world. TMEIC is a successful joint venture between Toshiba Corporation and Mitsubishi Electric. Industries include Steel, Mining, Pulp and Paper, Cement, Solar Power Inverters and Material Handling and General Industrial Systems.

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