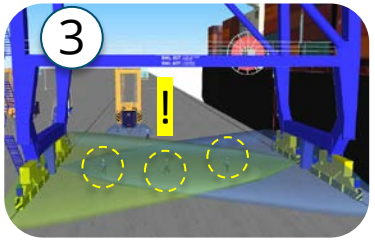
DYNAMIC POSITION DETECTION AND COLLISION AVOIDANCE - RADAR IS THE SOLUTION

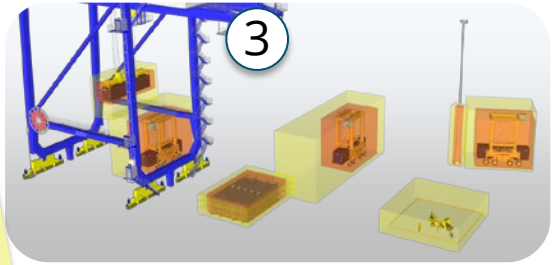
KYMATI

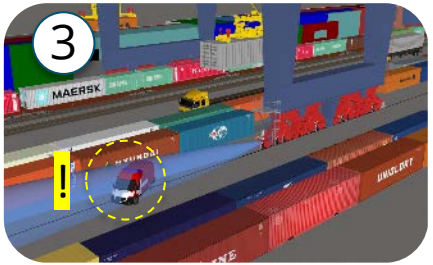
WAVES ARE OUR VISION

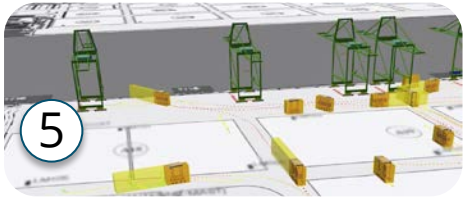
DYNAMIC LOCATION IS KEY
GNSS/GPS IS NOT SOLVING ALL ISSUES

1. **Container tracking** on yard
2. **Navigation and job assignment** for transport vehicles and cranes
3. **Collision avoidance** in 3D and no-go zones:
4. **Event creation** – exception tracking
5. **Dynamic 3D Visualization – Digital Twin** covering all different makes





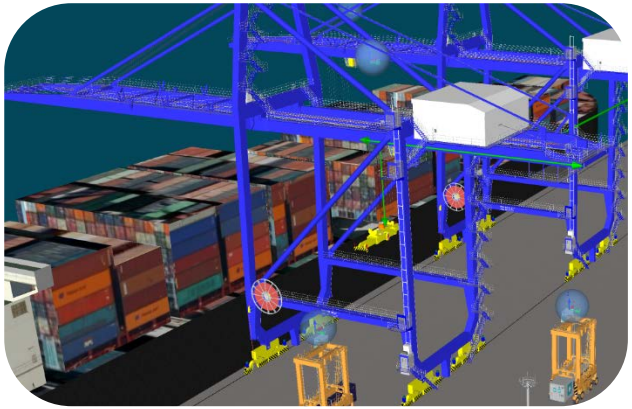




Due to signal reflections, GPS does not work reliable under and close to cranes...
... and some terminals already consider a complete independence from GPS for geopolitical reasons.

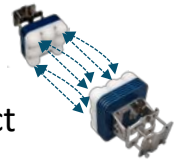
PRECISE CHE*) MOVEMENT – RADAR MEASUREMENT

1D (X,Y,Z) POSITION ON CRANES (CRANE TRAVEL, TROLLEY POSITION, SPREADER HEIGHT)



BENEFITS

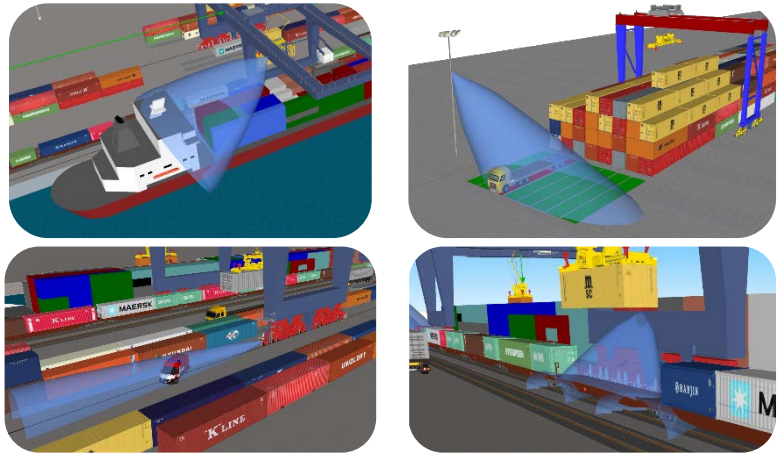
- No infrastructure installation (no RFID transponders along track)
- No maintenance, quick retrofit, no precise alignment or reflectors necessary
- Not affected by sunshine, water, fog, snow, sandstorms or similar weather impact
- High reliability and lowest cost for outdoor applications



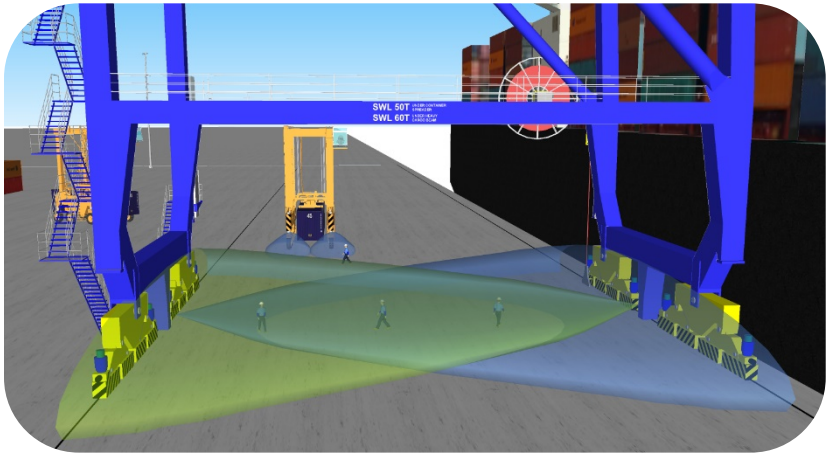
*) CHE=Container Handling Equipment

CONTAINER TERMINAL – ABSENCE & PRESENCE

OBJECT DETECTION

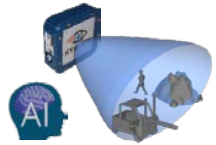


PERSON DETECTION



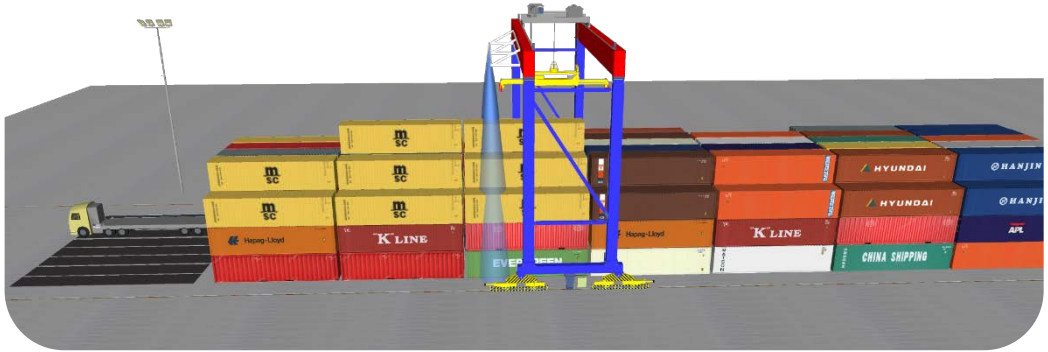
BENEFITS

- 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



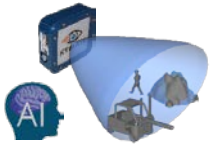
CONTAINER TERMINALS – STACK PROFILING

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.

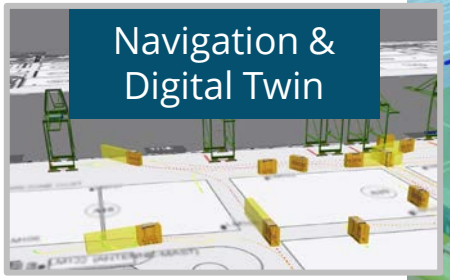


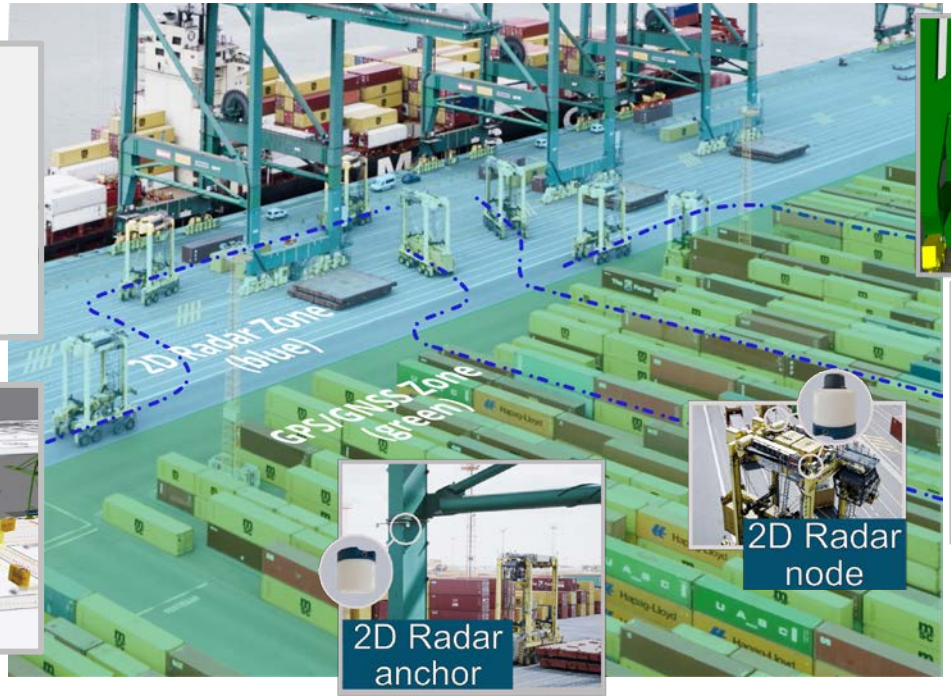
KYMATI @ MPET, ANTWERP, BELGIUM
SINGLE LARGEST TERMINAL IN EUROPE

35 STS, 240 STRADS AS OF 2025 …AND EXPANDING

KY-LOC 2D: PRECISE GPS-DENIED POSITIONING CREATES SAFETY, AWARENESS AND COST REDUCTIONS

Collision Avoidance



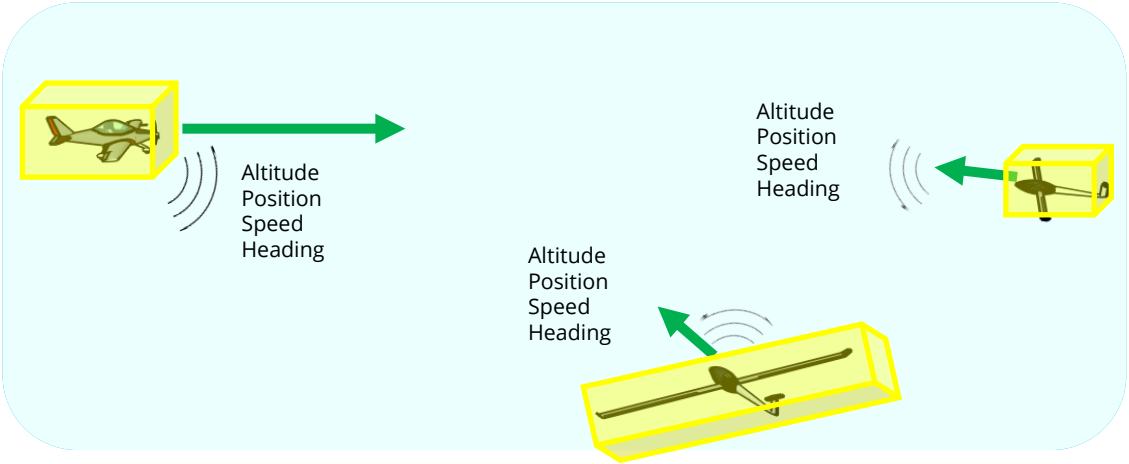


Heat Maps

CRANES/VEHICLES CAN WORK LIKE AIRPLANES…

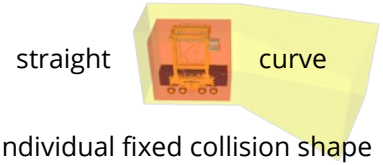
HOBBY PILOTS COLLISION AVOIDANCE

- Small aircraft outside commercial air traffic make use of a send/receive unit with GPS-based position, heading and speed to avoid collisions.
- All units continuously radio broadcast this data, without an established communication partner.
- All units listen in parallel, receive other aircraft´s broadcast messages when in receiving distance, and compute their individual collision risk, based on own position, speed and heading, as well as on the movement of those near by.
- Full 3D collision avoidance in any direction
- No central brain/server/operator involved.



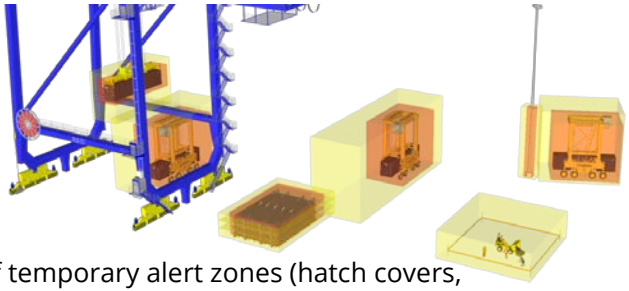
3D COLLISION PREVENTION ON TERMINALS

HIGHLY PRECISE COLLISION ANALYSIS – WARNINGS ONLY IF REQUIRED



Individual fixed collision shape
Individual, speed and heading dynamic warning shape

Overlap of dynamic warning shapes (yellow) and active movement prediction based on approach speeds:
=> warning will be triggered



Positions of temporary alert zones (hatch covers, temp. work zones, silent monitoring zones) and permanent obstacles (buildings, light poles, power lines) are stored in the KY-LOC 2D database.Whenever there is an update, the database is redistributed to all CHE.

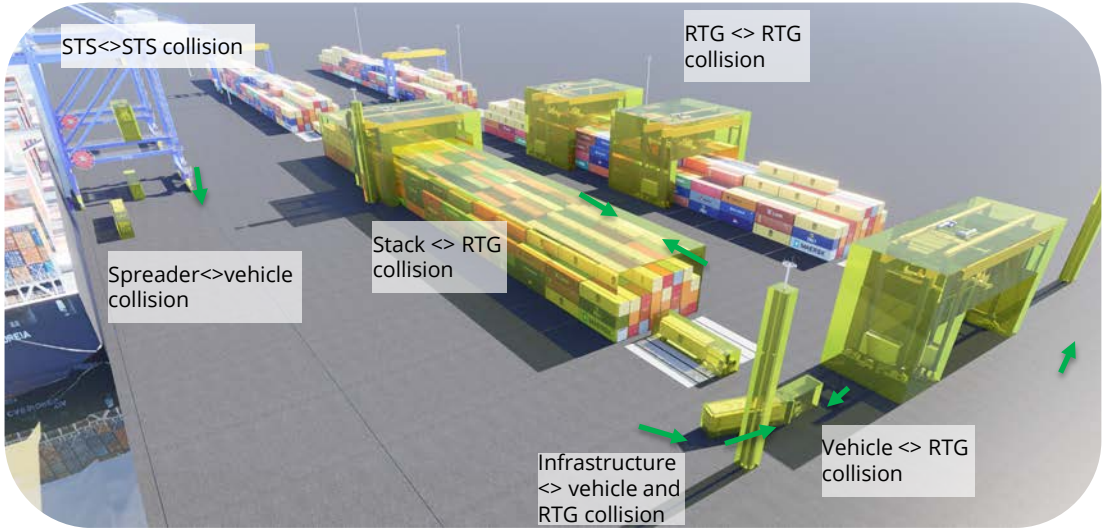
BENEFITS

- All CHE have precise position/heading and a collision radio to listen to near-by objects
- Each CHE calculates independent collision risk against other dynamically moving units (vehicles, cranes, containers) and static objects in their local database (updated when required).
- Safe and uninterrupted operation, no server, no central point of failure
- Warning precisely adjustable, only if really required => strong acceptance by operators/drivers

KY-LOC 2D: RTG CONTROL & COLLISION AVOIDANCE

RTGs <> STS SPREADER & CONTAINER <> TERMINAL TRACTORS - ONE SYSTEM FOR ALL

- With only the precise position measured, all static (lightpoles, buildings, stacks) and dynamic objects (all CHE) can be protected in all three dimensions.
- With all vehicles, RTGs and STS cranes, a full digital twin in 3D, dynamically representing all movements and positions of equipment in real time is provided by the optional web-based KY-OMNI application.
- Collision avoidance does not require any server or network connection

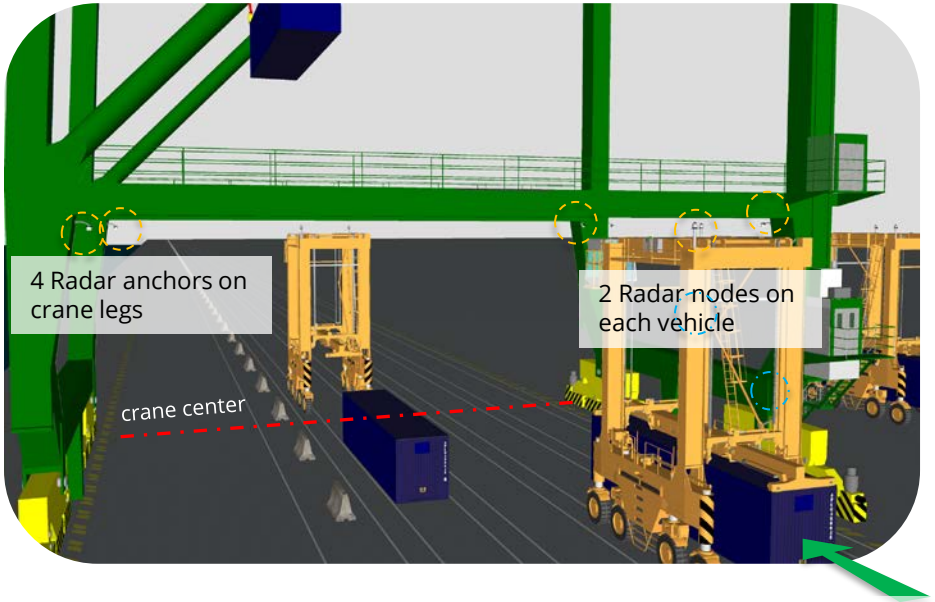


PRECISE HANDOVER POSITION UNDER CRANES

GUIDANCE FOR DRIVERS OR AGV OPERATION

BENEFITS

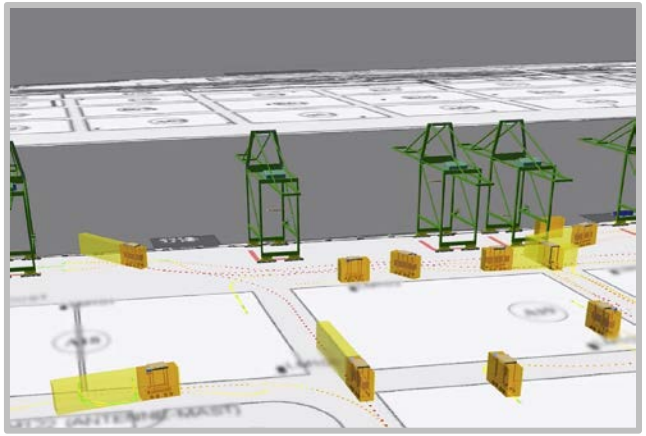
- Position detection allows precise vehicle position in GPS/GNSS denied areas under and next to the crane.
- Several stopping points for CHE can be preconfigured per each crane, depending on the container size under spreader, crane type and vehicle make (individually).



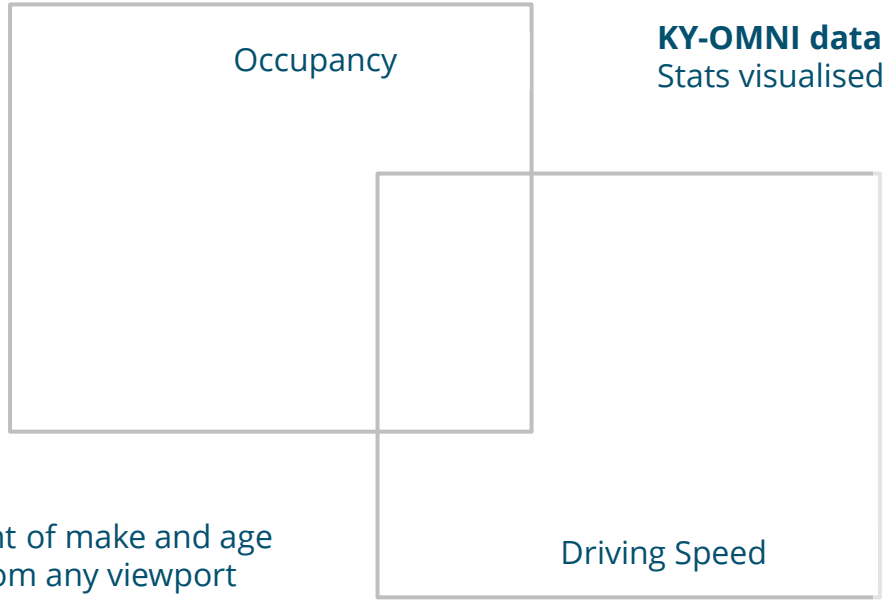
- Driver gets optical ‘car wash-like’ position indication (visual and audio) on cabin display
- AGV control receives continuous position in GPS/GNSS format or local coordinates.

KY-OMNI - RECORDED MOVEMENT DATA ANALYSIS

KY-OMNI PROVIDES UNRECOGNIZED INSIGHTS INTO OPERATIONS



KY-OMNI Digital Twin
- All CHE displayed, independent of make and age
- **replay any scene,** any time, from any viewport



KY-OMNI data mining
Stats visualised:

- Occupany / time
- Speed / area
- Container sources / destinations
- Your criteria...

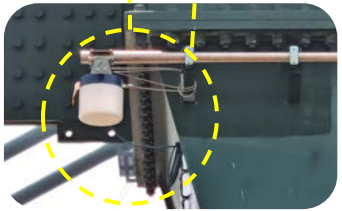
KY-LOC 2D ON TERMINAL - IMPRESSIONS

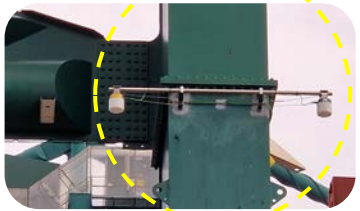
RETROFIT INSTALLATION DONE - OEM SUPPLY WITH NEW MACHINES

2 nodes on top of strad

PDS screen in cabin

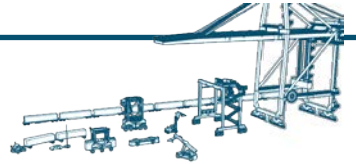
6 anchors under
STS crane/backreach



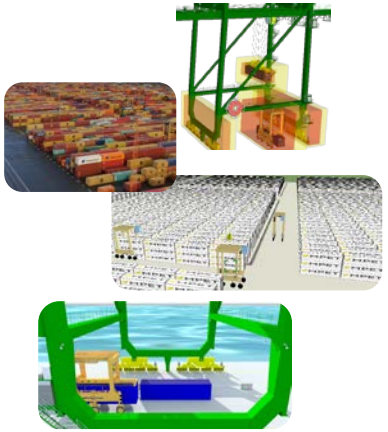


1 anchor only on last row
of lightpoles towards
quay

SAFETY, SECURITY AND COST REDUCTION

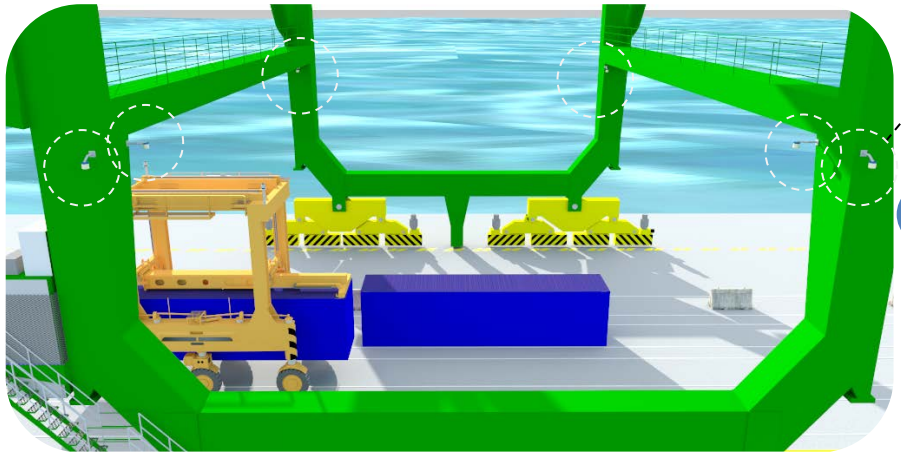


- **Precise Position Detection System** (PDS) for **all types and makes, manned or automated CHE** – mixed fleets can be equipped.
- **3-dimensional collision avoidance** and **operator safety** for moving equipment – **accidents/downtime avoided**, **staff protected, insurance rates** reduced.
- No server, no sensors req´d, **no latency**, **no central point of failure – cm precise warning, no continuous operator nuissance by false alerts.**
- **Zone surveillance/alert options** for work safety areas, monitoring zones, traffic control, and unauthorized movements/stops are detected.
- **Tracking of container and CHE** movement for **TOS** and **housekeeping moves optimization.**
- **3D visualization** of all movement – **replay** of selected events from any required viewport **–** a **realtime Digital Twin.**
- **Automation of terminal tractors, strads, AGVs** with solid **2D (GPS denied) position,** everywhere in the terminal. **Full independency from GPS** for entire terminal is an option.



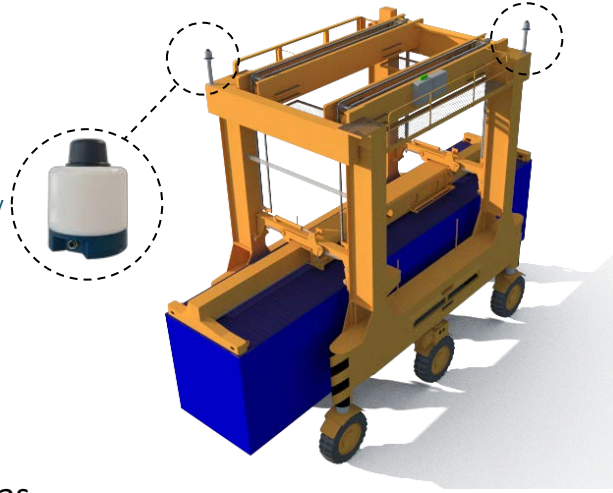
KY-LOC 2D FOR FULLY AUTOMATED 1OVER1 STRADS

AUTOMATED 1OVER1 STRADDLE CARRIER POSITION



A KY-LOC 2D anchors under quay crane and on last row of lightpoles

N KY-LOC 2D nodes on straddle carrier (2D Radar & GNSS)



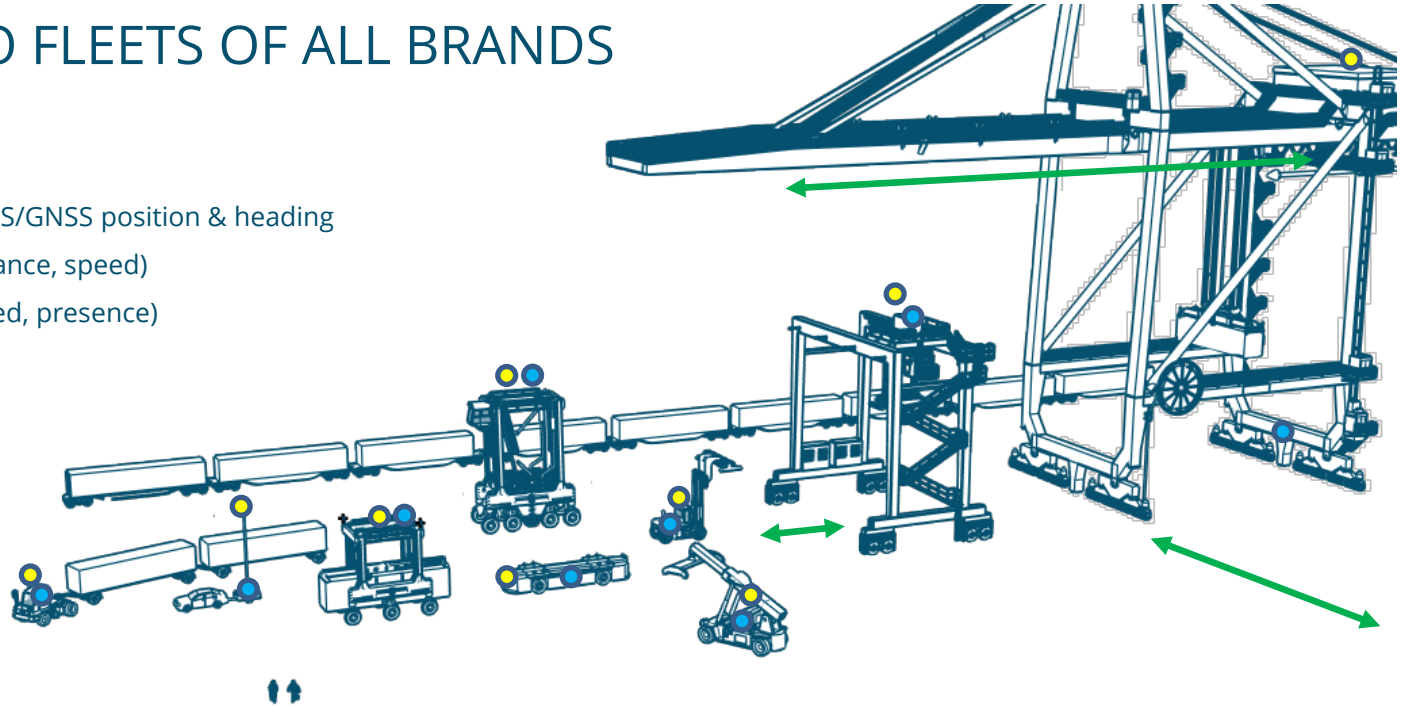
BENEFITS

- Highly reliable and precise position in GNSS denied areas
- RTK-GNSS used in yard areas – no infrastructure required
- Maintenance-free – no moving parts, not affected by weather or dust
- 2D accuracy ±3cm with built-in redundancy, for high SIL/PL level of automation

KY-LOC 2D - FOR ALL CHE* TYPES

APPLICABLE TO FLEETS OF ALL BRANDS

- Kymati 2D Radar & GPS/GNSS position & heading
- Kymati 1D Radar (distance, speed)
- Kymati 3D Radar (speed, presence)
- navigation hub

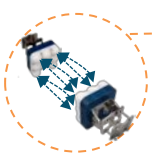


*) CHE=Container Handling Equipment

INTERMODAL TERMINAL – CRANE POSITIONING & COLLISION AVOIDANCE EXAMPLE

- Cranes have a precise position and collision avoidance over up to 1000 m length of crane bay.
- Active Radar collision avoidance ensures safe operation between cranes and transport vehicles (e.g. empty handlers, reach stackers)
- Objects on the rail (e.g trucks, containers) obstructing crane movement are detected by Radar to avoid collisions and interruptions of operation.
- All movement data are transmitted to the TOS and also saved, visualized and replayed on request in KY-OMNI

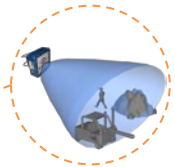
INTERMODAL TERMINALS
SAFE MANUAL OPERATION UNDER AUTOMATIC CRANES



KY-LOC 1D for XYZ crane coordinates and collision warnings

Reach stacker, empty handler, manlifter and other vehicles:

Continous KY-LOC 2D position for location tracking and collision avoidance



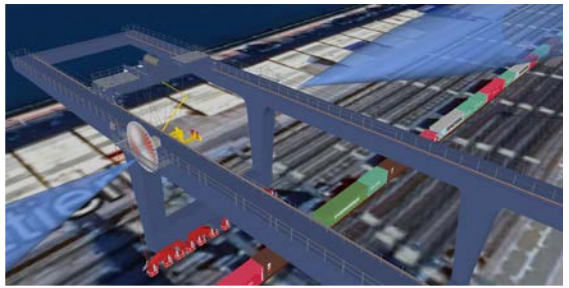
KY-RAY 3D Radar to detect objects (collision avoidance) and right/wrong position for handovers

INTERMODAL TERMINAL – TRAIN TRACKING

9 RADAR UNITS CAN COVER THE ENTIRE TERMINAL

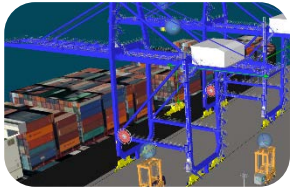
Radar gate
at terminal entry

1 Radar unit per direction
on each of 4 cranes



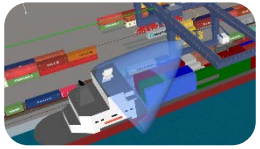
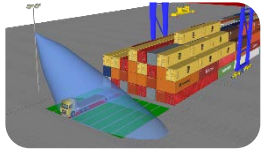
KYMATI RADAR: RAISING STATE OF THE ART FOR TERMINAL EXCELLENCE & SAFETY

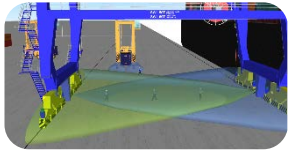
X-Y-Z crane coordinates measurement

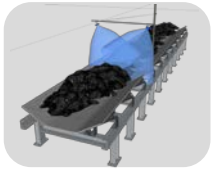
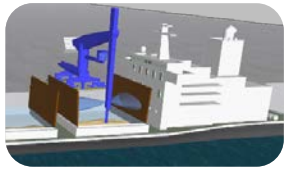

Position, speed and heading measurement

Imaging radar for detection, qualification and safety

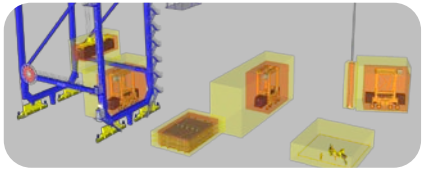
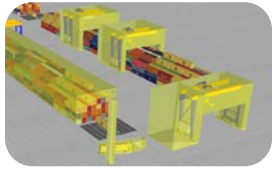



Bulk material handling operations

Collision prevention/geo-fencing

3D Digital twin

GET IN TOUCH

KYMATI

WAVES ARE OUR VISION

Kymati GmbH
Am Hochacker 5
85630 Grasbrunn
Germany
Tel. +49 89 515 75 90 0
info@kymati.com