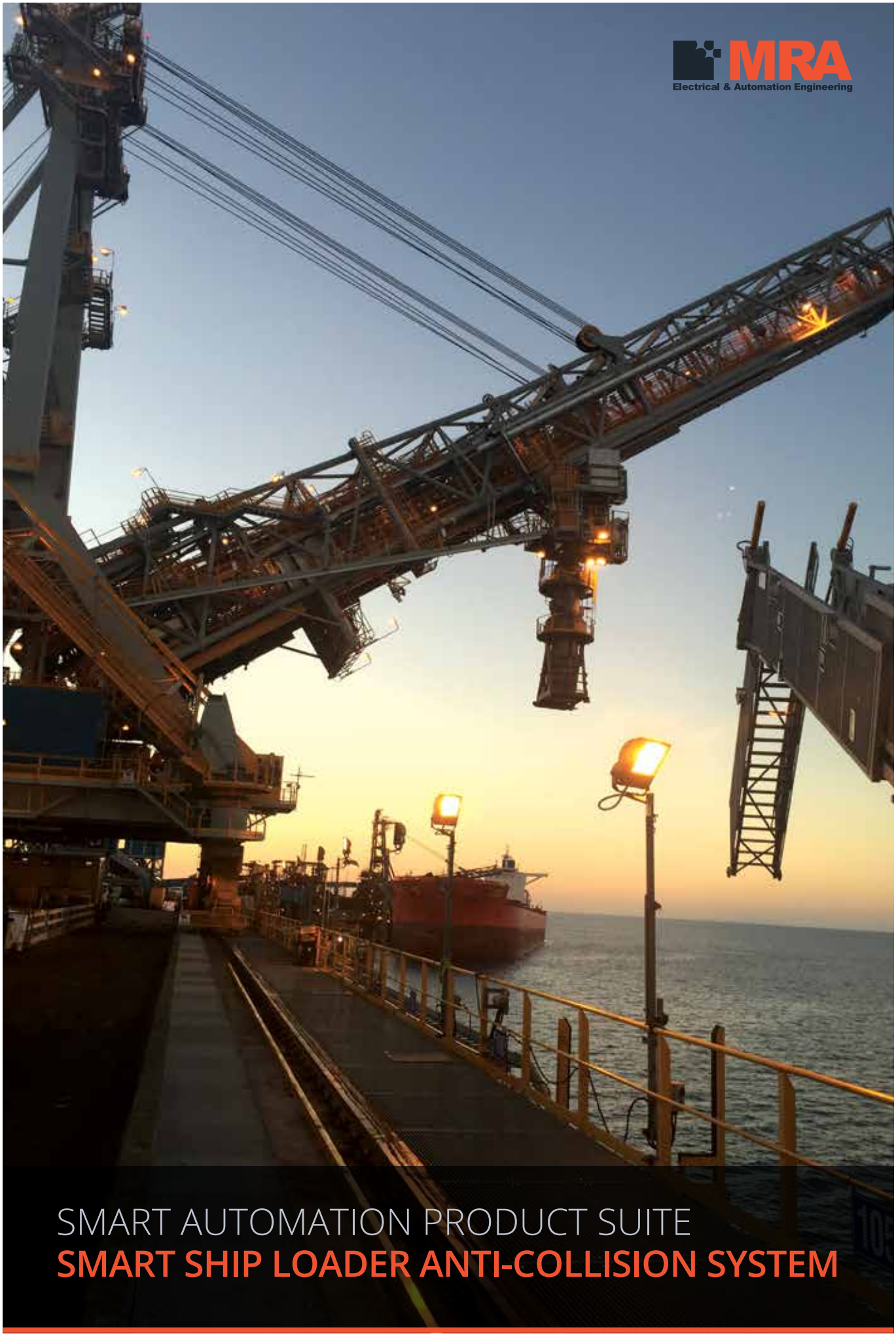


SMART AUTOMATION PRODUCT SUITE

SMART SHIP LOADER ANTI-COLLISION SYSTEM

SMART AUTOMATION PRODUCT SUITE
SMART SHIP LOADER ANTI-COLLISION SYSTEM

Laser accuracy makes for a safe and reliable ship loading environment.

The safety of personnel operating a ship loader or in its vicinity is paramount. Ship loader collisions that threaten personnel, damage valuable assets or limit operational availability can be avoided.

MRA's Smart Ship Loader Anti-Collision System (SLAC) establishes a real-time protection zone surrounding the ship loader's boom and shuttle, its spout or spoon and operator cabin. During operations, any object entering or nearing this dynamically defined zone will trigger a collision warning.

The SLAC calculates highly accurate real-time and projected position information for the vessel including list, trim and draft and its position along the wharf during loading. Key separation distances to the ship loader are available in a 3D visualisation and for integration with the ship loader PLC for actioning including, alarm, slow down and inhibit.

The SLAC works with all major vessel classes, bridge configurations and hatch types, including butterfly and horizontal; and, accounts for any deck gear such as cranes, hoists and light poles. It requires no GPS or equipment to be installed on the vessel and works in both harbours and the environmentally challenging open port environments.

MRA has been using laser technology and advanced data modelling to revolutionise the mine-to-port materials handling process for more than seven years. Smart technology allows us to deliver a reliable real-time Ship Loader Anti-Collision System with equipment that is relatively low cost, requires minimal maintenance and has a proven, long life span.

As the geometry of each ship loader varies, our ability to model optimal laser positioning offsite in a simulation environment increases the accuracy of data collection and reliability of coverage reducing set up and cost and speeding up commissioning.

The SLAC has been successfully deployed at Port Waratah Coal Terminal in two A-Frame ship loaders and at Port Kembla Coal Terminal in a Portal ship loader.

There have been zero collision incidents during 58 months of active operations.

THE SHIP LOADER ANTI-COLLISION CHALLENGE

The ship loader anti-collision challenge is complex and uncertain as both the ship loader and the vessel can move.

The ship loader is controlled by an operator in a cabin on the ship loader, who initiates deterministic movements such as, long travelling and luffing and shuttling of the boom.

The vessel movements are more random and subject to environmental factors such as sea swell, tide and passing vessels. The vessel will also pitch and roll as it deballasts and is loaded.

The key to meeting the ship loader anti-collision challenge is two-fold:

- Know in real time, the vessel's profile, location and orientation in relation to the ship loader.
- Implement the protection zones so as not to impact on operations throughout all stages of loading including centre pour and trimming.

KEY FEATURES

- Deployed in A-Frame and Portal ship loader configurations.
- Works with all vessel and hatch types – butterfly and horizontal.
- Works in harbours and open ports.
- Highly accurate model and powerful visualisation tools.
- Control aspects all performed in the PLC.

The MRA Smart Automation Product Suite inclusions

The Smart Ship Loader Anti-Collision System is part of our Smart Automation Product Suite that also includes:

Smart Wagon Products form part of a full train load-out or dump station automation solution that can replace an onsite operator or an aged photo-electric (PE) cell solution. It includes speed detection, hang-up detection, profile monitoring for over and under loading, derailment protection, train speed indication integration and wagon door status detection.

Smart Stockyard Management is world class and represents a significant advancement in the management of a modern mined material stockyard, its stockpiles and machines, including job and task management, rich visualisation and machine optimisation.

Mine-to-Port Quality Management accurately tracks the age and properties of mined material from the mine site through the train network to the stockyard dump station, conveyor network, stockpile and onto the vessel.

Machine-to-Machine Anti-Collision works seamlessly with our Stockyard Management System to provide a SIL-rated functional safety anti-collision solution.

KEY BENEFITS

- Protects personnel safety.
- Protects key assets.
- Helps maintain operational availability.
- Smart technology offsets need for expensive laser systems and processing.
- Laser systems are industry proven, require little maintenance and long lasting.
- Off-site simulation environment for each machine geometry increases accuracy and lowers the cost of setup and commissioning.
- In-house team for PLC and SCADA programming and integration.
- Australian based technology team.

THE MRA ADVANTAGE

- Delivering large scale, complex materials handling projects for over 20 years.
- Providing end-to-end design through to commissioning, integration support and custom PLC and SCADA programming.
- Pioneering the use of the latest in scanning technologies and analytics, working in collaboration with the University of Newcastle (Mechatronics).
- 100% Australian owned and operated.

SMART SHIP LOADER ANTI-COLLISION – SYSTEM OVERVIEW

The core components of the Smart Ship Loader Anti-Collision System include:

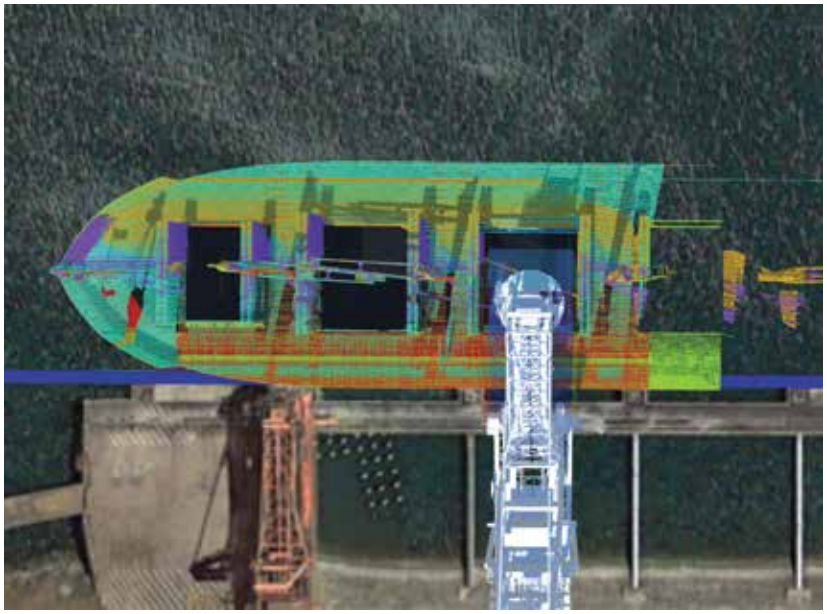
From top: Port Kembla Ship loader visualisation showing highly accurate, scanned vessel laser data, overlaid on an aerial image; highly accurate 3D model of the ship loader.

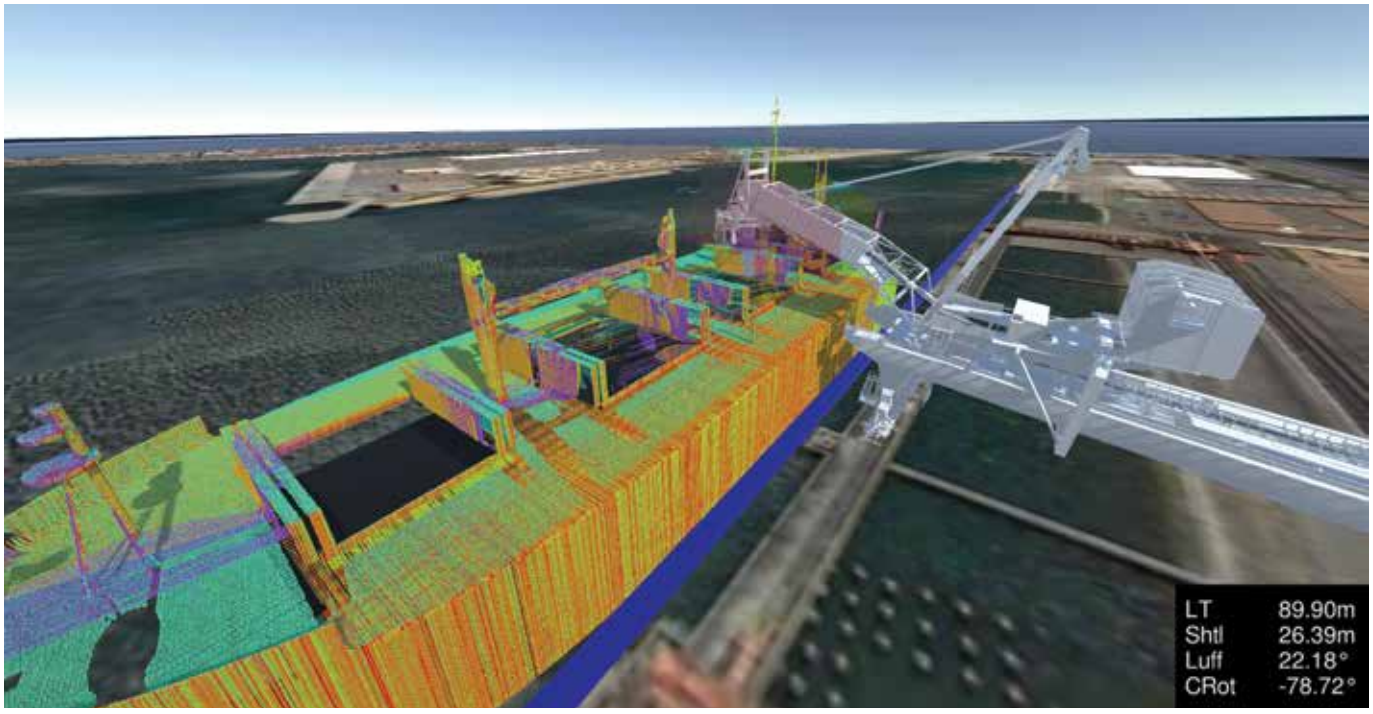
LASER DATA COLLECTION

A 3D model of the ship loader and the vessel alongside the wharf is assembled from the millions of laser-sourced data points. This model is created in real time and continuously refined as more and more data points becomes available and as the ship loader moves. Overlapping data points and perspectives make for a highly accurate and reliable model.

In our base configuration, 7 lasers are located on the ship loader: three on the boom and four surrounding the spout. Additional lasers can be used to protect a rotating or shuttling operator cabin, each, located on the boom.

The SLAC uses industry leading lasers that have had a zero-failure rate across many projects. There are no GPS requirements or need for equipment to be installed on the vessel.



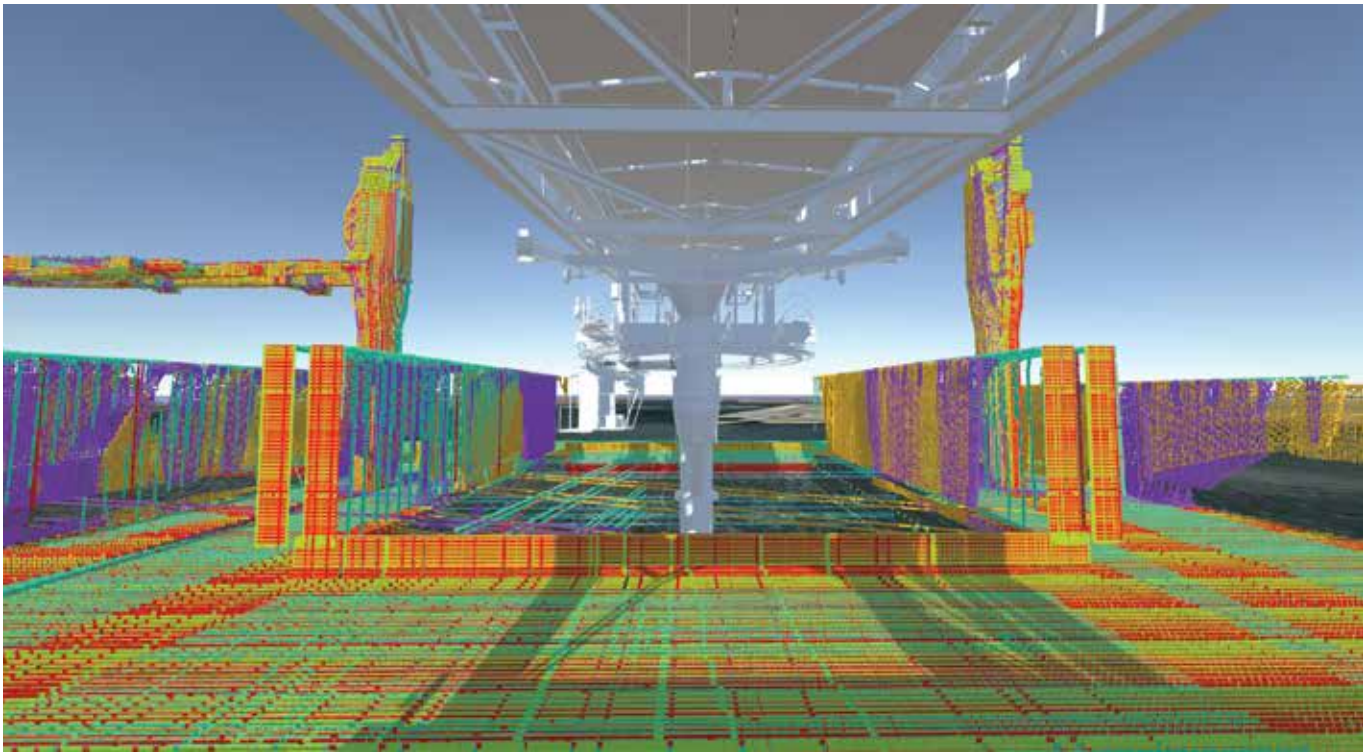


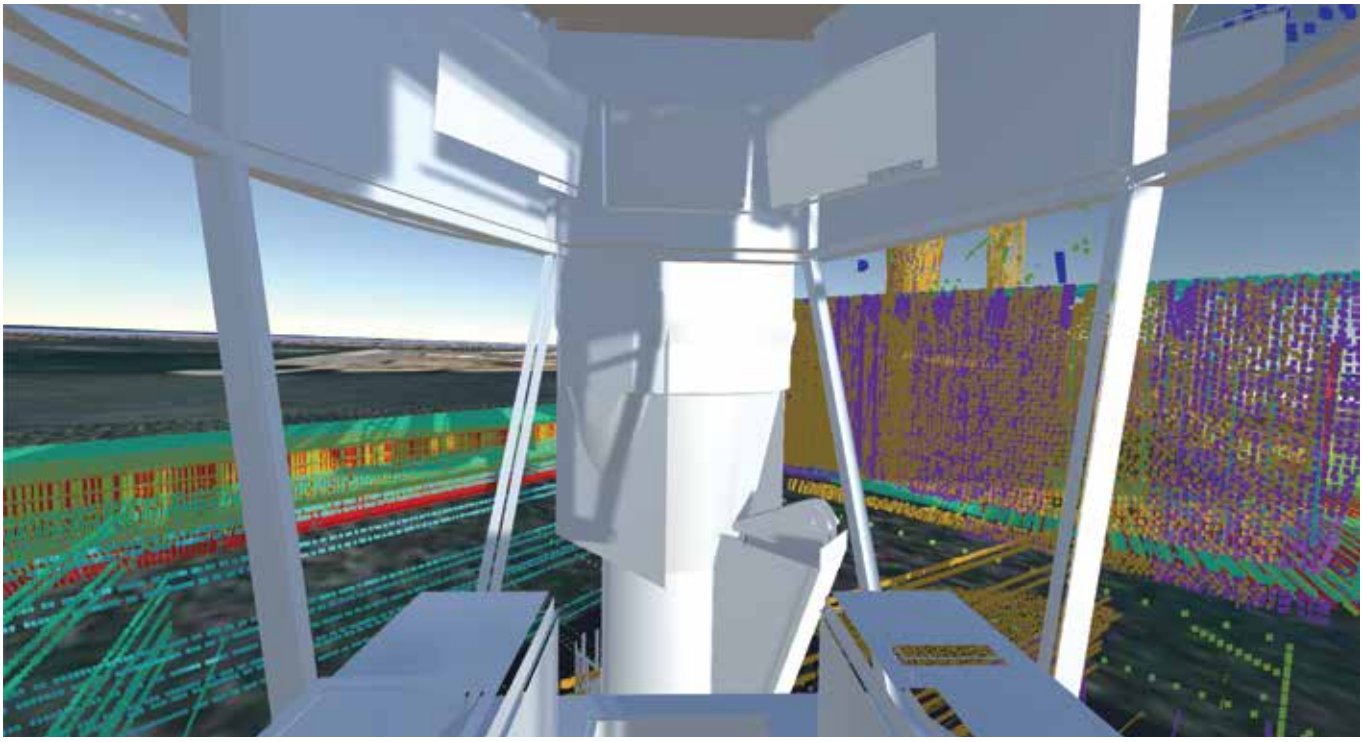
HIGHLY ACCURATE DATA MODEL

The vessel's profile, location and orientation are known in real-time and its movements can be accurately predicted in both harbours and open ports.

The SLAC uses two methods to build an accurate and predictive model of the vessel and ship loader. A mapping system is used to build an historical picture of the vessel and the ship loader. A curtain system is used for real-time data analysis. Together, the combination increase accuracy and provide redundancy across the core components being monitored.

Below, the highly accurate 3D model of the ship loader and a scanned section of the vessel alongside the Port Kembla wharf. Each colour represents a different laser source which has been superimposed over an aerial image of the site. The butterfly hatches, deck cranes and light post are clearly seen.





The laser models level of detail and breadth of point of view is evident in the images above. ***Top:*** *Port Kembla Ship loader laser models perspective from under the boom with the spout lowered into the hatch.* ***Above:*** *Port Kembla Showing the perspective from the operator's cabin on the boom with the spout lowered into the hatch.*

ANTI-COLLISION ANALYSIS – PROTECTION & SLOW DOWN ZONES

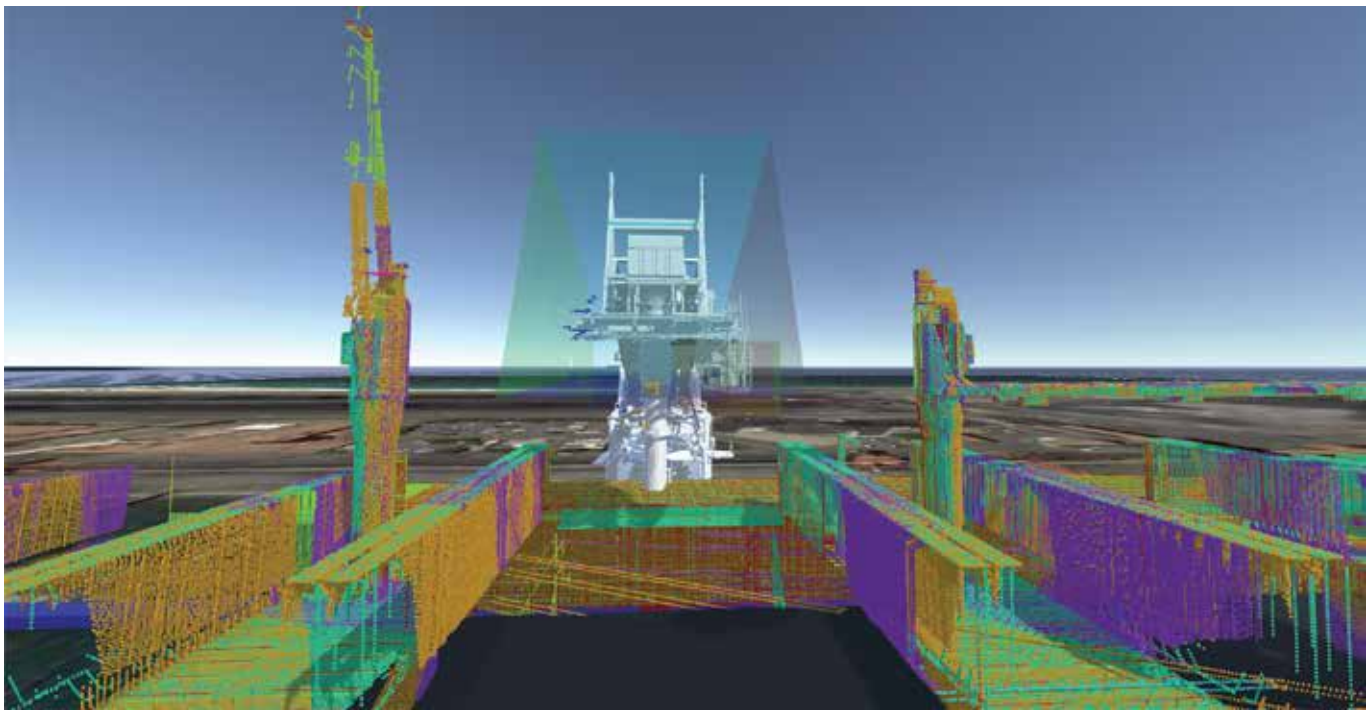
The boom and shuttle, spout and spoon, and operator cabin are dynamically modelled by the system and compared against the vessel. The distance of each machine part to the vessel in each motion direction is calculated in real time.

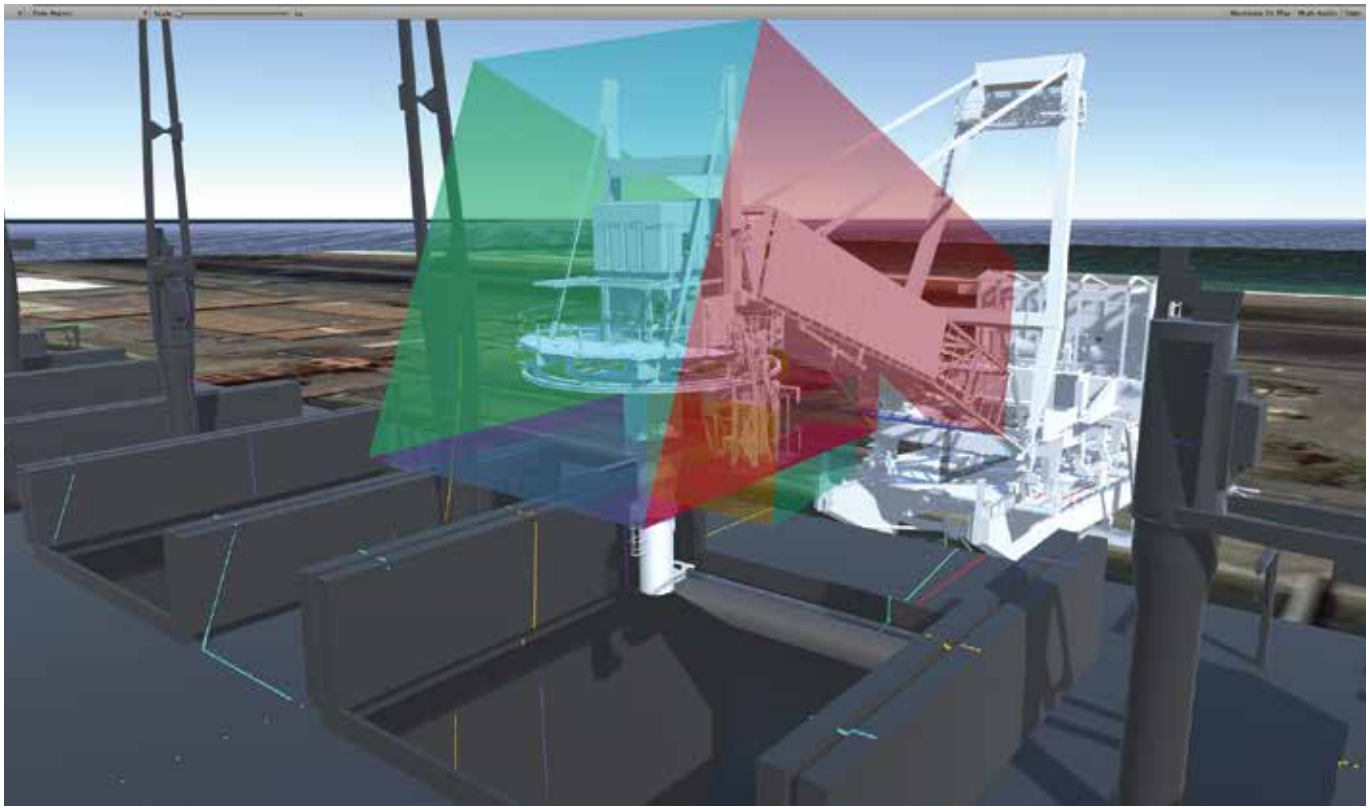
As the machine approaches the vessel, the PLC can act on the calculated separation distances, instigating slow down and eventual inhibit as required, to prevent collision.

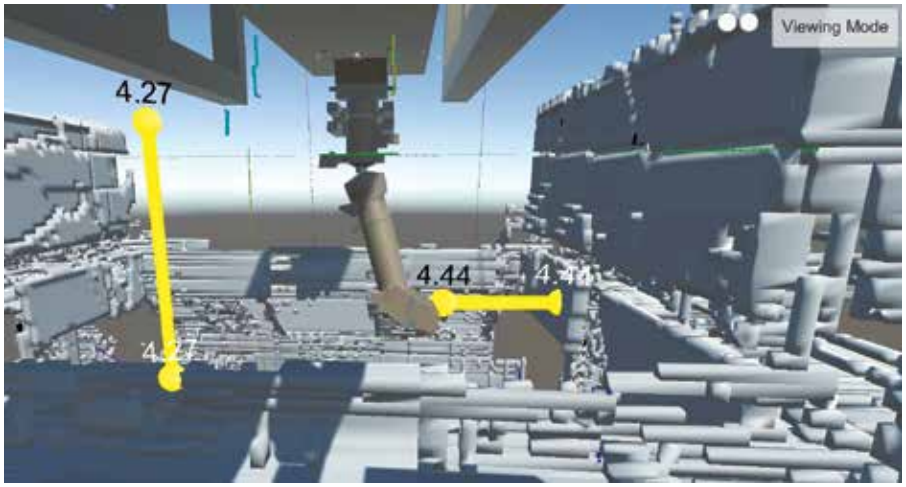
The system is able to track the recent history of hatch edge positioning to allow the ship loader shuttle operational limits to be dynamically set to account for base swell level and other vessel movements.

The protection zone surrounding the ship loader can be seen in the following images. The SLAC calculates vessel and ship loader separation distances from the vessel, hatch and any miscellaneous objects from the boom and shuttle, spout and spoon and operator cabin. Thousands of separation distances are calculated in real time with key distances displayed in 10cm increments for the operator's convenience.

Port Kembla Theonshore view shows the protection zone surrounding the ship loader as it is lined up over vessel's butterfly hatches.







Port Waratah The accuracy of the laser model and the real CCTV view can be seen with separation distances from the boom and spout to the hatch edge displayed. Distances shown in metres.

OFF-SITE SIMULATION ENVIRONMENT

Ship loaders range in size and physical configuration and each has a unique machine geometry.

MRA can fast track optimal setup for each ship loader by leveraging its well-proven off-site simulation environment. This analysis will determine the ideal position for lasers to optimise data collection including, breadth of coverage, redundancy and ease of maintenance. The offsite simulation will save considerable time and expense for set up and commissioning.

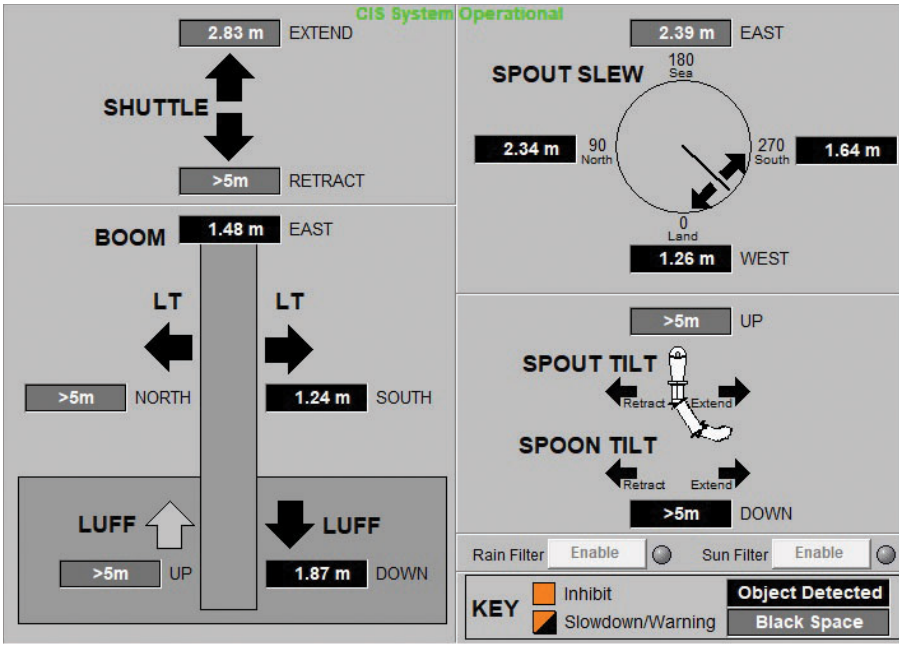
PLC INTEGRATION

MRA has extensive expertise in PLC and SCADA programming and integration of large machines and automation systems. The Smart Ship Loader Anti-Collision System can be integrated into SCADA systems and provide audible alerts and commands. These actions are all in open PLC.

VISUALISATION SYSTEM

MRA's Smart Ship Loader Anti-Collision System includes a visualization front-end that shows real time views of the vessel and ship loader with separation distances from the vessel, hatch and any miscellaneous objects from the boom and shuttle, spout and spoon and operator cabin.

The visualisation runs as an application in the Windows environment and allows multiple simultaneous users.



SCADA display showing key separation distances.

SHIP LOADER AUTOMATION – FUTURE DIRECTIONS

MRA is actively researching automation modules that move beyond ship loader anti-collision towards full ship loader automation. The two key steps are:

Automated Hatch Positioning currently in development. This will automate the ship loader's movements along the side of the vessel, location of the hatches and the start position. One of the key challenges in automated hatch positioning is the identification and classification of different types of objects on the vessel.

Automated Ship Loading can be broken into two parts: the initial pour to around 70% capacity; and, final trimming to achieve targeted load profile.

The current focus of MRA's automated loading program is on the initial pour. A key consideration is our ability to support a range of material types including coal, iron ore, bauxite and alumina.

Keen to find out more?

You're welcome to contact our Engineering Manager **Peter McPherson** m 0403 453 250 e peter.mcpherson@mra.com.au w mra.com.au