iSAM
GROUP

Advanced Anti-Collision System for Shiploaders

Advanced Anti-Collision System for Bulk Material Shiploaders with an Option for Fully Automated Operation

- 3D laser scanning system for boom protection

- 3D laser scanning system for ship modelling

- RTK-GPS system for machine positioning

- Suitable for ship sizes ranging from small barges to capesize vessels, including ships with deck cranes and butterfly hatches

- Software for sensor data evaluation and detection of possible collision hazards

- Interface with existing machine control systems

- Visualization of ship-model and collision information in the operator cabin or at a remote control center

The Industry

Bulk export and import terminals typically have extreme levels of equipment utilization. At most locations, the equipment is utilized 24/7, when minutes of downtime create a considerable impact on the profit margin. One of the major business risks is the breakdown of critical equipment. A common, worst-case scenario is mechanical damage to a shiploader caused by a collision, e.g. with the superstructure of a ship. The protection of those valuable assets is therefore a top priority, second only to the safe operation of the terminal.

The Task

In general, most ship loaders are equipped with simple sensor systems such as microwave barriers or pull-cords along the boom to prevent collisions between the boom structure and a possible obstruction in the work area of the machine. These systems are designed to stop critical movements but not to predict collisions or to alarm an operator before a collision happens. For both the manual operation and specifically for a fully automated operation of a shiploader, it is crucial for the automation system to "see" in advance a collision hazard and to be able to calculate future machine movements to prevent collisions. Therefore, sensor and evaluation systems must be implemented that

- work reliably in an industrial 24/7 all-weather production environment
- provide the required accuracy to detect typical obstructions such as light towers, radar masts etc.
- require minimal maintenance
- perform under critical environmental conditions

The Solution

iSAM has developed and implemented a sensor and evaluation system which enables a shiploader control system to obtain complete information about its own position and also of all other objects in the vicinity. For the first time, this allows for the effective protection of the shiploader boom in manual mode. It also creates the foundation for remote or an even fully automated operation. To do so, the system integrates data from three main sensor components:

- 3D laser scanning system for real-time boom protection
- 3D laser scanning system for ship modelling
- RTK-GPS system for machine positioning
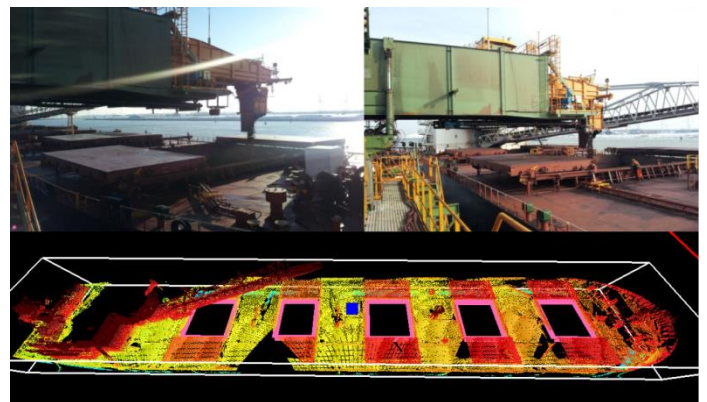
Shiploader and ship with self-discharging conveyor, 3D ship model of same ship

The 3D laser system for real-time boom protection scans an area enclosing the boom structure to reliably detect deck obstructions such as cranes, light poles, the ship's bridge or open butterfly hatches posing a collision hazard.

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The system uses defined slow-down and final-stop zones around the boom. For each zone, it provides the distance to the closest detected collision hazard as well as a stop signal in case the obstruction violates the defined final-stop zone to the machine PLC.

In addition to the collision protection described above, a three-dimensional ship model - calculated from laser scan data and georeferenced by RTK-GPS position measurement - is built and continuously updated. It allows configuring additional zones for either protecting the boom or individually moving structures such as an operator cabin or a telescopic chute. Should the machine be equipped with a shuttle, the related zones are automatically adjusted to match the actual boom length.

The system provides all necessary data to the machine control system to ensure a safe stop of the shiploader before a collision occurs.

A standard industrial PC can be used to display the 3D model in the operator cabin or a remote control room. The **iSAM** visualization client provides the following main views:

- 3D ship model in a pan / tilt / zoom view
- Overlay with machine 3D CAD model
- Virtual cameras providing dedicated views
- Precise position of hatches
- Highlighting of collision hazards based on current data (pink-colored in picture above, on the right)
- Material distribution within a hatch
- Distance and direction of nearest collision hazard
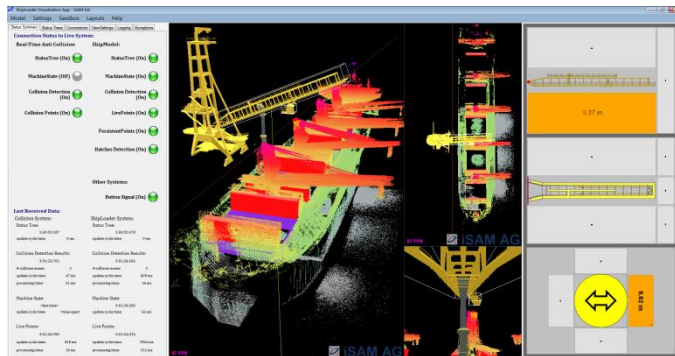
Visualization of 3D laser data and highlighting of collision zones
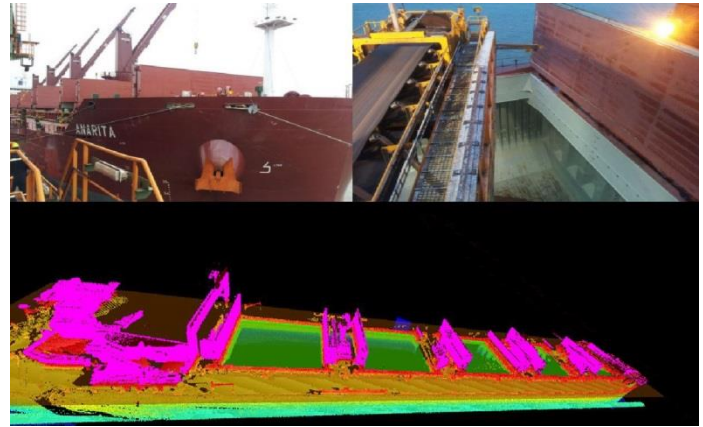
Shiploader and ship with butterfly hatches and deck cranes, 3D ship model of the same ship

The **iSAM** advanced anti-collision system can be upgraded to facilitate fully automated ship loading. This system utilizes the 3D ship model and the 3D boom protection systems and hence makes it possible not only to control the entire loading process from a remote location but also provide an unprecedented level of automation, enabling one operator to easily control several shiploaders from a central control room.

The Benefit
The system provides a comprehensive protection of the complete boom structure by providing collision hazard information to the machine control system as well as to the operator. Optionally, it can be used to fully automate a shiploader, running several shiploaders from a central control station at a remote location.

Advantages of the System
- Automatic identification of all collision hazards
- Timely warning to the machine control system to stop critical movements before a collision occurs
- Customer-defined slow-down and final-stop zones to operate the shiploader as close as possible to obstructions
- Prevention of damage to valuable assets
- Prevention of downtime
- Reliable sensor equipment while loading during obstructive weather and environmental conditions such as rain, wind, dust, fog or snow
- Optional upgrade to fully automated ship loading from remote locations

Supported by:
Federal Ministry of Economics and Technology
on the basis of a decision by the German Bundestag

Facts

Launch Customer:	Europees Massagoed-Overslagbedrijf (EMO) bv, Rotterdam, Netherlands	Software:	■ iSAM 3D boom protection application ■ iSAM 3D ship model application
Industry:	Bulk material export and import terminals	Data output:	■ Fieldbus + digital interface to machine PLC ■ Ethernet for scan and 3D data
Hardware:	■ Standard industrial PC ■ iSAM 3D laser scanner for boom protection ■ iSAM 3D laser scanner for ship model	Visualization:	■ iSAM 3D boom protection client application ■ iSAM 3D ship model client application

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