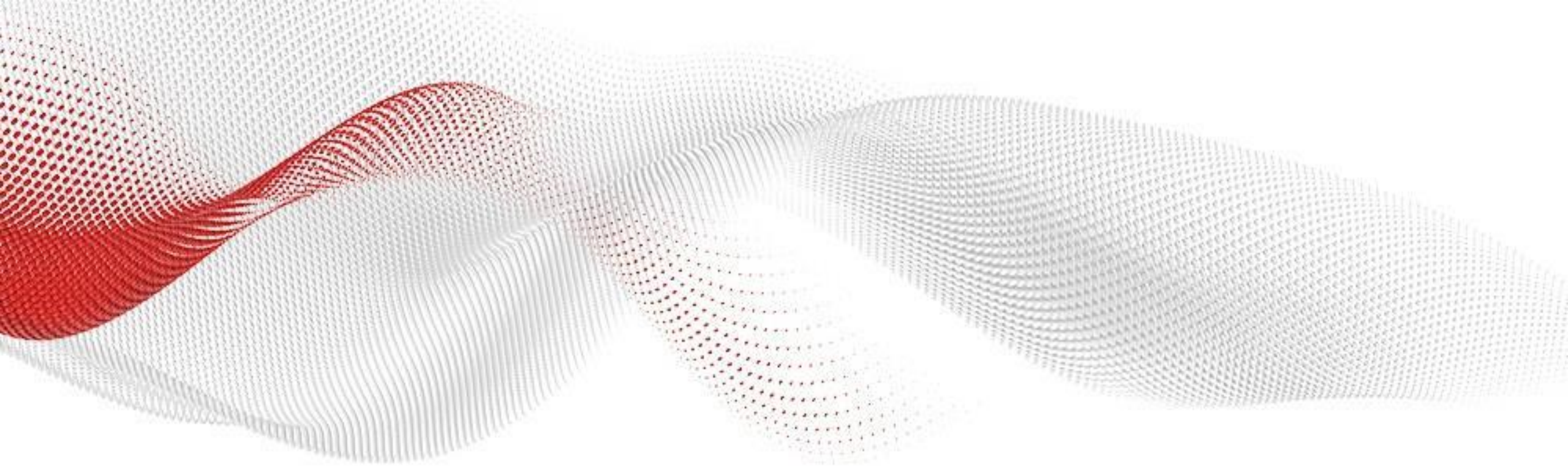

DECEMBER 02, 2019

Perception Challenges in Industrial Applications

Remus Boca, ABB Future Labs

ASTM International Committee on 3D Imaging Systems (E57), NIST Workshop

Perception Challenges in Industrial Applications

Bio

Bin Picking

2008

https://www.youtube.com/watch?v=09LzufOnbX0

Perception Challenges in Industrial Applications

Agenda

As the world moves towards autonomy, the sensing and perception are becoming (critical) important.

Industrial applications have their own challenges as they operate in possible harsh environments, they require continuous and robust operation, need to accommodate unstructured environments, acknowledge a wide range of states and unexpected events.

This talk presents perception needs and challenges across many industries such as ports, mining, transformer inspection and robotics.

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Perception Challenges in Industrial Applications

Ports

Ship to shore cranes (IN / OUT)

Straddle carriers

Stacking cranes operating in the shipyard

Port gates (IN / OUT)

https://new.abb.com/ports

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Perception Challenges in Industrial Applications

Ports

Multiple vision modalities for different tasks

- **remote control**
- **pick / drop container**
- **safety**

Outdoor operation

- **Enclosure is needed**
- **environment conditions : day / night; sunny, cloudy, rain, snow, wind; humidity**

Working range

- **from 1m to 30m (stacking crane)**
- **from 1m to 85 m (ship to shore)**

Accuracy medium to low (cm)

Access to sensors is required

Objects of interest wear and tear

- **container & container stacks**
- **chassis**
- **ships / bays**

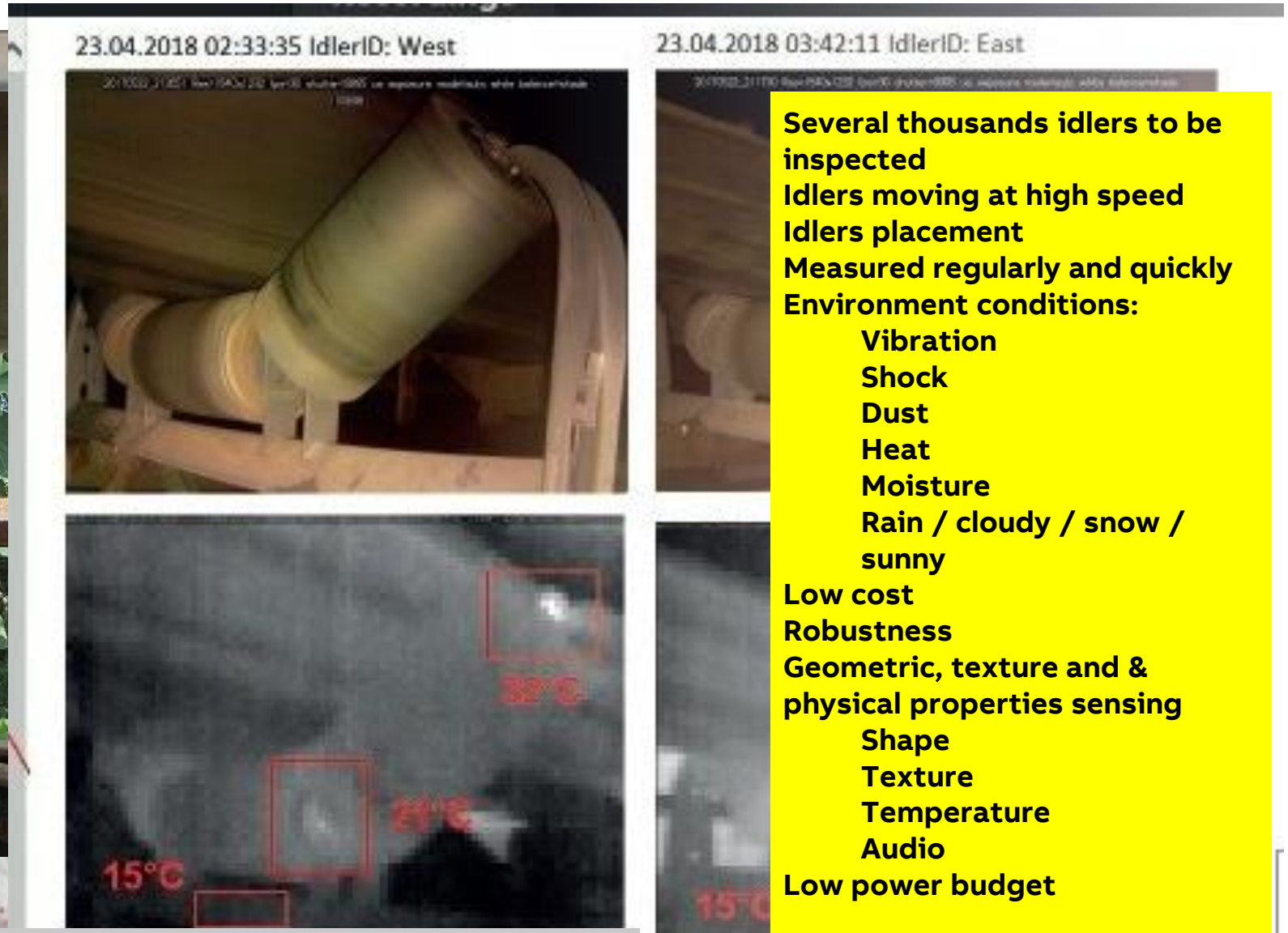
Perception Challenges in Industrial Applications

Mining

https://new.abb.com/news/detail/11252/abb-ability-conveyor-roller-inspection-services

Perception Challenges in Industrial Applications

Mining



Several thousands idlers to be inspected
Idlers moving at high speed
Idlers placement
Measured regularly and quickly
Environment conditions:
- **Vibration**
- **Shock**
- **Dust**
- **Heat**
- **Moisture**
- **Rain / cloudy / snow / sunny**

Low cost
Robustness
Geometric, texture and & physical properties sensing
- **Shape**
- **Texture**
- **Temperature**
- **Audio**

Low power budget

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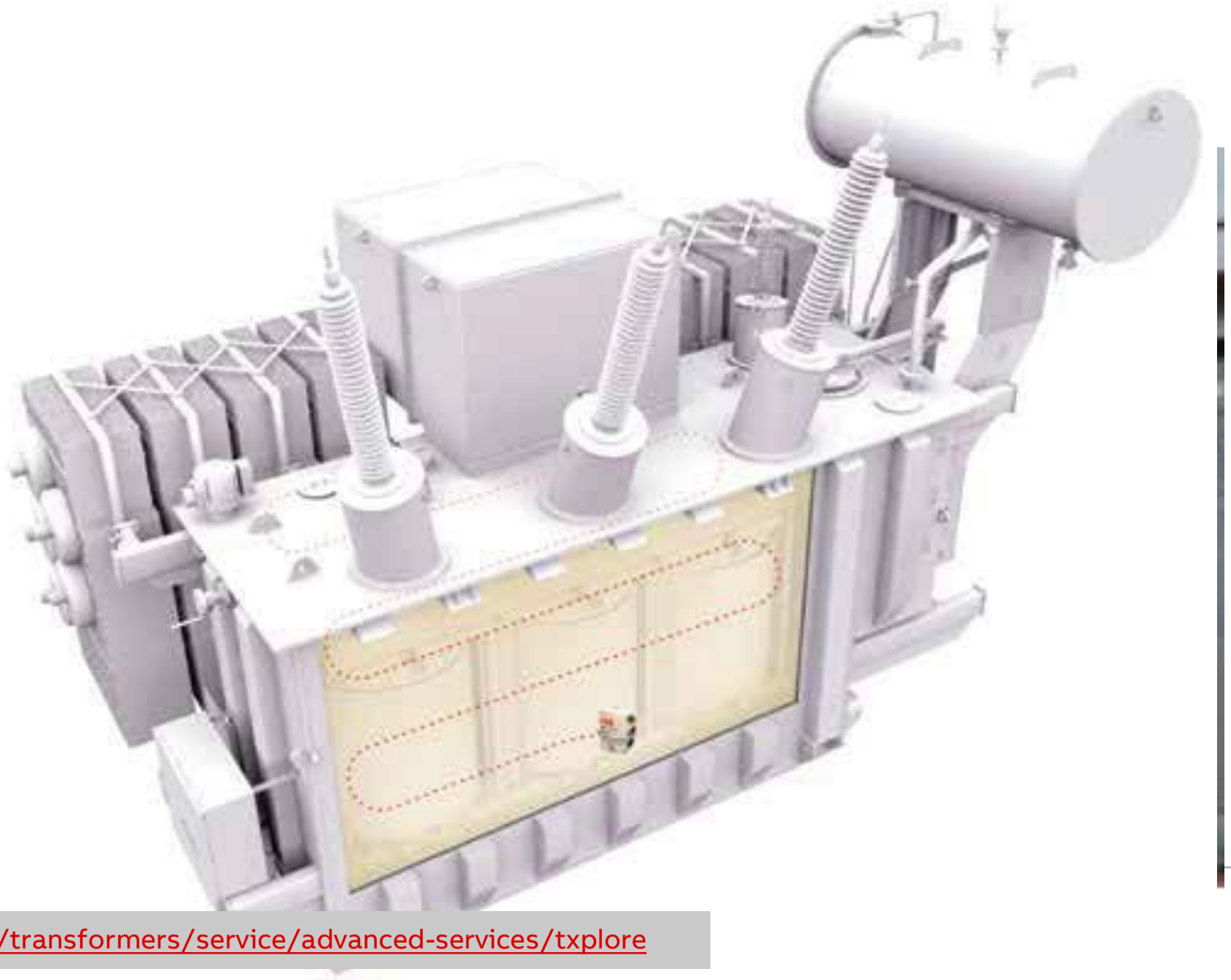
Perception Challenges in Industrial Applications

Transformer inspection



https://new.abb.com/products/transformers/service/advanced-services/txplore

Perception Challenges in Industrial Applications

Transformer inspection

- **Operating environment**
  - **It can be contaminated**
  - **Decontaminate after every use**
  - **Wide range of temperatures**
- **Resolution for quality images**
- **Field of view / surround**
- **Short distance**
- **Lighting**
- **More than one sensor**
- **Many types of defects**
  - **Appearance**
  - **Geometric**
- **Wireless communication**
- **Sensors are critical to operate while submersed (expensive to recover the device)**
  - **redundant cameras**

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Perception Challenges in Industrial Applications

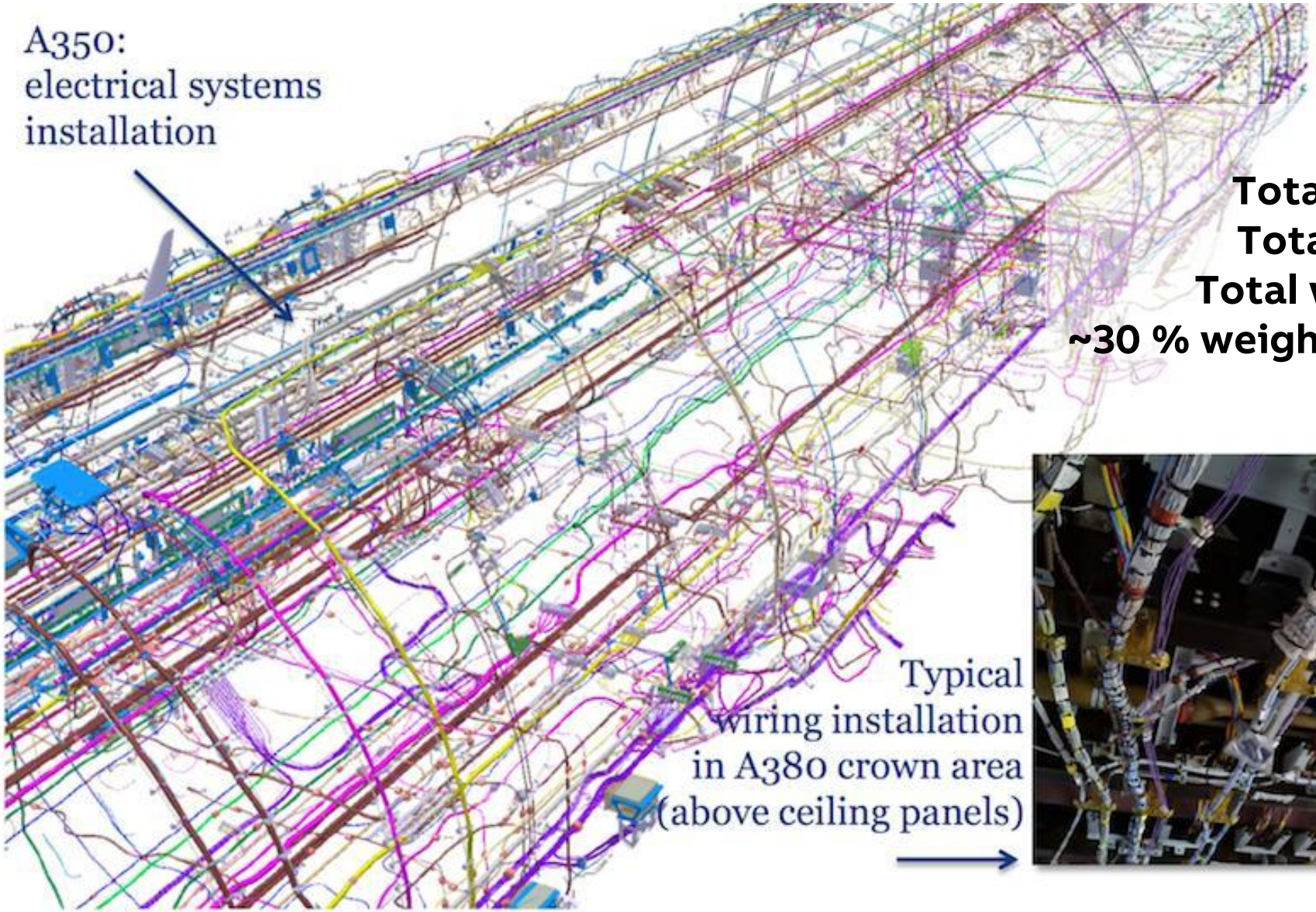
Transformer Inspection

ABB Ability TXplore

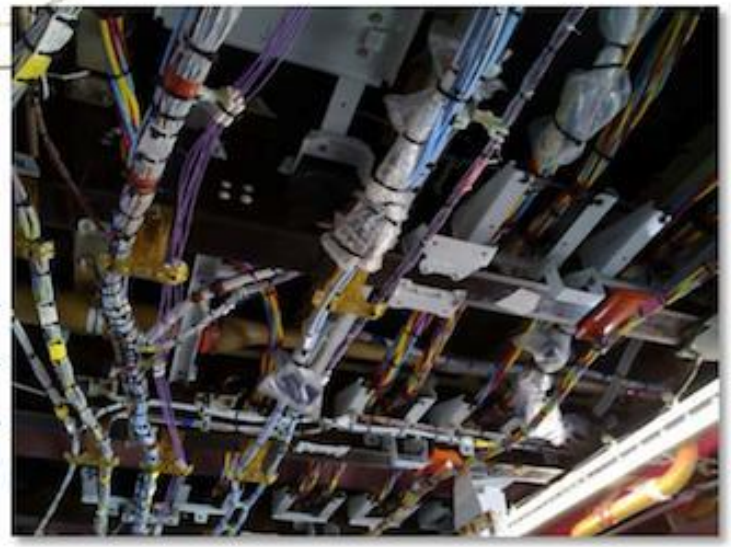
https://www.youtube.com/watch?v=OclzoEc8plE

Perception Challenges in Industrial Applications

Wire assembly



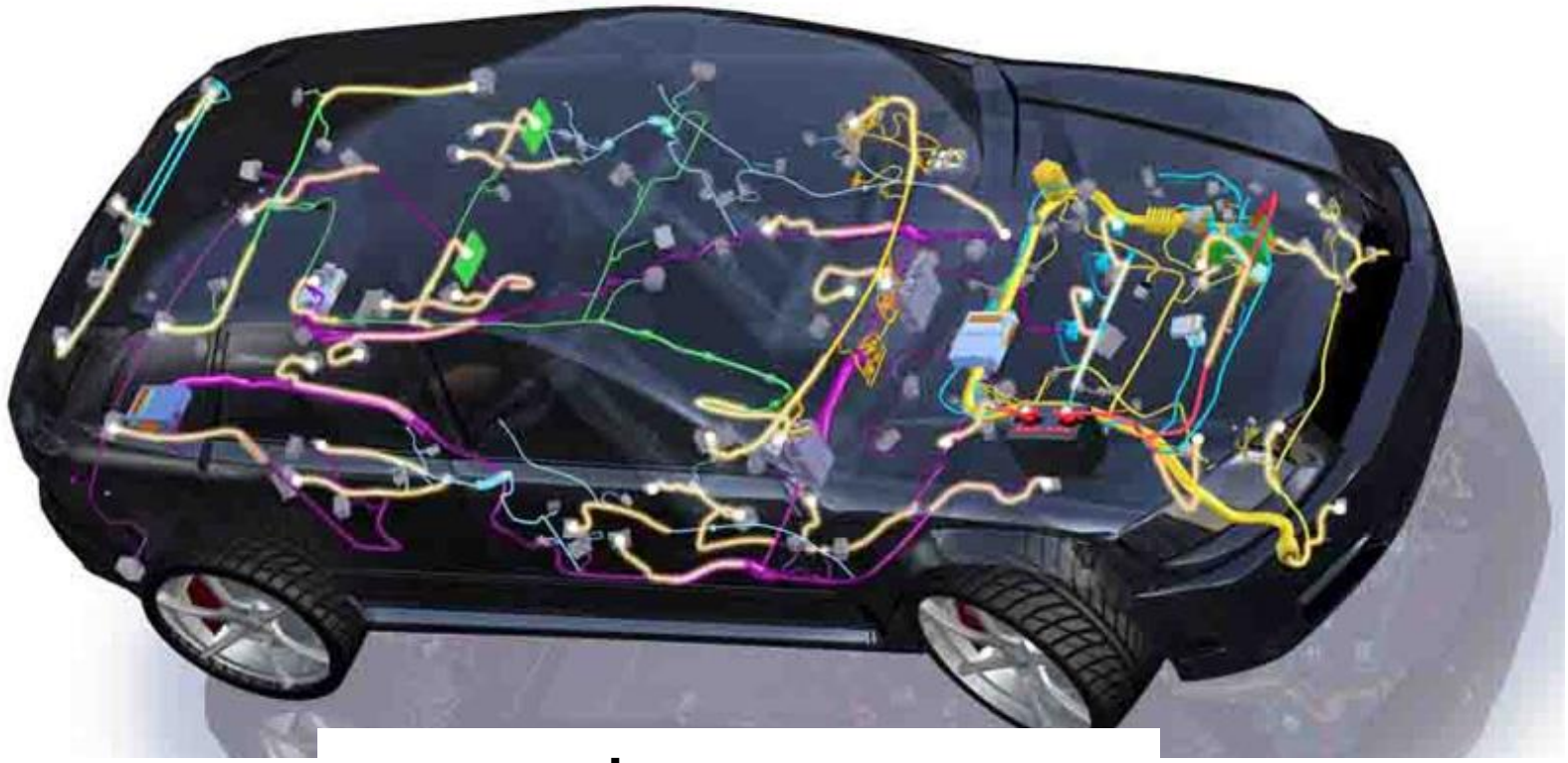
A380
Total wire count ~100 000
Total wire length ~470Km
Total weight of wires 5700 Kg
~30 % weight to fix cables to the structure



Typical wiring installation in A380 crown area (above ceiling panels)

Perception Challenges in Industrial Applications

Wire assembly



Luxury car
Total wire count ~1500
Total wire length ~1 Mile
Total weight of wires 150 #

- Accuracy sub-mm
- High resolution
- High frame rate
- Small and large field of view
- Small footprint
- Short range
- Quality components (lens, global shutter)
- Multiple sensors working on the same field of view
- Low cost
- Lifecycle as long as a robot
- Easy diagnostic
- Industrial communication protocols
- Easy customization

Perception Challenges in Industrial Applications

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