ARE HUMANS AN OBSTACLE FOR AUTOMATION?

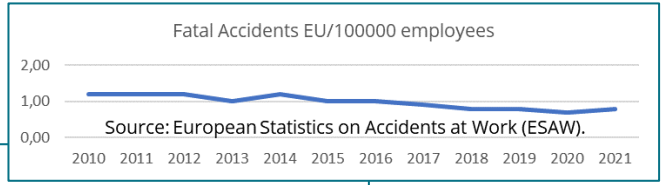
- INTELLIGENT SENSORS ENABLE A SAFE MAN-MACHINE COOPERATION

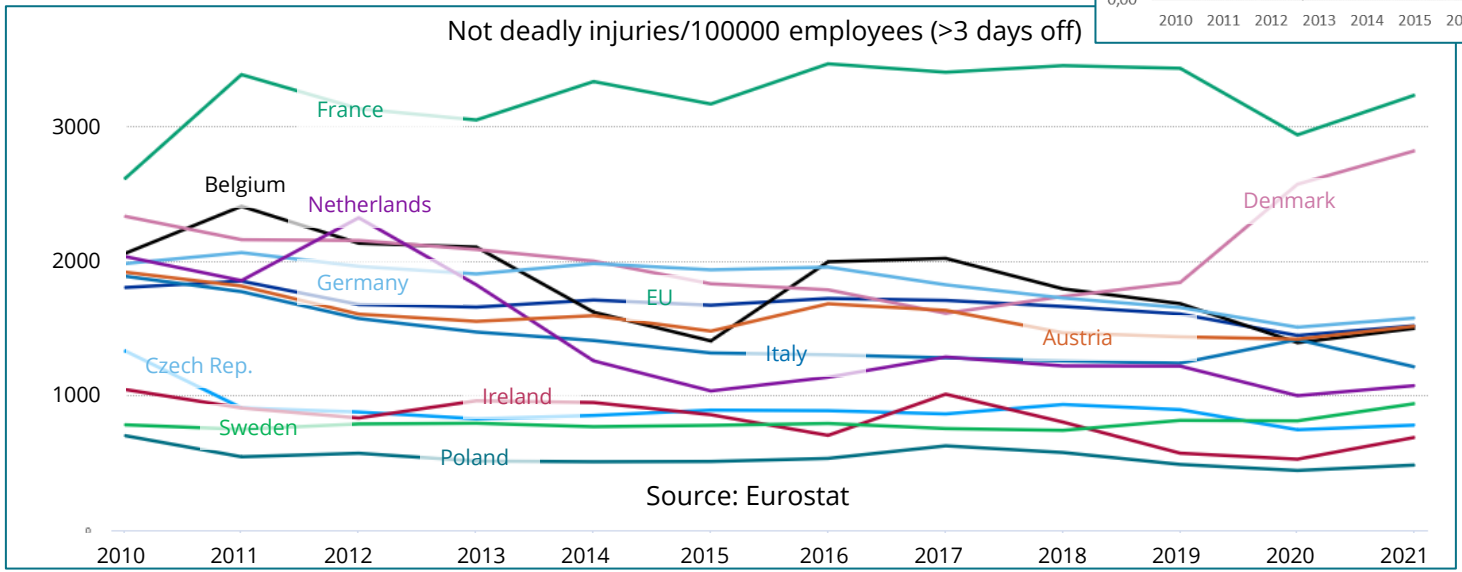
KYMATI

WAVES ARE OUR VISION

INJURY STATISTICS OF LAST DECADE

AUTOMATION HAS NO SIGNIFICANCE





- High degree of automation in industrialized countries does not cause rise in work accidents.
- Technical progress helps reducing work accidents over time.

CHALLENGES WITH AUTOMATION

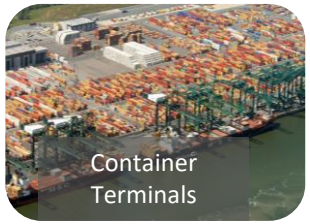
PRACTICAL ISSUES WITH HIGHER DEGREES OF AUTOMATION

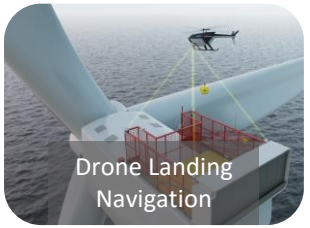
- **High cost** of automated production machines and automatic transport – full automation is not an option for many => **technical mix** is a consequence (Example: Forklift trucks and AGVs).
- Automated machines can operate at **high speeds and generate high danger with massive forces**.
- High demand on **safety measures to maintain person & machine safety** in case of errors, malfunctions and technical service (deadly accident @ Kraft Food, Granite, USA, 2012).
- No automation project goes from 0 to 100 in one day – projects have long deployment phases with even increased **mix of staff and machines**.
- For some operations, **occasional staff or visitors crossing automation areas** is unavoidable – stop all machines or continue automatic operation? (container terminals see vessel staff and truck drivers disembarking and wandering around on the terminal).

=> For the safety of humans and the integrity of automated machines, **sensors** are a crucial means to **mitigate risk**.

RADAR SENSORS FOR INDUSTRIAL AUTOMATION

KYMATI DESIGNS, MANUFACTURES AND INTERNATIONALLY MARKETS RADAR SENSORS FOR 1D, 2D and 3D POSITIONING & OBJECT DETECTION APPLICATIONS.





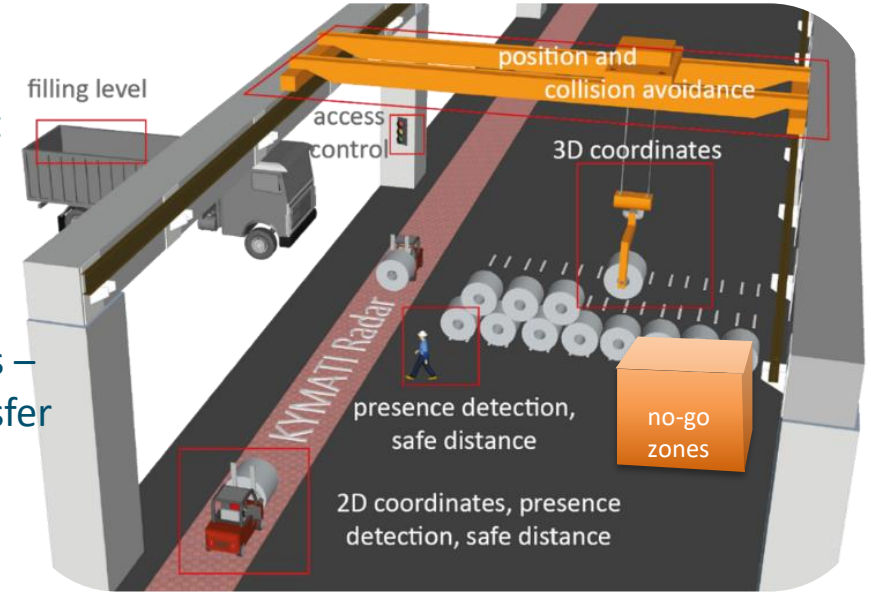
BENEFITS

- Radar sensors operate extremely robust and precise
- Maintenance-free in harsh indoor and outdoor environments,
- Reliable under adverse weather, dust and temperature conditions

CRANES & RADAR – APPLICATION OVERVIEW

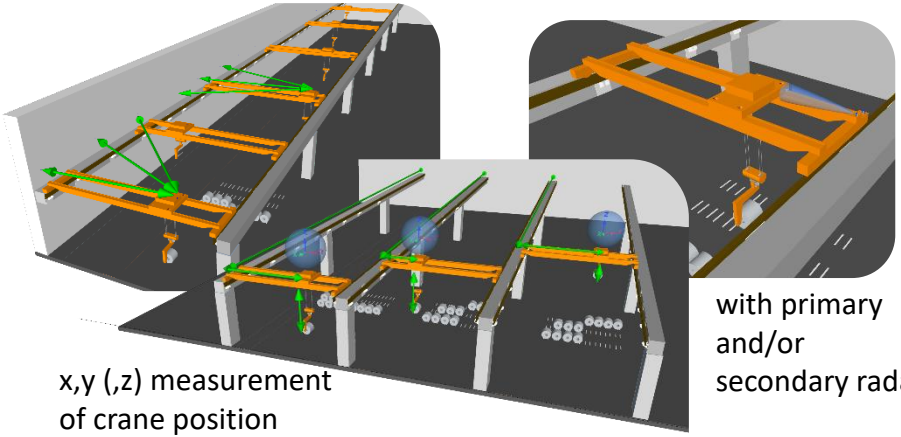
TYPICAL APPLICATIONS ON AND AROUND CRANES:

- Crane and crane hook: **xyz position**
- **Collision avoidance**: crane-crane (same or different level, crane-infrastructure, no-go zones
- **Detection zones** on the ground – **objects** on rails, **persons** in the operation area
- **2D position and loading status** of logistic interfaces – product receiving postions, delivery by trucks, transfer cars, conveyors
- **Access control** for cross traffic
- **Filling level** of load receiving containers



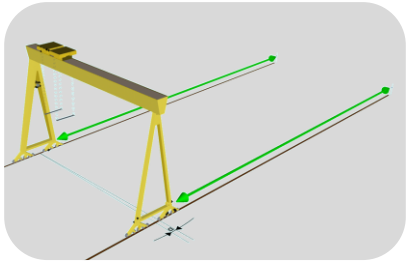
CRANE AUTOMATION

POSITION MEASUREMENT, ANTI-SKEW AND 1D COLLISION AVOIDANCE

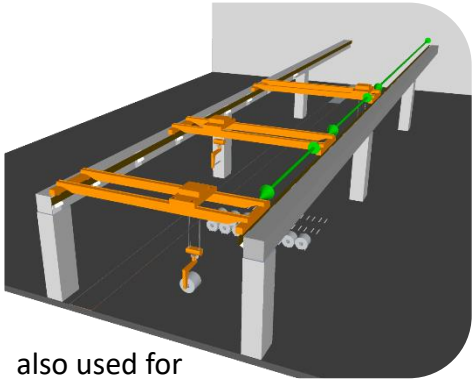


x,y (,z) measurement of crane position

with primary and/or secondary radar



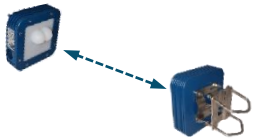
Position and skew control on portal cranes



also used for collision avoidance

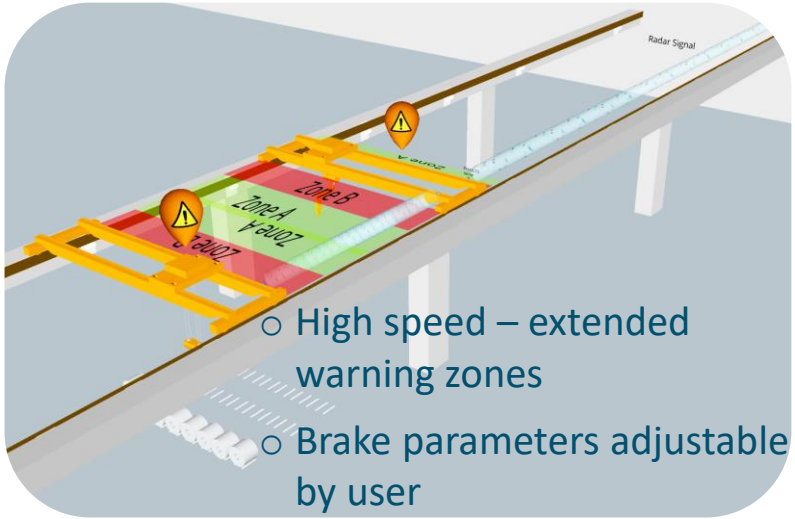
BENEFITS

- Low invest, low cost of ownership,
- No maintenance, no re-adjustment or cleaning,
- No service interruptions in plant operation
- High reliability for safety and logistics applications

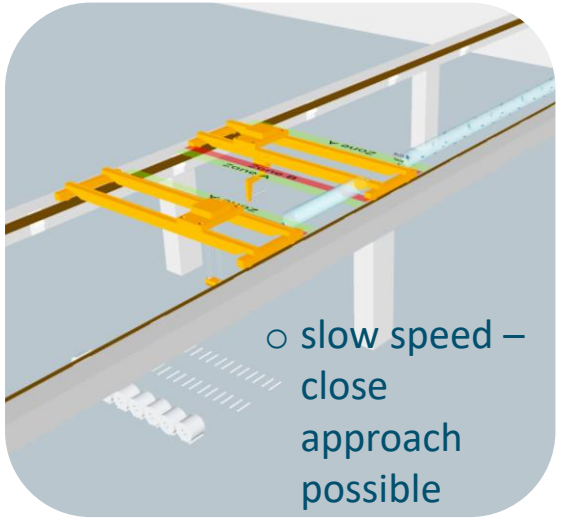


BUILT-IN COLLISION AVOIDANCE

ON-BOARD ALGORITHM TO CREATE WARNINGS BASED ON APPROCH SPEED AND DISTANCE

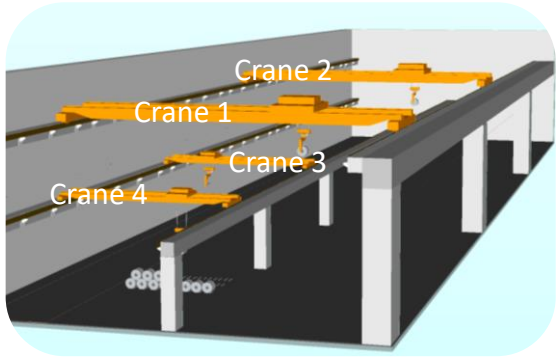


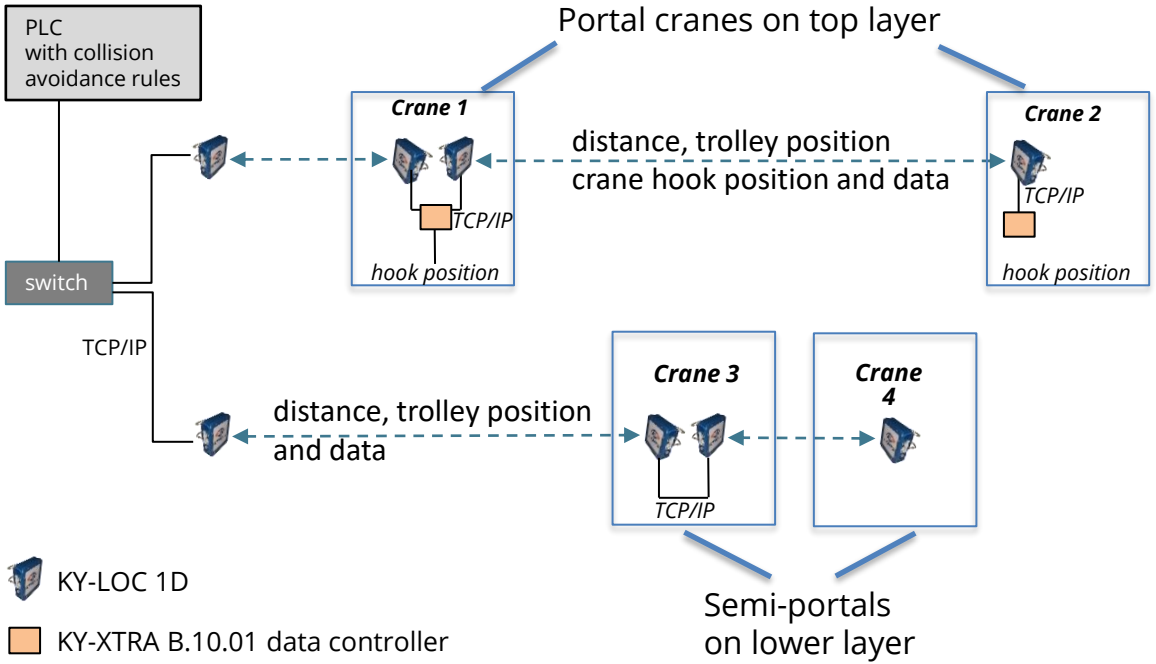
- High speed – extended warning zones
- Brake parameters adjustable by user



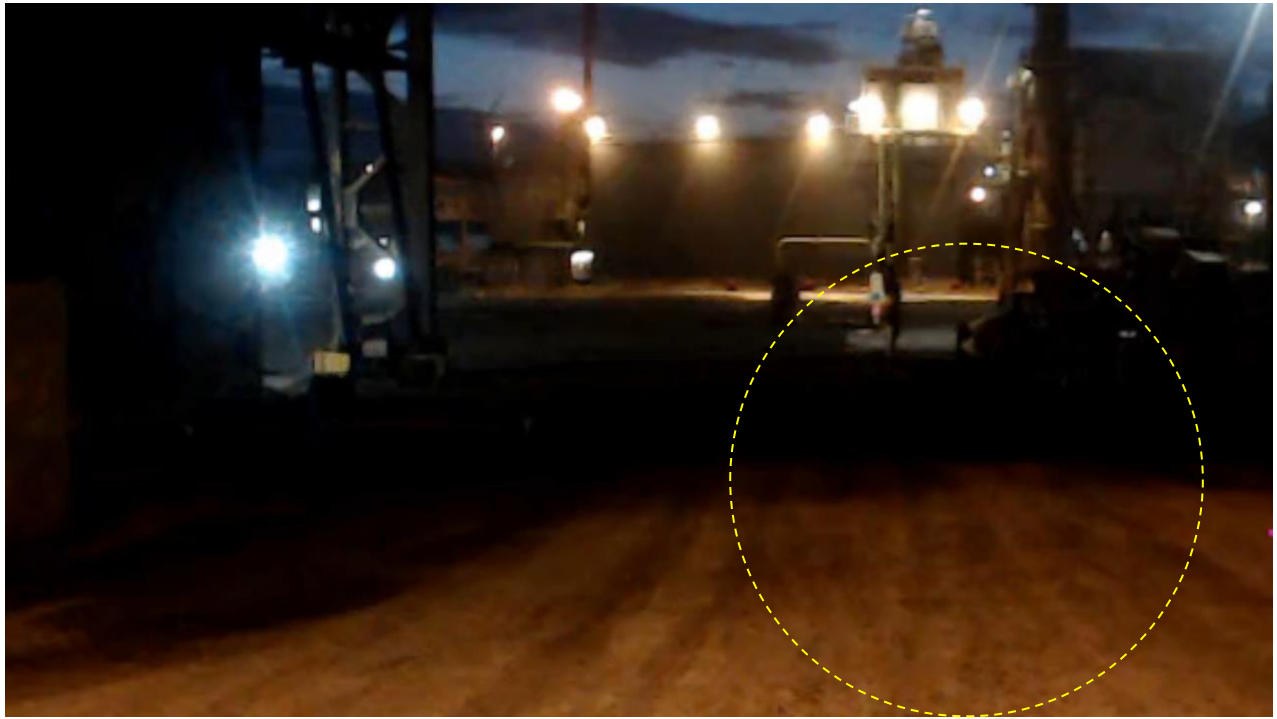
- slow speed – close approach possible

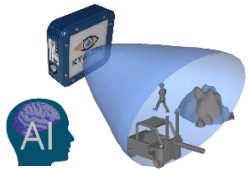
COLLISION AVOIDANCE – MULTILEVEL CRANES





SAMPLE VIDEO – PERSON DETECTION





PERSON DETECTION WITH KY-RAY 3D.04.01

PERSON DETECTION AROUND CRANE

Task

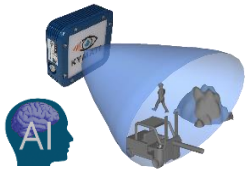
Detection is required if a person is in the warning area of the crane.

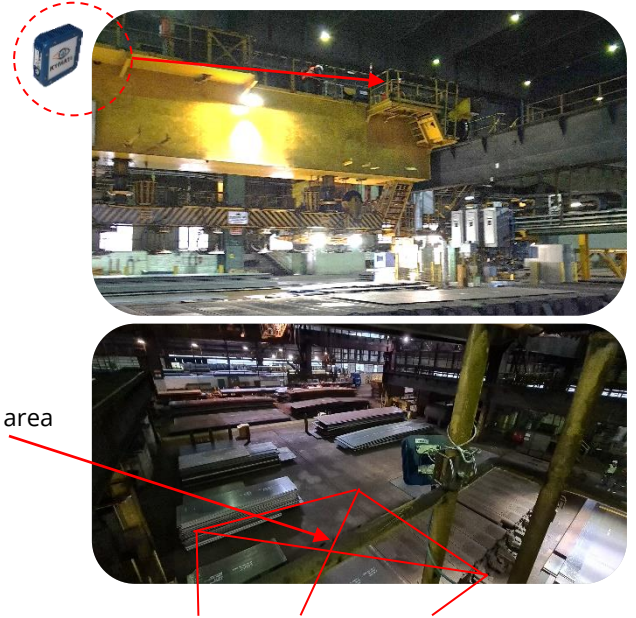
Cameras are not allowed in this area of the plant and are ruled out as a solution.

Solution

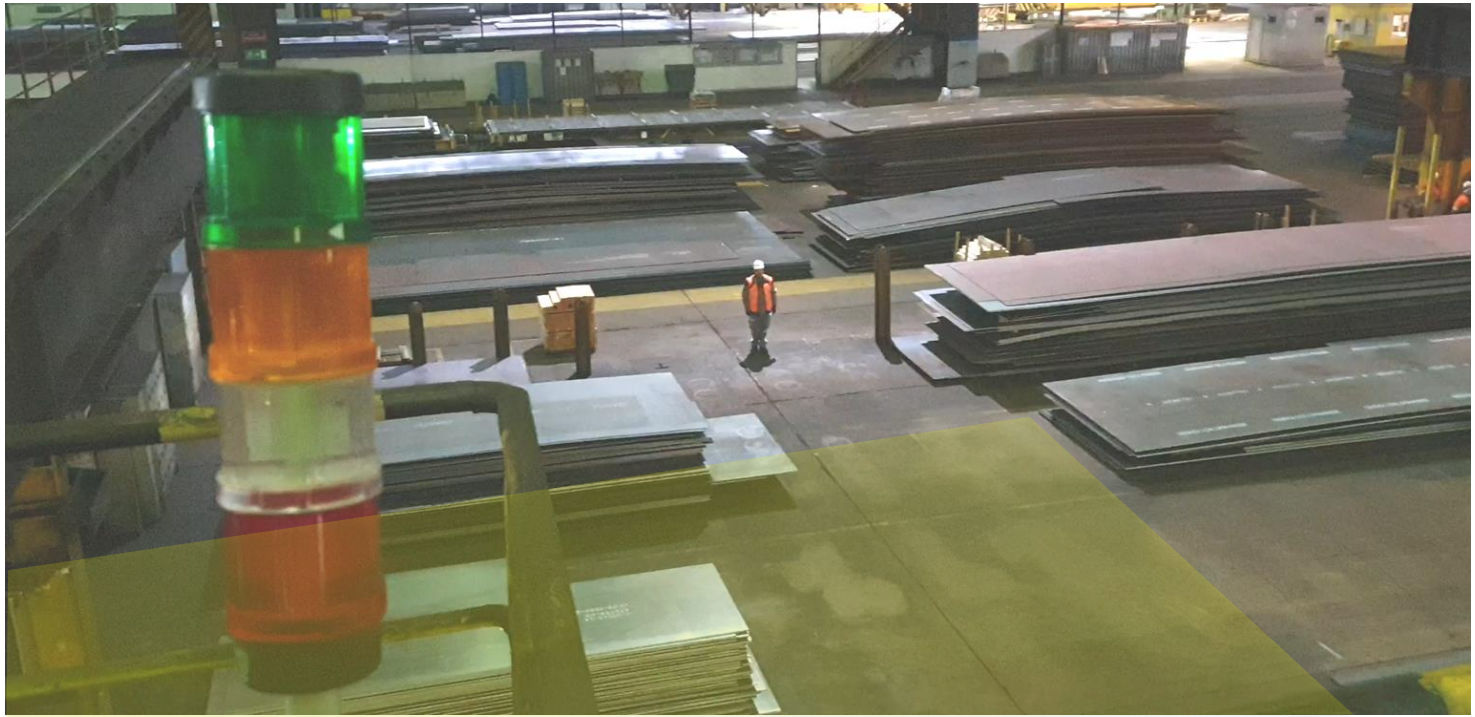
A warning zone was defined, with a limited x, y and also z area, so that slabs on the roller conveyor or a slab stack were ignored and only persons were recognized, activating the warning signal for the remote crane operator.

Sensors (2 or more):





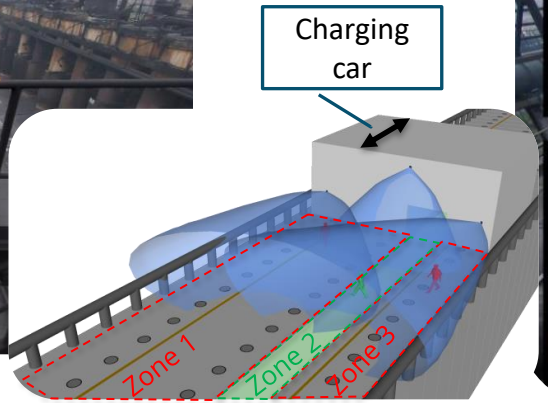
PERSON DETECTION IN STEEL PLANT



COKE BATTERY - SAFETY

PERSON DETECTION – CHARGING CAR

Charging car on top of battery



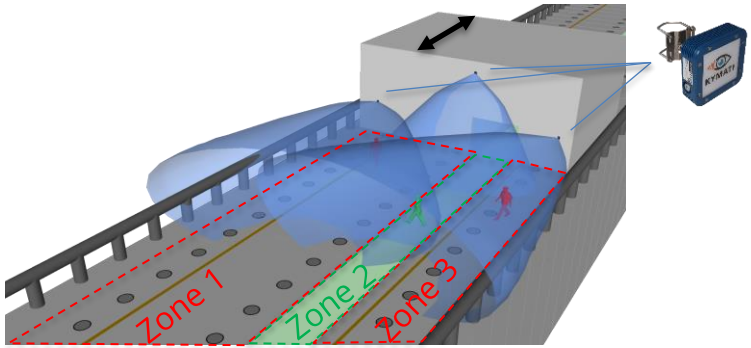
Warning zones zones and green (walking/no warning) zones

Up to three KY-RAY radar units to watch the scene

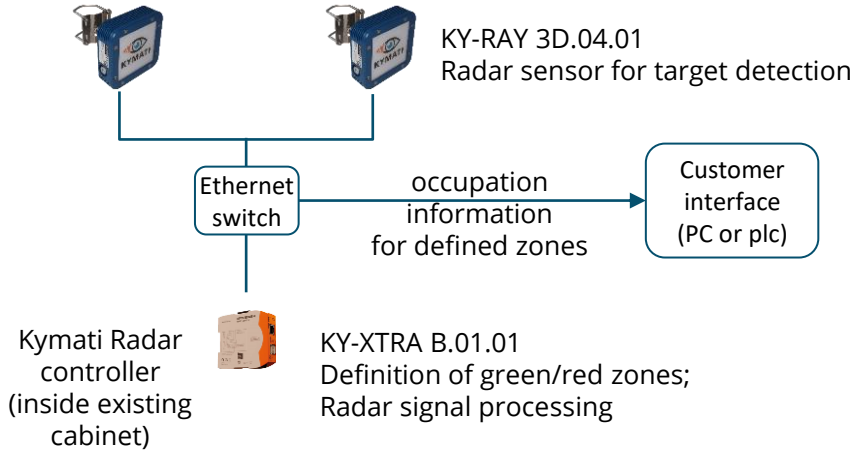
KY-RAY 3D.04.01 OBJECT/PERSON DETECTION

SAFETY ASSISTANCE FOR MOVING MACHINE OPERATORS

PRIMARY RADAR, MULTIPLE SENSORS



SYSTEM ARCHITECTURE



PORT ELIZABETH – NEW JERSEY 1962

- The worlds first container terminal was opened in August 1962:

  Port Elizabeth Marine Terminal in New Jersey

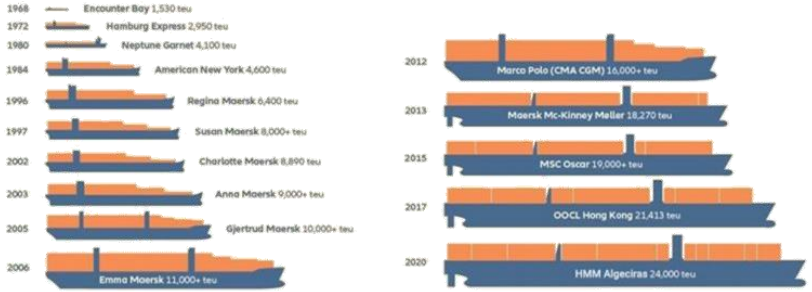
CONTAINER TERMINAL CHALLENGES

MAJOR DEVELOPMENTS

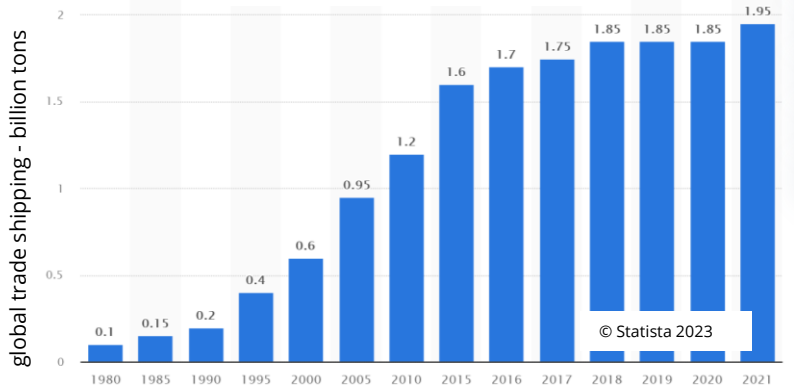
- Vessel size – longer, wider, stringent time constraints for turnover at the terminal.
- Global shipping volume – more than tripled since year 2000.

  …and all that with a confined space for individual container terminals.

=> Consequences: Increased operational requirements…

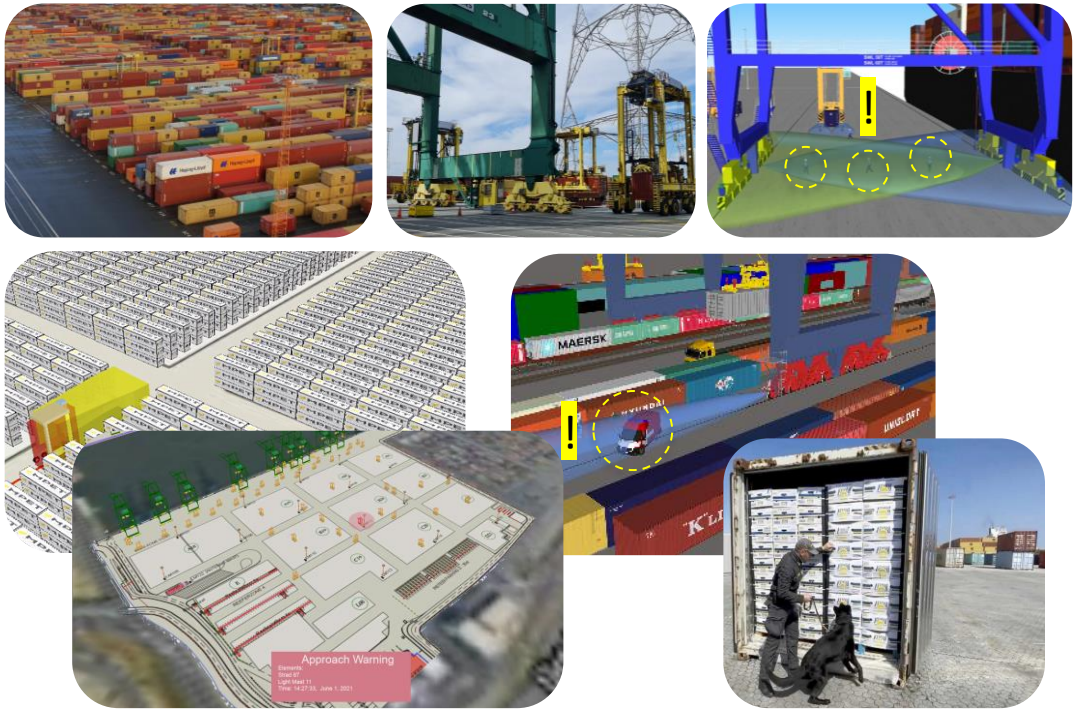


Source: Allianz Global Corporate & Speciality



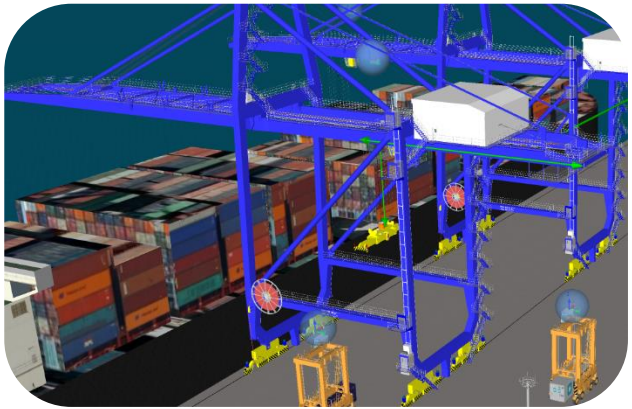
MAJOR LOCATION RELATED REQUIREMENTS

- **Container tracking on yard:**
  - Where is container xyz? No direct location information possible=> use transport equipment load change position.
- **Position of transport vehicles and cranes:**
  - For job assignment and container tracking
- **Collision avoidance and no-go zones:**
  - Temporary road work, denied areas; temporary hatch cover positions and person/object detection.
- **Event creation - vehicle movement tracking:**
  - Event replay in 3D from any desired viewport; Driver training and detection of unwanted moves (e.g. drug-trafficking).
- **Fleet management:**
  – Collect data like distance full/empty, tyre pressure, strong shock, engine temp, ...).
- **Dynamic 3D Visualization for drivers and operators:**
  - Allow mixed fleets of various brands of cranes and vehicles.



PRECISE CHE*) MOVEMENT MEASUREMENT

1D POSITION ON CRANES (LONG TRAVEL OF RMG, RTG, QC; CRANE TROLLEYS; SPREADER LIFTING HEIGHT)



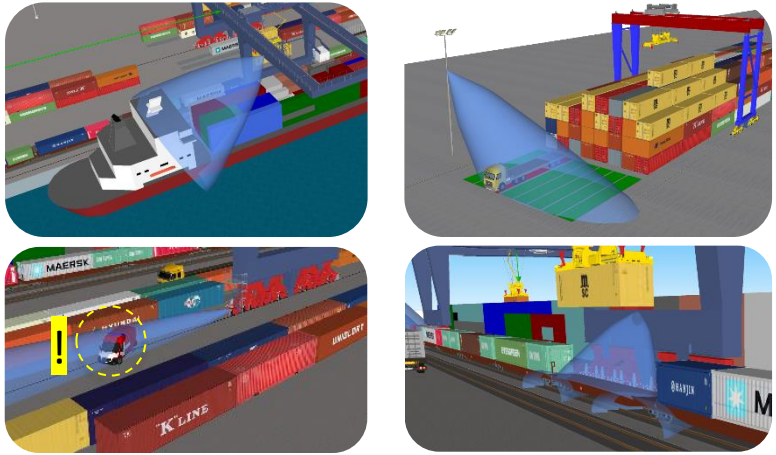
BENEFITS

- No infrastructure installation (no RFID transponders along track)
- No maintenance, quick retrofit
- Not affected by water, fog or snow on the ground
- High reliability for outdoor applications

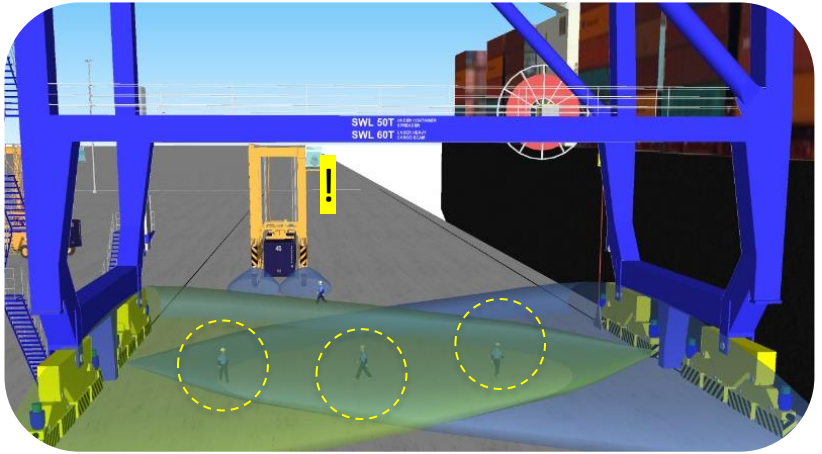
*) CHE=Container Handling Equipment

CONTAINER TERMINAL – ABSENCE & PRESENCE

OBJECT DETECTION



PERSON DETECTION

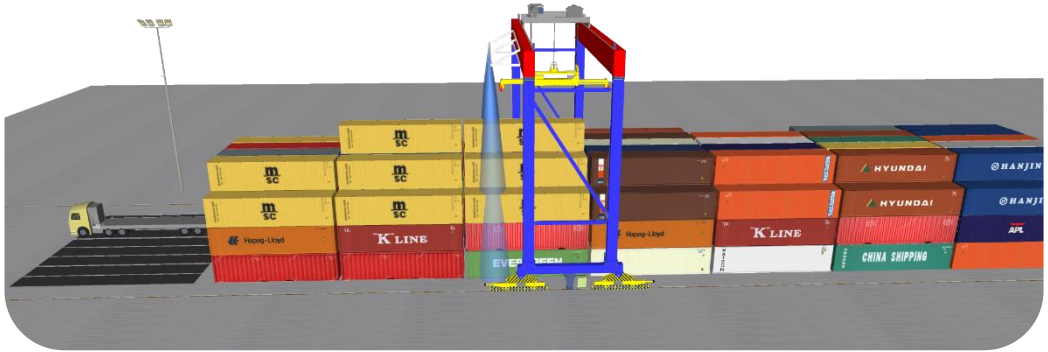


BENEFITS

- High resolution radar can detect, qualify & count objects
- No maintenance, no re-adjustment or cleaning, no interruptions for installation
- High reliability for operational safety and automation of processes

CONTAINER TERMINALS – STACK PROFILING

ACTUAL STACK PROFILE MEASUREMENT



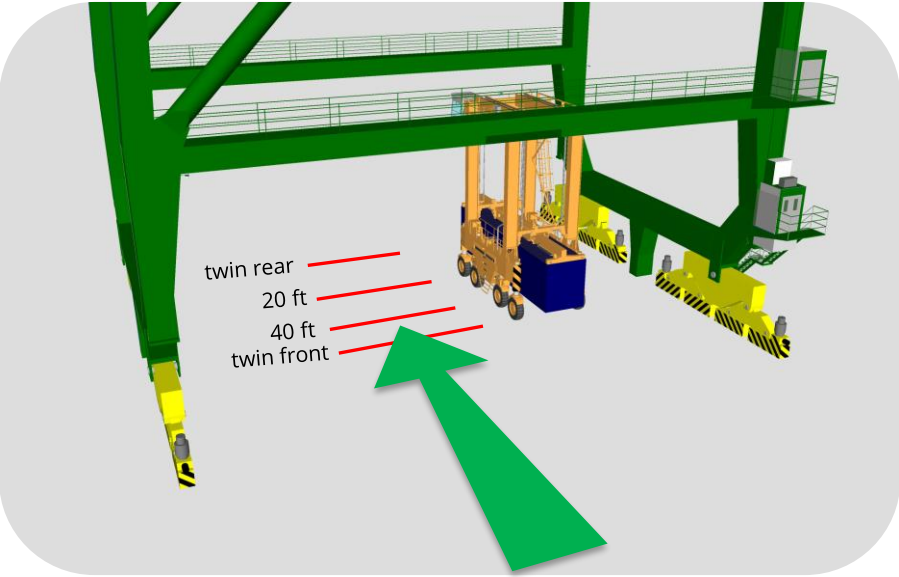
BENEFITS

- Only 4 sensors for 8 rows required to get complete shape data
- No maintenance, no re-adjustment or cleaning, no interruptions for installation
- High reliability for operational safety and TOS data.

STOPPING POSITION UNDER CRANE

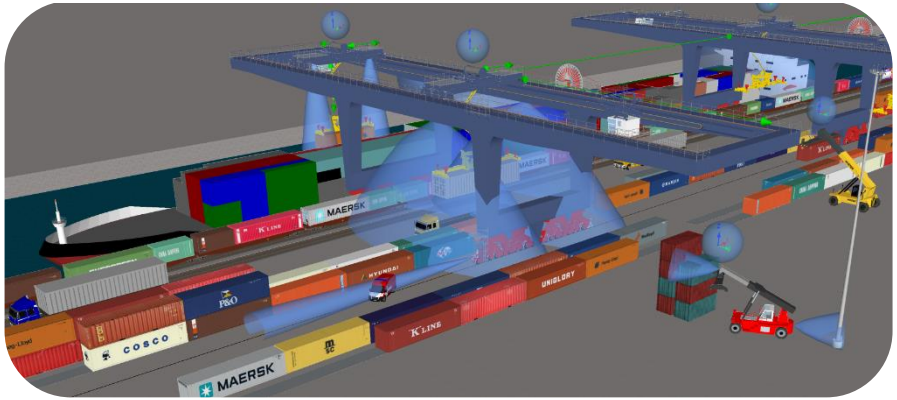
VIRTUAL STOP LINES - GUIDANCE FOR DRIVERS

- Position detection under crane allows precise drop-off position for container by indicating the correct stopping point to the driver
- Several stopping points for CHE can be preconfigured per each crane, depending on container under spreader and crane type
- Driver gets optical ‘car wash-like’ position indication
- Crane does not have to move sideways to pick delivered container => safety and efficiency gains.



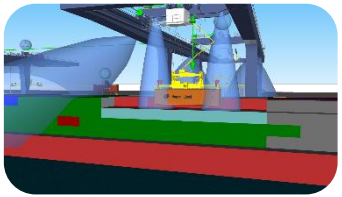
INTERMODAL CONTAINER TERMINAL

RADAR SUPPORTS EFFICIENT OPERATION

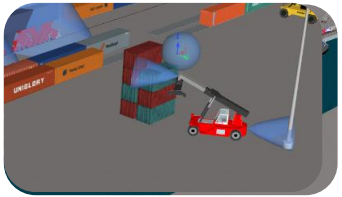


- **Precise 1D and 2D Position Radar**
  for crane/vehicle position and collision prevention
- **Primary Radar**
  for presence/absence detection

- XYZ crane coordinates and collision warnings
- Reach stacker & empty handler: sensor fusion of GNSS with vehicle movement for position.



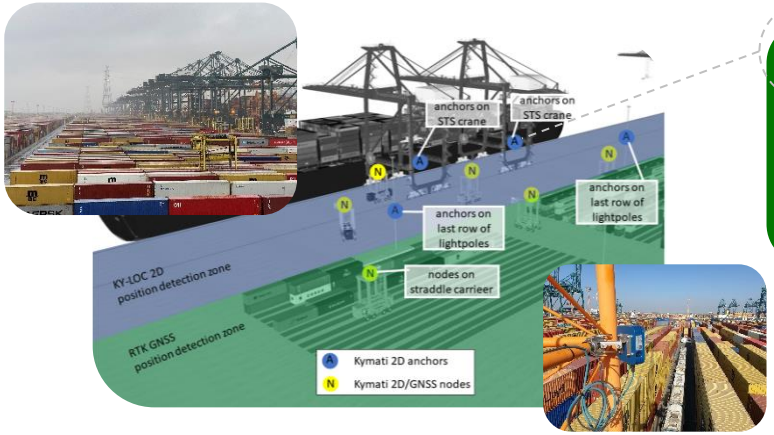
- 1D measurement for lifting height
- Radar to detect free space

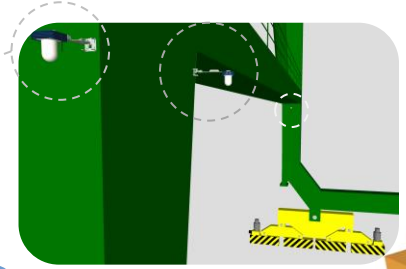


- Radar to prevent collisions with containers and infrastructure

ACCURATE ABSOLUTE POSITION MEASUREMENT

2D POSITION (FREE RANGING VEHICLES) – TRACKING & AUTOMATION





KY-LOC 2D anchors under quay crane and KY-LOC 2D nodes on strad

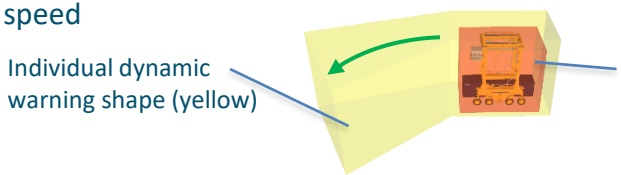
BENEFITS

- Very high position reliability, also when under QCs
- Independence from GNSS close to and under obstructions, but use of GNSS in open yard area
- Maintenance-free – no moving parts, not affected by weather or dust
- Cm accuracy - can be designed with system performance for automatic operation

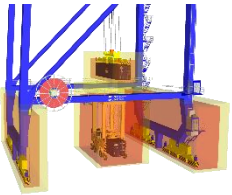
VEHICLE/CRANES TRACKING & COLLISION WARNING

CONTAINER TERMINALS

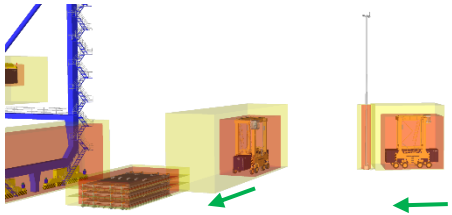
- **Track CHE movement (pick/drop container)** and supply updates to TOS
- **All Container Handling Equipment (CHE):**
  - **Measurement** of xyz-coordinates, speed and heading
  - Equipment has dynamic **virtual collision shape** based on heading and speed



  - **Collision warning** for quay cranes and for free ranging vehicles (against other vehicles, cranes and spreader, light poles, buildings, temporary work zones, hatch covers)

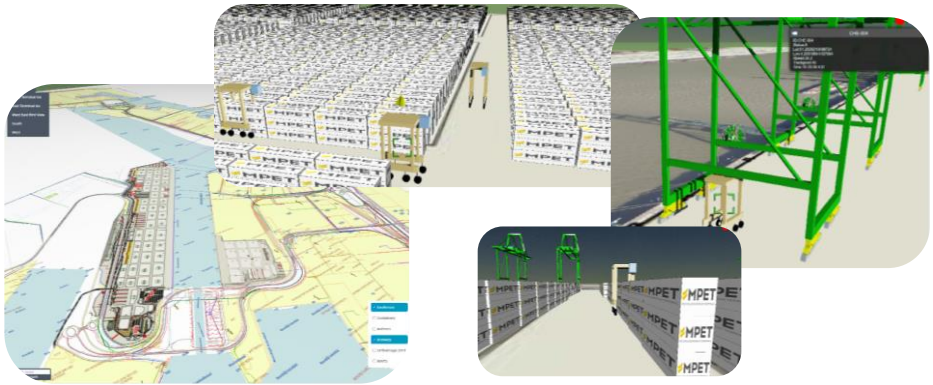


If collision shapes (yellow) intersect => warning via low latency radio is activated

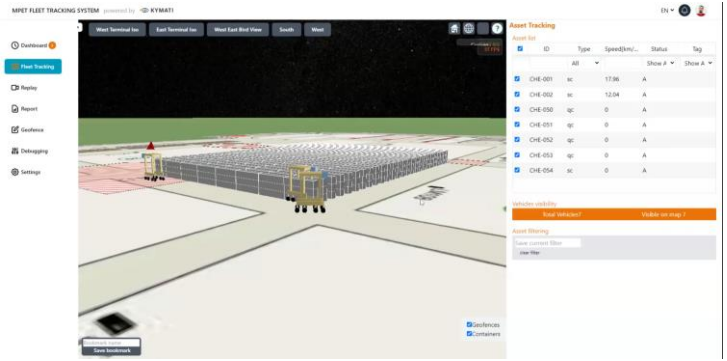


KY-OMNI: VISUALIZATION & FLEET MANGEMENT

PREDEFINED CUSTOMIZED VIEWS



REPLAY SCENES OF ANY DAYTIME FROM ANY NEW VIEWING ANGLE



BENEFITS

- **Hardware agnostic** – any CHE type and brand could be included
- **Tracking and replay** of movements, dangerous situations from **any chosen 3D viewport**
- **Monitoring equipment data** (mileage, net operating hours, idle time, shock, …)
- **Generate event messages** based on predefined filter rules (e.g. near misses, speeding, idling)
- **Web based** – KY-OMNI runs on all mobile and desktop equipment, different access level roles

BULK HANDLING: STACKER / RECLAIMER OPERATION

PERSON DETECTION AROUND STACKER/RECLAIMER WITH KY-RAY 3D

Task

Person detection in hazardous areas on the Stacker/Reclaimer

Solution

KY-RAY 3D detects persons and objects in a range of up to 20 m with an opening angle of +/- 45°. Based on the targets, the connected PLC generates a warning threshold at 10m and a stop signal at 5m distance.

BENEFITS

- Cost-effective solution for significant safety gain
- Reliable detection even in the most difficult environments
- Standardized approach that works for all stacker/reclaimers

WASTE INCINERATION

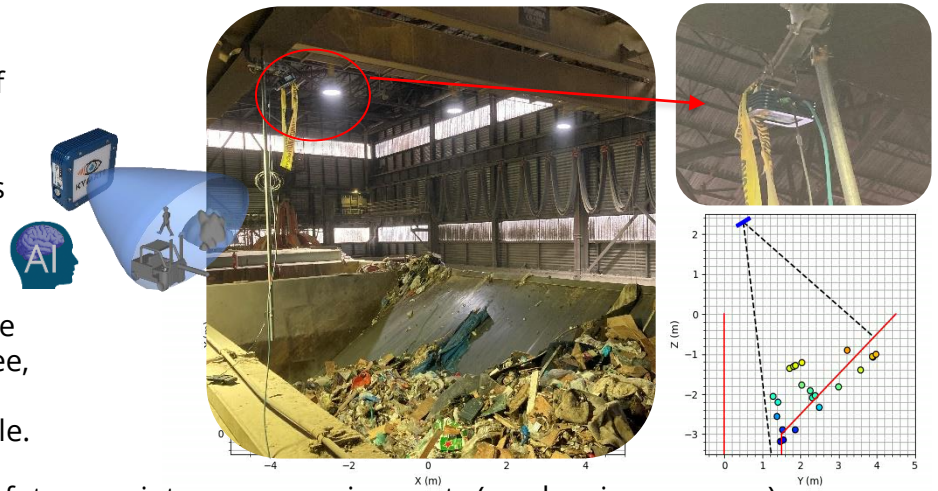
MONITOR HOPPER FILLING LEVEL

Task

In order to increase efficiency, the current determination of the waste filling level at the infeed hopper of the waste incineration must be determined – a 2D laser scanner mounted on the crane, failed with dust and dirt affecting its function.

Solution

With KY-RAY 3D.03.01, which is statically mounted above the hopper, the filling level can be determined maintenance-free, independently of the crane position, so that the crane can automatically approach the hopper when filling in is possible.



BENEFITS

- Cost-effective solution with no future maintenance requirements (no cleaning, no wear)
- Increase uptime and production efficiency, avoid costly mistakes (garbage spilling by overfilling)
- Standardized approach that works for all waste incineration plants

KYMATI K-LOC 3D NAVIGATION ENABLES NEW SEGMENT: HIGH RANGE - HIGH PAYLOAD VTOL* DRONES

BVLOS FLIGHTS IN U-SPACE

- Automated power line and pipeline monitoring
- Search and rescue missions on land & sea
- General camera-based surveillance
- Topographic and weather measurements
- Spare parts/urgent goods logistics (e.g. to vessels, wind turbines, logistic distribution centers)
- Border control

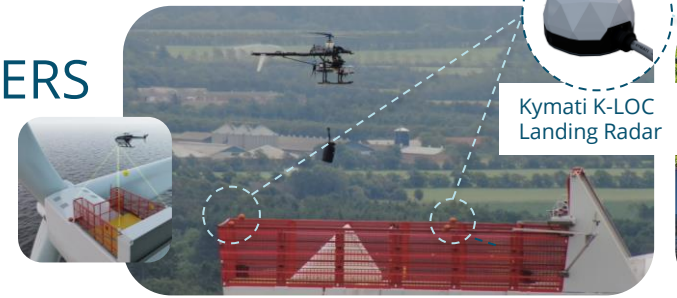
TYPICAL DRONE PARAMETERS

- Weight: >100kg
- Payload: >50kg
- Combustion (or electric) engine
  - **Several hours flight time**
  - **Several 100s of km range**

*) VTOL=vertical take-off and landing

Stromkind STR 35

KNDS BoxerUAV



Kymati K-LOC Landing Radar

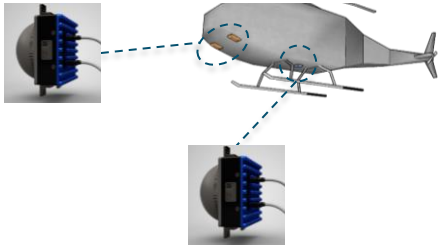
Spare part deliveries to wind turbines

Cricket patient evacuation drone by AVILUS

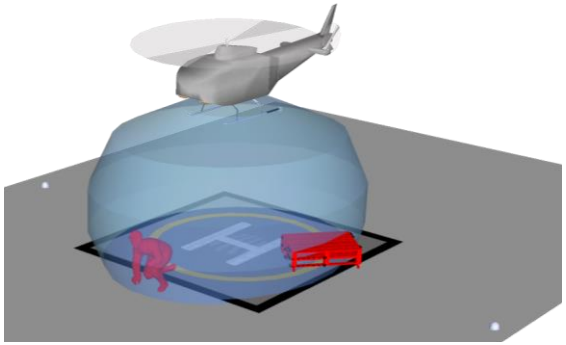
KYMATI K-LOC 3D LANDING GUIDANCE SENSORS

LEIGHTWEIGHT AIRBORNE UNITS

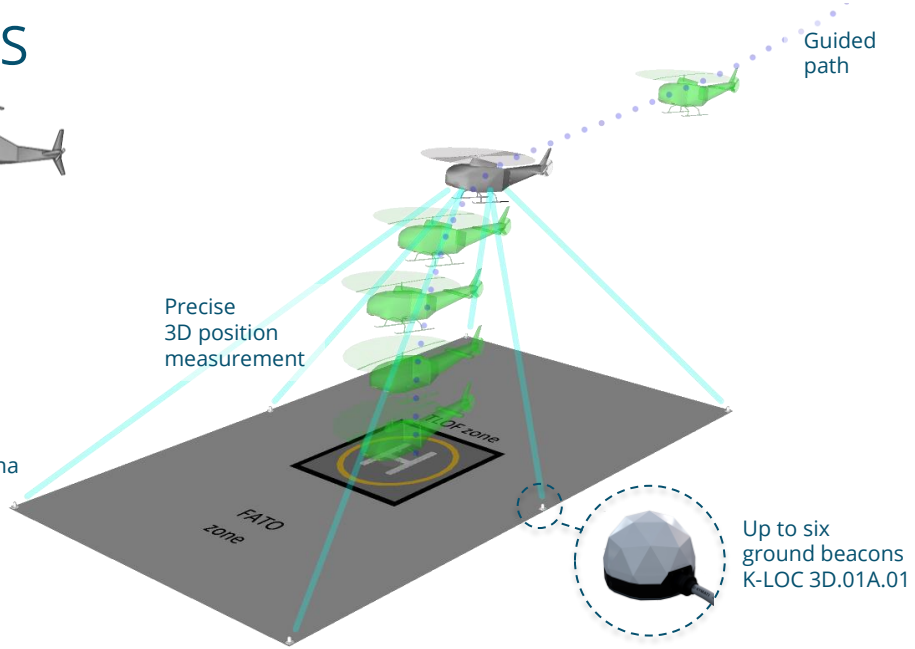
One or two (optional) K-LOC 3D.01N.01 signal receivers with integrated antenna



KY-RAY 1D.03.01 altimeter and obstacle Radar (optional), with integrated antenna



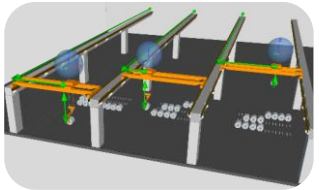
altimeter and obstacle Radar pointing downwards



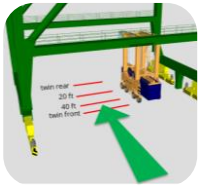
SIMPLE INFRASTRUCTURE

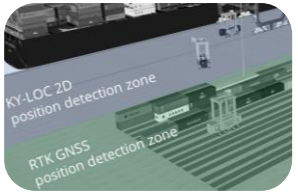
RADAR FOR POSITION DETECTION AND SAFETY

1D movement: xyz coordinates, speed, data

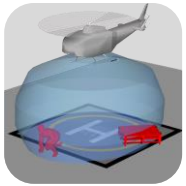


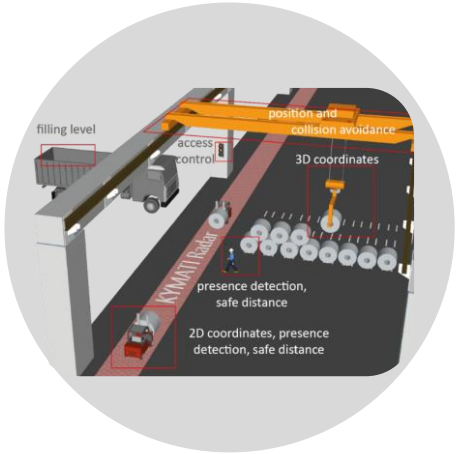
2D and 3D position, speed, heading, data



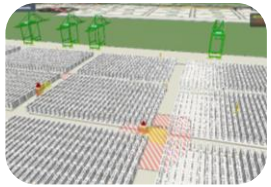


Collision prevention 1D, 2D & 3D

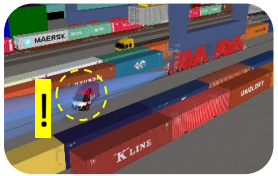


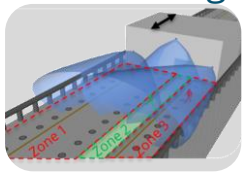


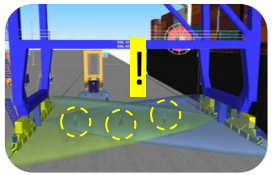
3D visualization



Imaging radar for detection, qualification and safety



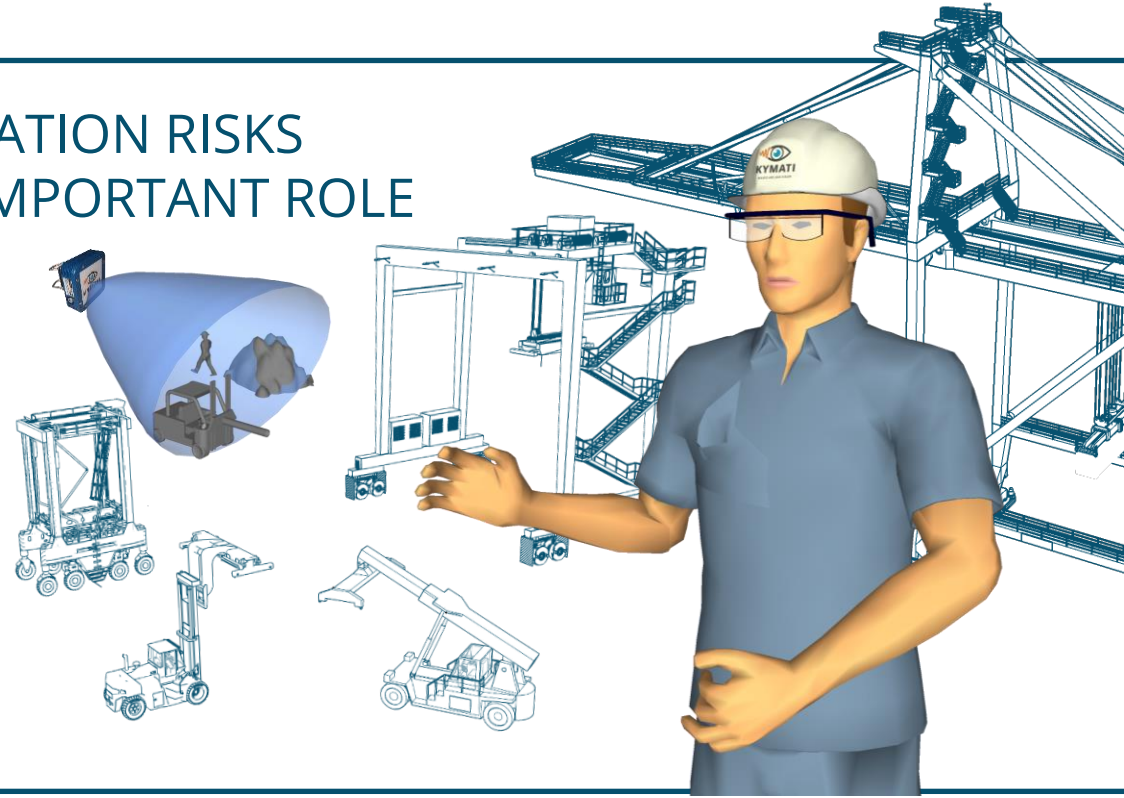




MAN & MACHINE DO CO-EXIST

SENSORS MITIGATE AUTOMATION RISKS - AND RADAR FULFILLS AN IMPORTANT ROLE

- Radar is the latest sensor technology to develop into mass applications due to late integration in chip design.
- Operators, service staff and visitors are always to be accounted for in all automation projects.
- Protection of people must have ultimate priority.
- Radar sensor solutions grow with automation challenges.



GET IN TOUCH

KYMATI

WAVES ARE OUR VISION

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COMPANY NAME

COMPANY NAME:
SEEING WITH ELECTROMAGNETIC WAVES

WAVE = [GREEK] KYMA

+

EYE = [GREEK] MATI

=

KY**MA**TI