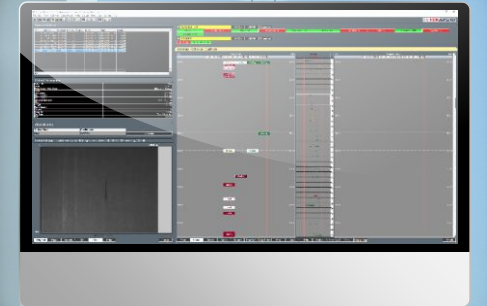




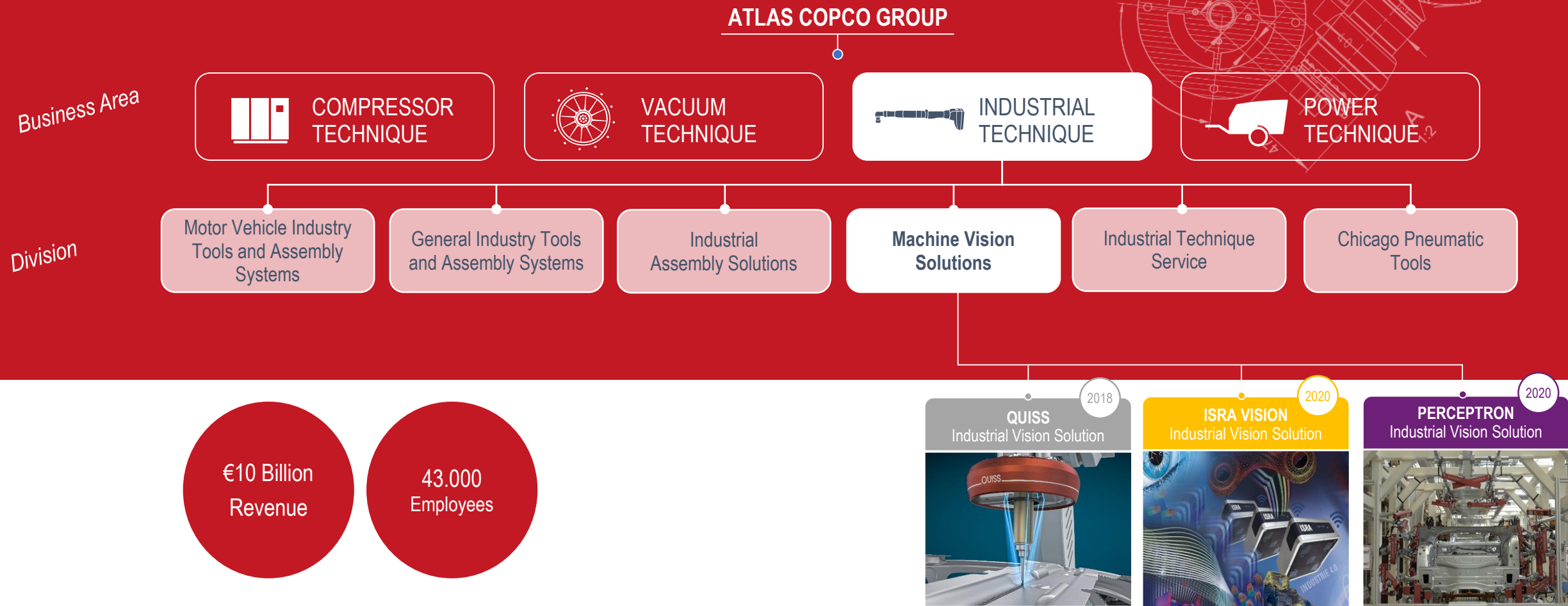
Quality Data



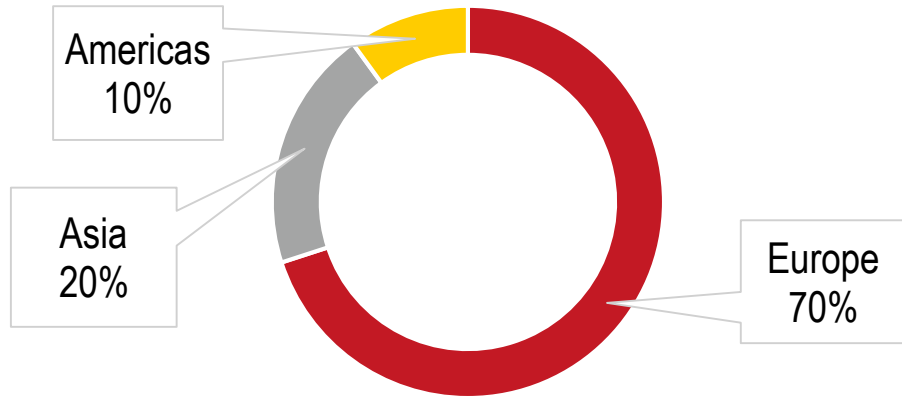
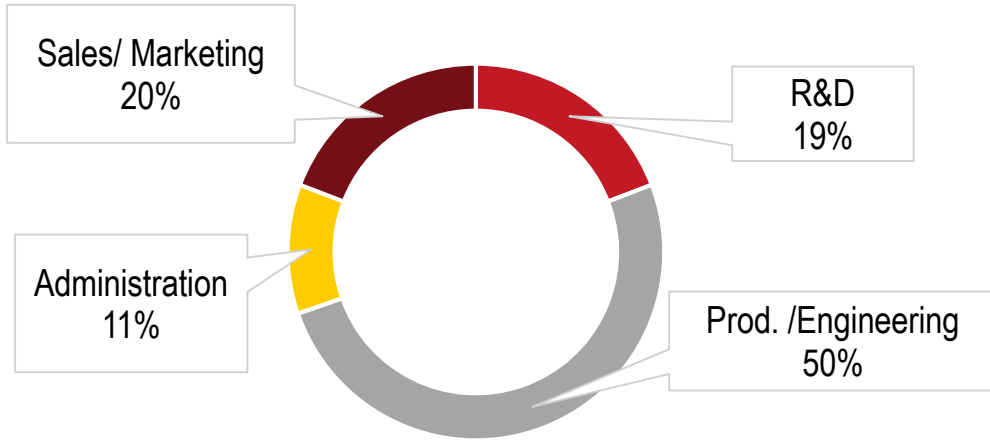
LATEST INNOVATIONS FOR SURFACE QUALITY CONTROL

Dominik Recker | 19.01.2023

ISRA VISION – AN ATLAS COPCO COMPANY



GLOBAL BUSINESS

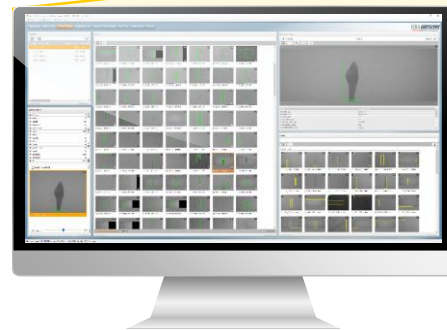
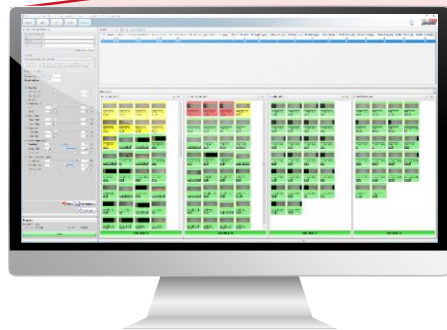
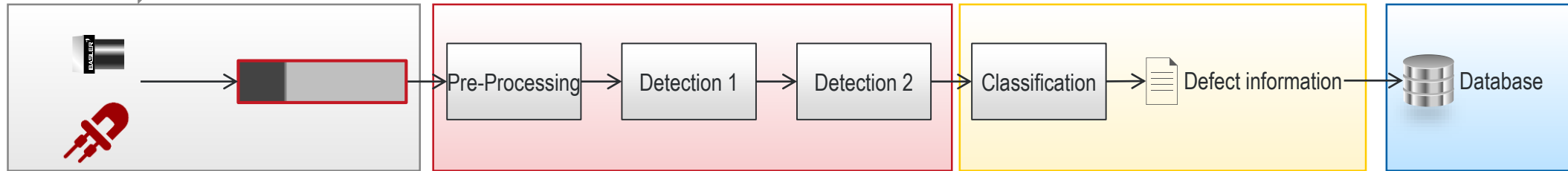
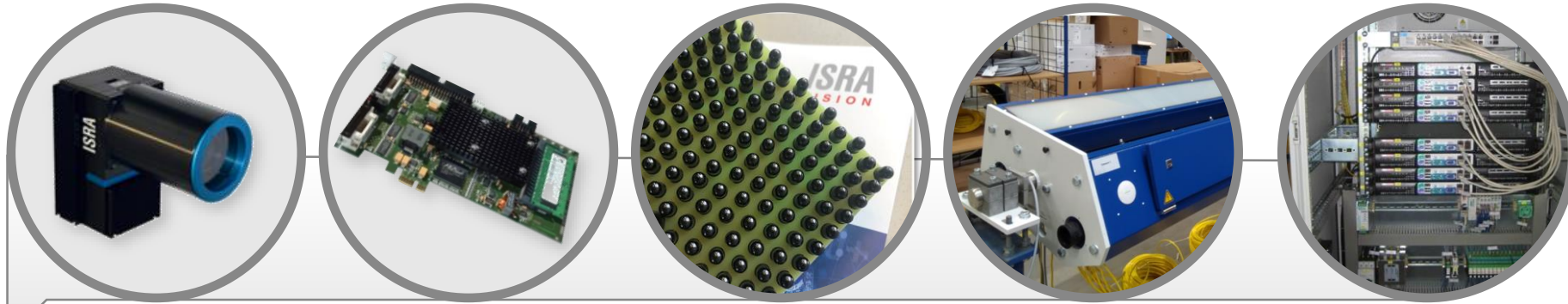


ISRA VISION – MORE THAN 30 YEARS EXPERIENCE IN SURFACE INSPECTION AND ROBOT VISION



ISRA DELIVERS...

Dedicated SOFTWARE & HARDWARE



COVERING AND CONNECTING THE ENTIRE PROCESS CHAIN

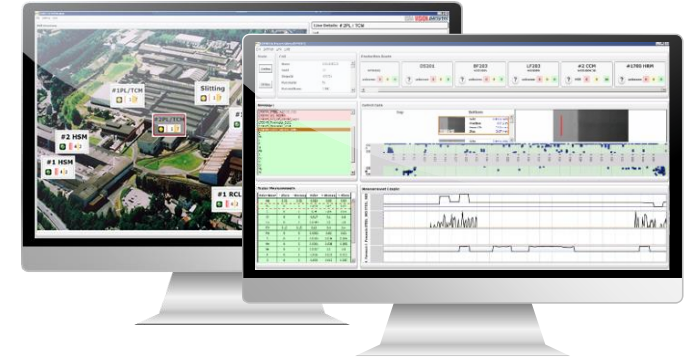
GUI



PERFORMANCE/CONDITION MONITORING



QUALITY MANAGEMENT SOLUTIONS



Process control Data

Slab (Casting) Hot Rolling (coil/plate) Pickling Cold Rolling Annealing Surface treatment Finishing



References, STEEL: 5
References, ALU: -



Inspection Data

CHALLENGES & INNOVATIONS

1. Pixelsynchronized, multi-channel image recording
2. Waviness detection
3. Profile (Extrusion) inspection
4. Neuronal Network Classification
5. Condition Monitoring
6. Quality Management

1

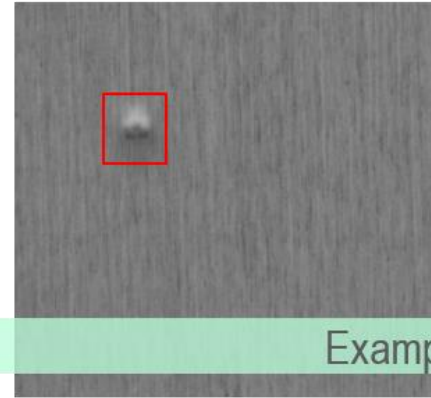
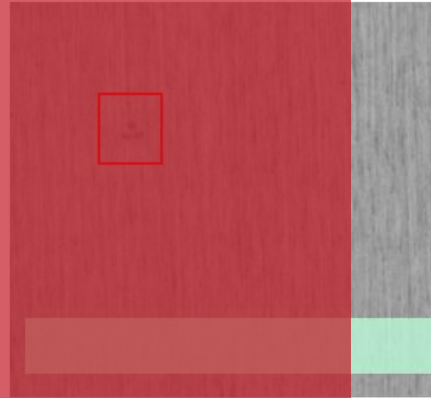
PIXELSYNCHRONIZED, MULTI-CHANNEL IMAGE RECORDING

Brightfield

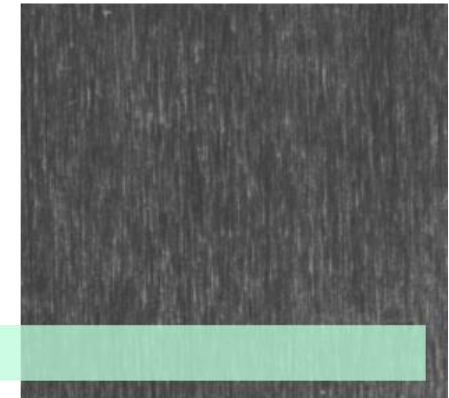
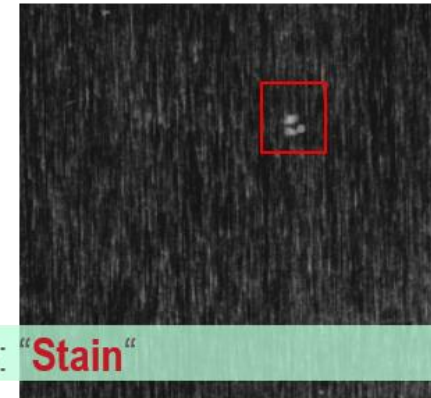
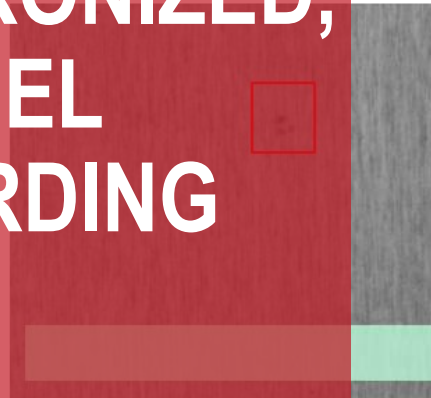
Transitionfield

Darkfield

Sidelight



Example: "Dent"



Example: "Stain"

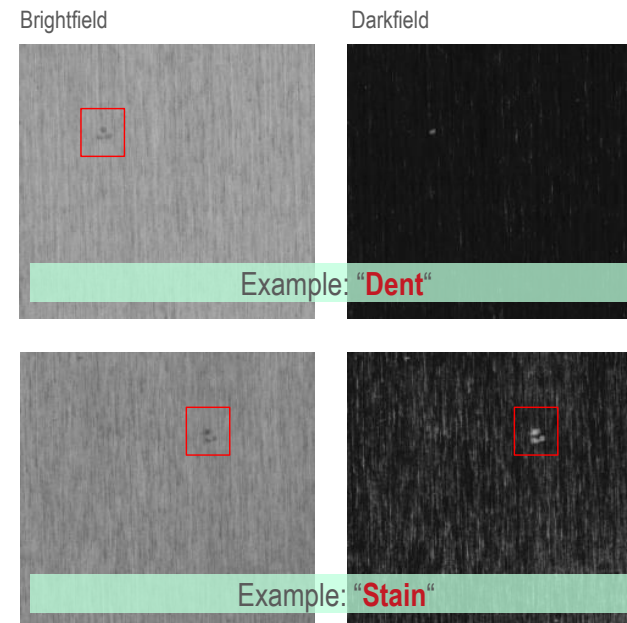
PIXELSYNCHRONIZED, MULTI-CHANNEL IMAGE RECORDING

CHALLENGE

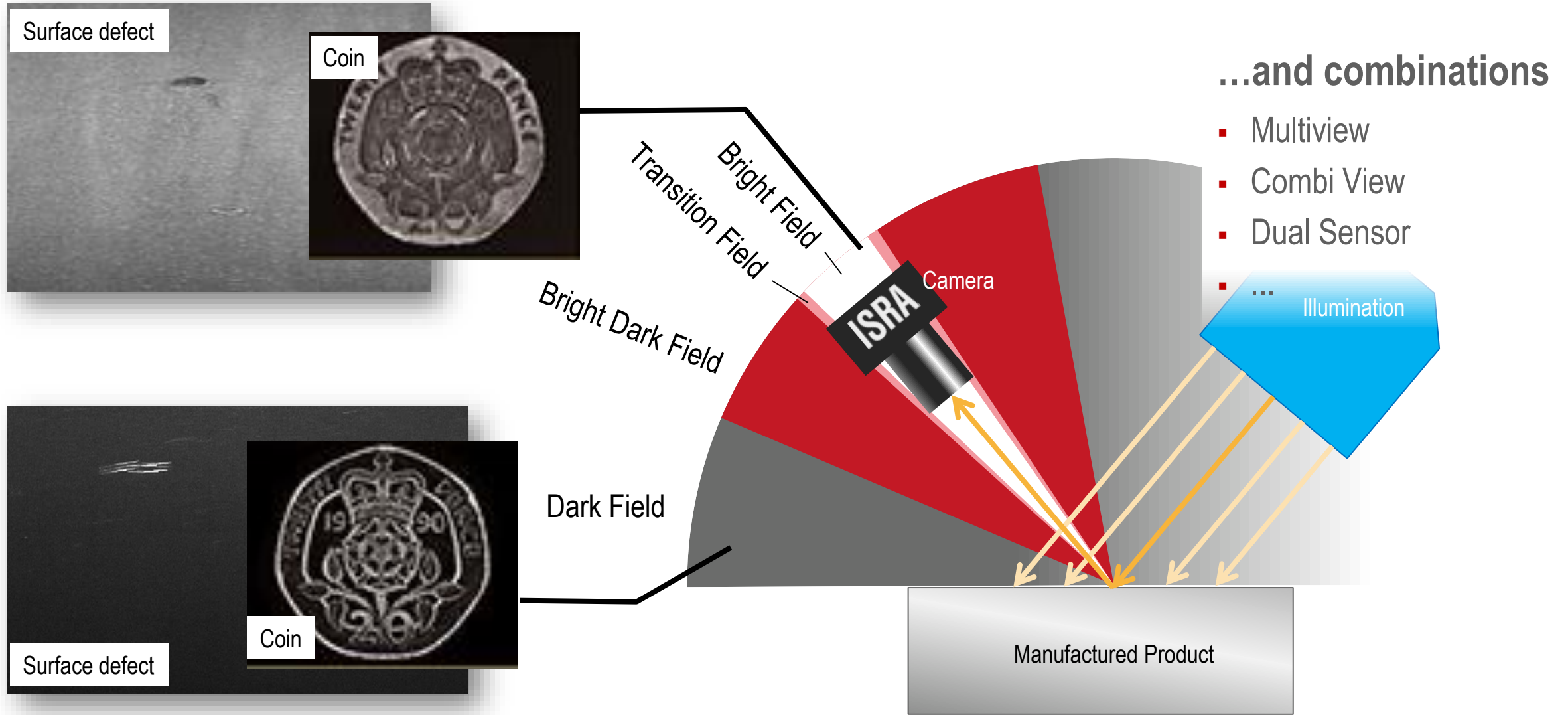
- Multiple views required for better classification
- Multiple views require larger sensors
- Image recording split in regards to
 - Time
 - (Location)

SOLUTION

- Combined sensor
- Pixel-synchronized image recording

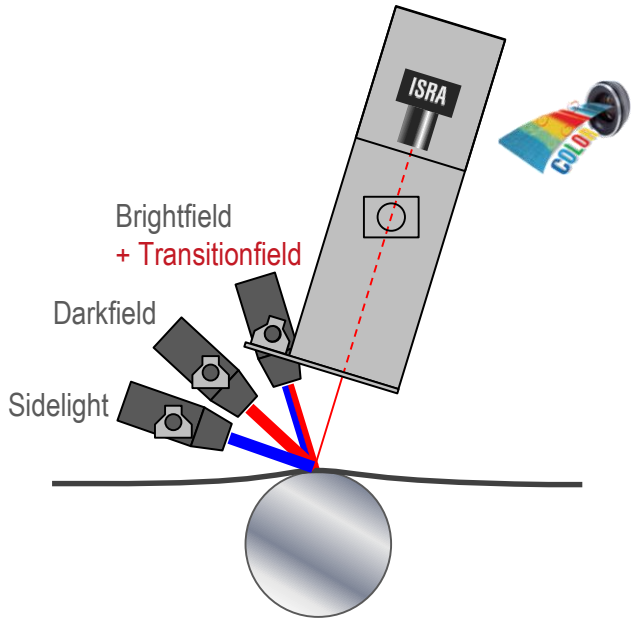


OPTICAL SETUP TECHNOLOGY



4 VIEWS IN 2 SHOTS – EXAMPLE 1

COLOR

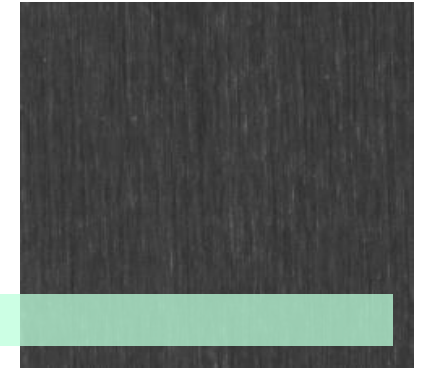
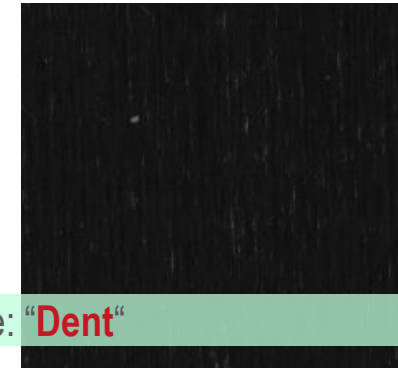
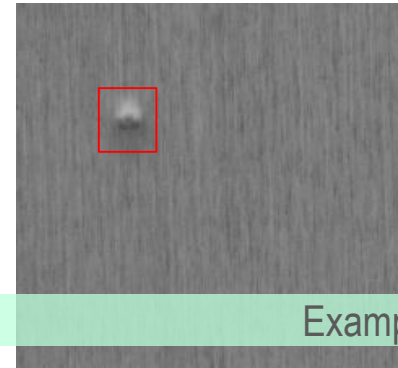
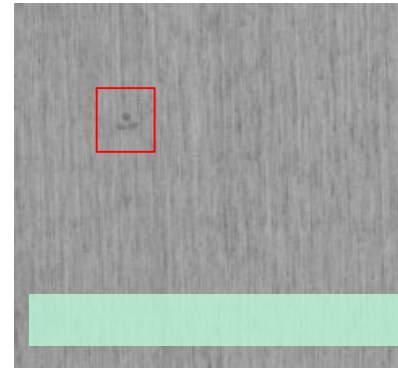


Brightfield

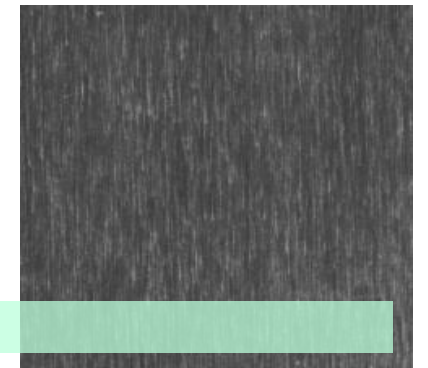
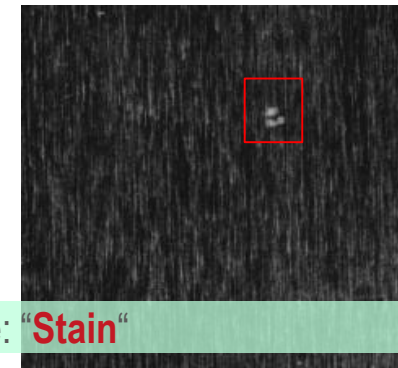
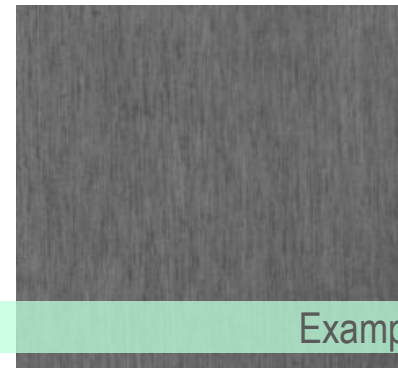
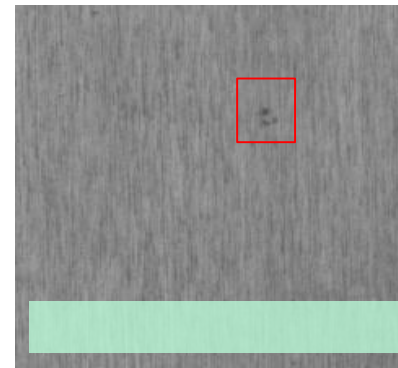
Transitionfield

Darkfield

Sidelight



Example: "Dent"



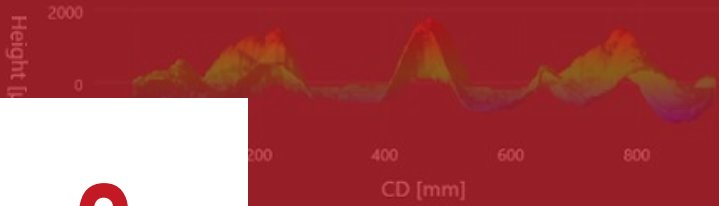
Example: "Stain"

Algorithm chain

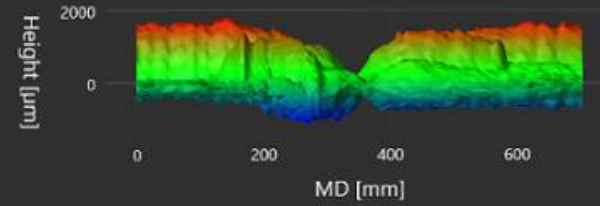


2

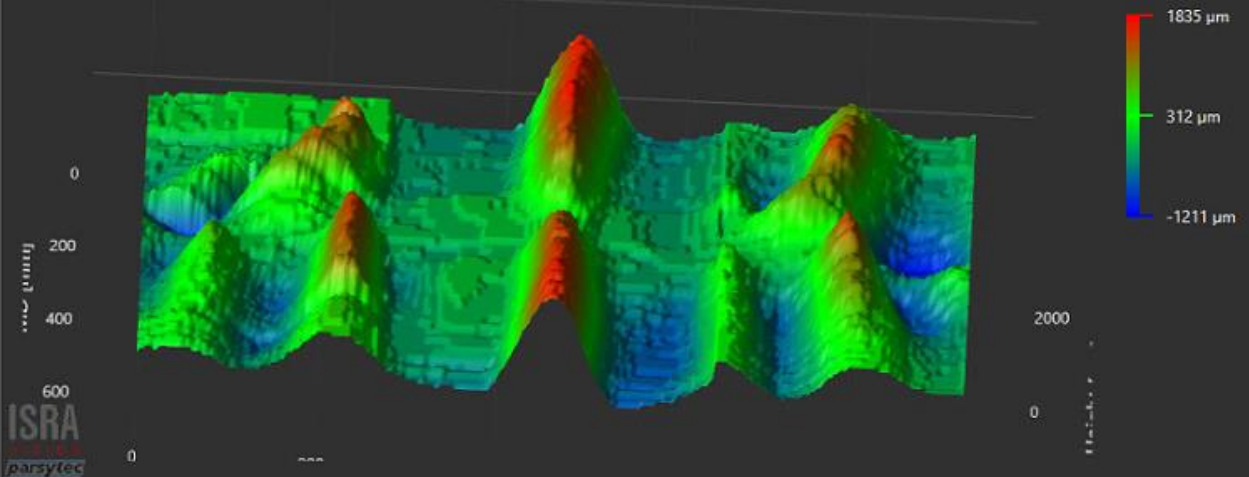
WAVINESS DETECTION



TOP View



3D View



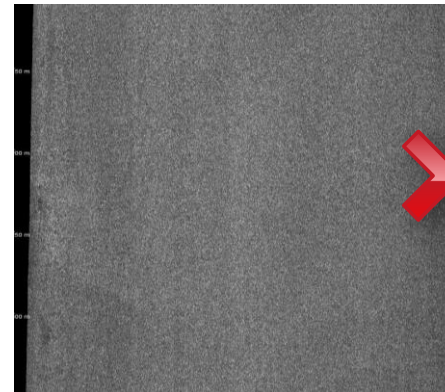
WAVINESS DETECTION

CHALLENGE

- Topography of metal strip (waves, buckles etc.) not always detectable with conventional technology

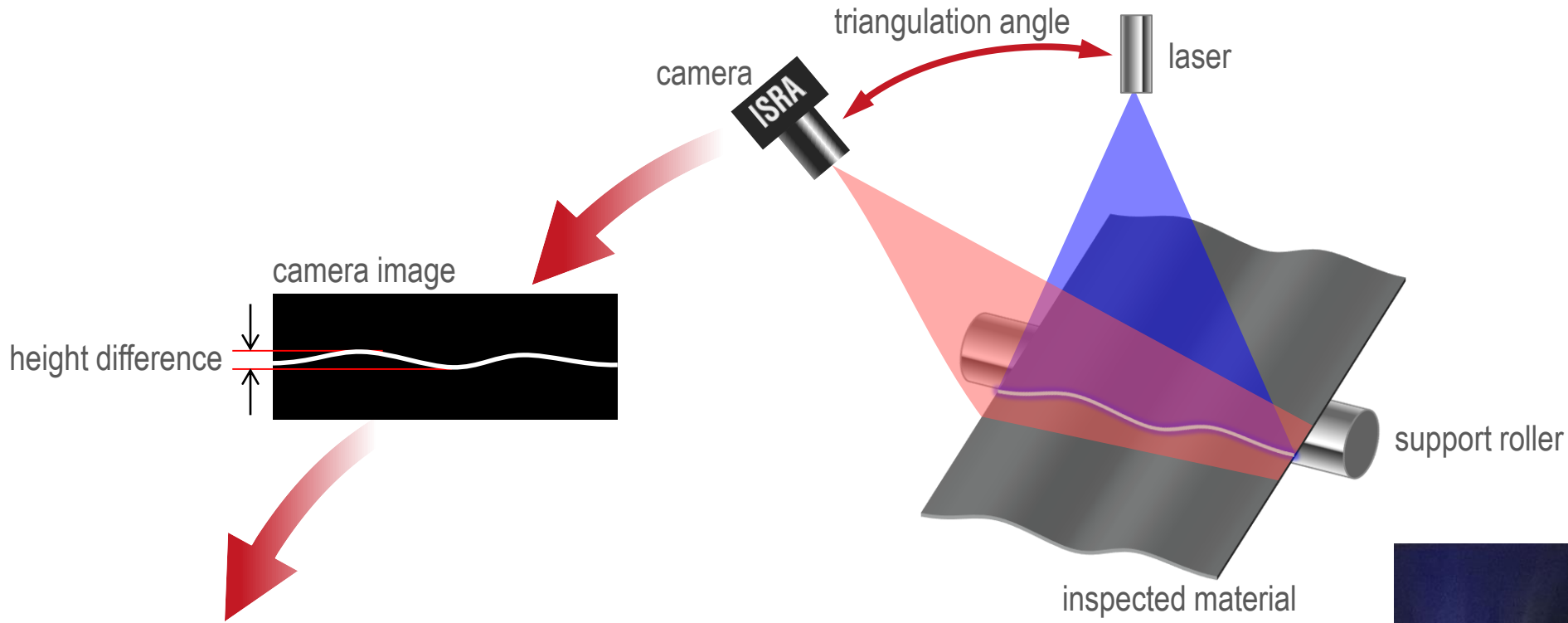
SOLUTION

- Laser triangulation to generate topographic (3D) surface scan of strip



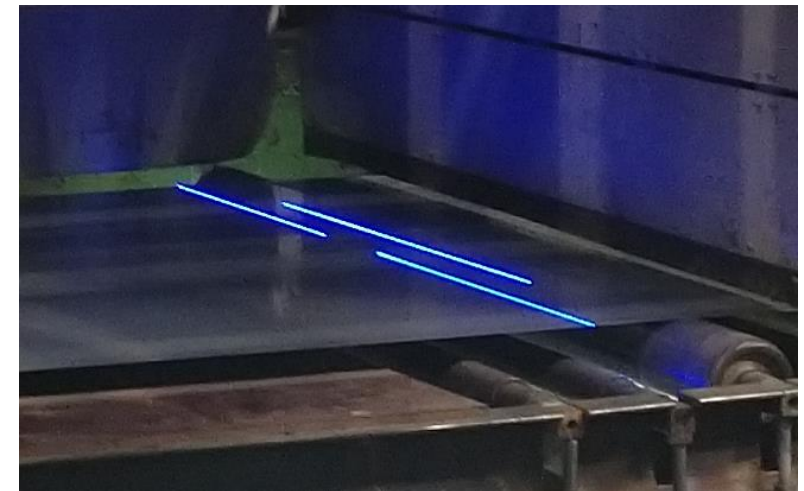
Nothing visible in conventional image

LASER TRIANGULATION



CALCULATION OF SURFACE TOPOLOGY/PROFILE USING

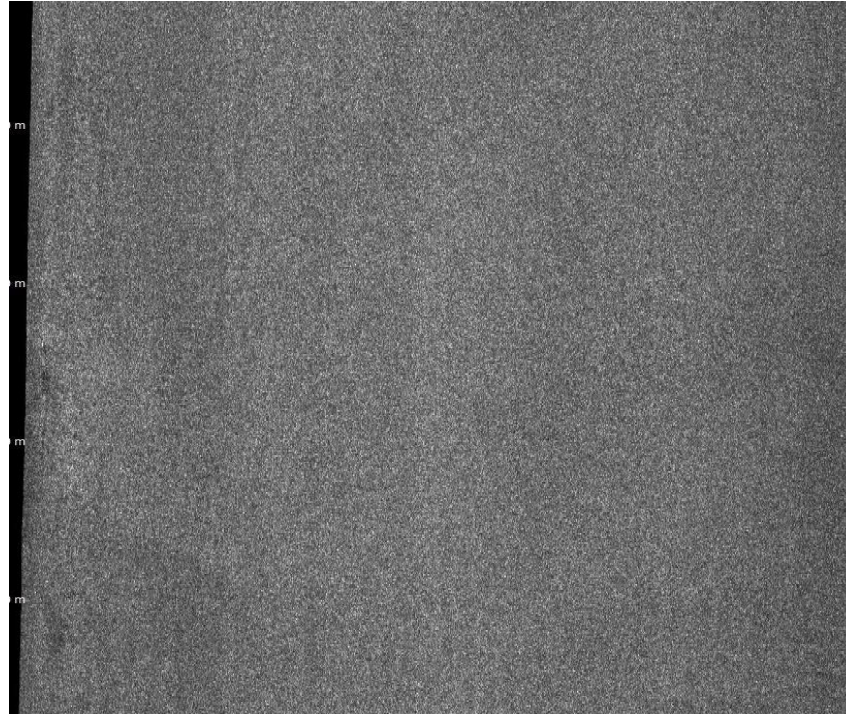
- image/camera resolution
- triangulation angle
- height difference in image pixels



2D + 3D INSPECTION OF WAVES

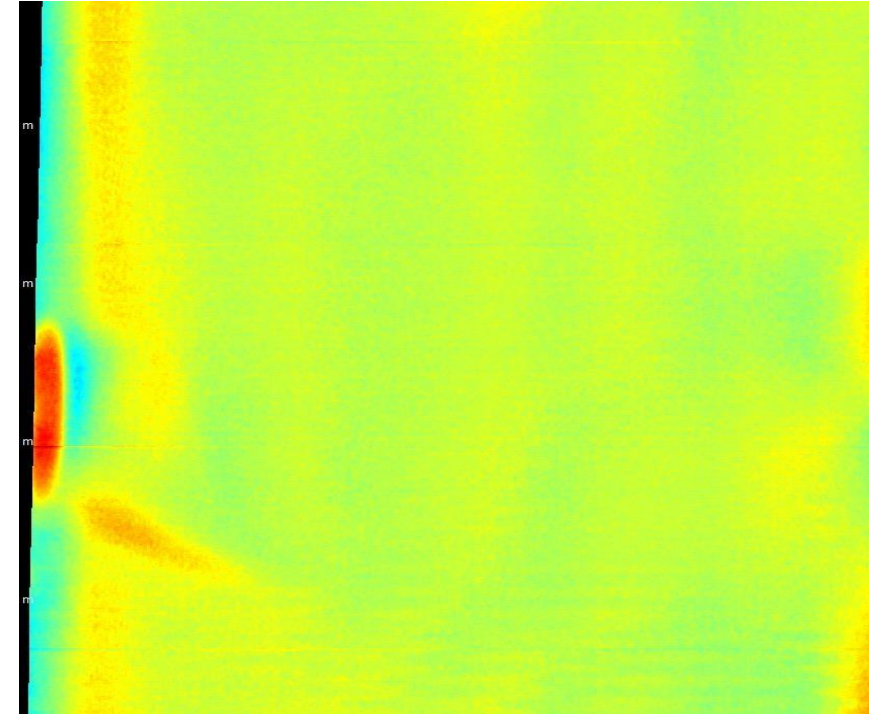


2D Channel



Nothing visible in conventional image

3D Channel

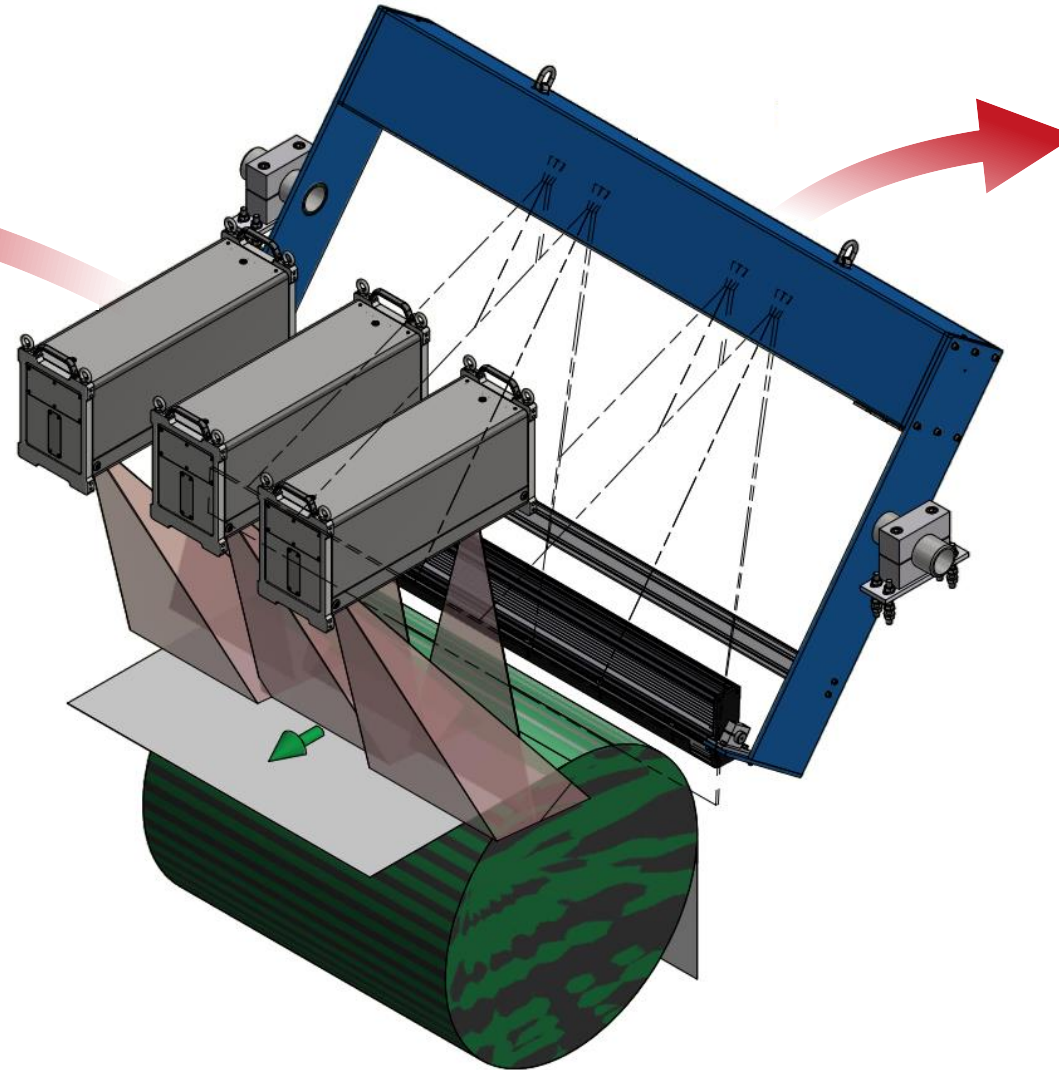
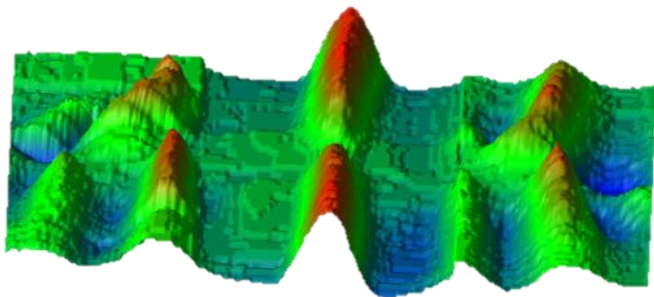


Detectable

STRIP INSPECTION: 3D + CONVENTIONAL INSPECTION

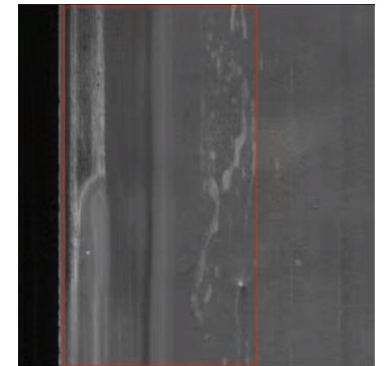
3D inspection

- waviness measurement
 - down-web direction
 - cross-web direction
- detection & classification of (large) topographical defects

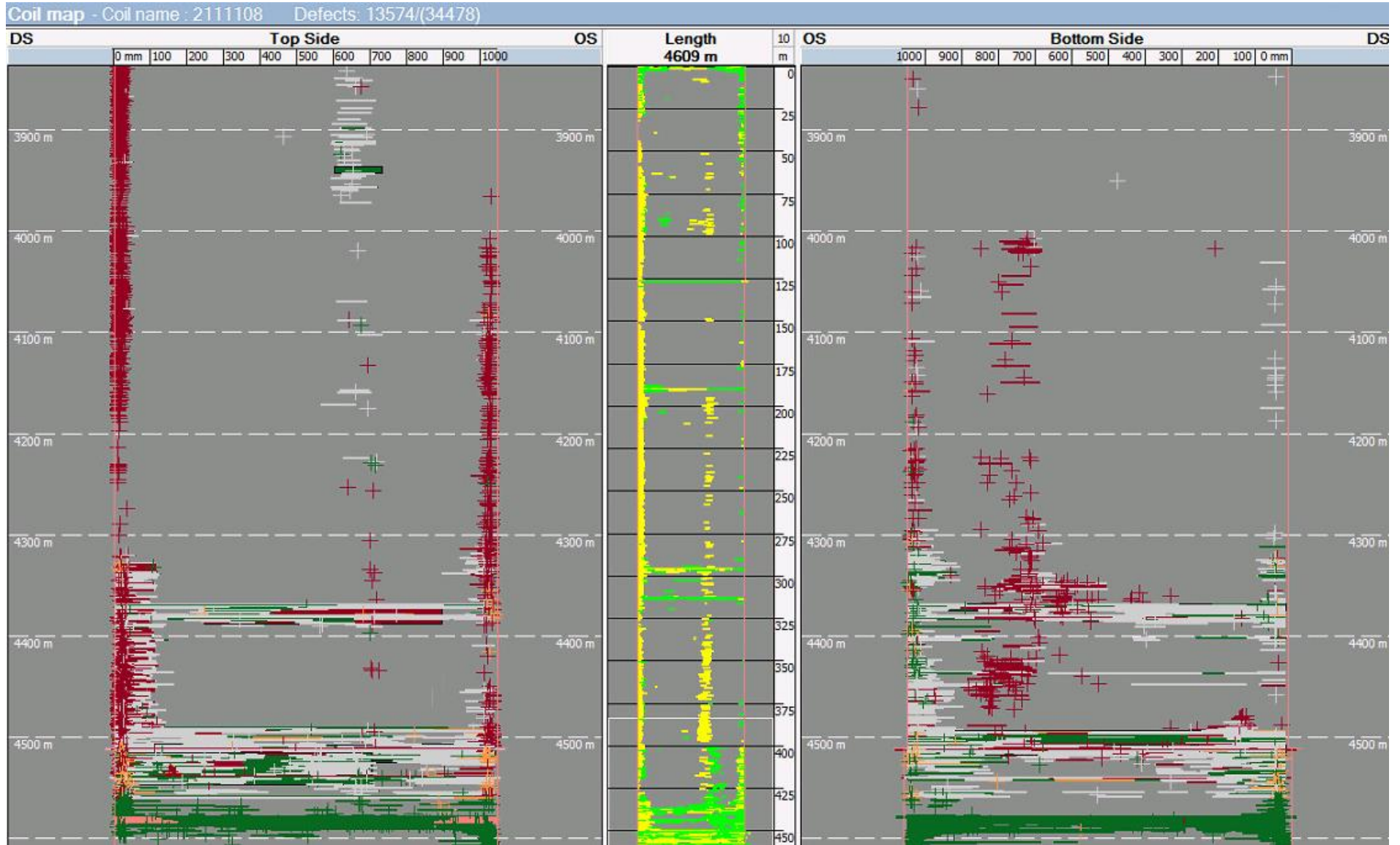


2D inspection

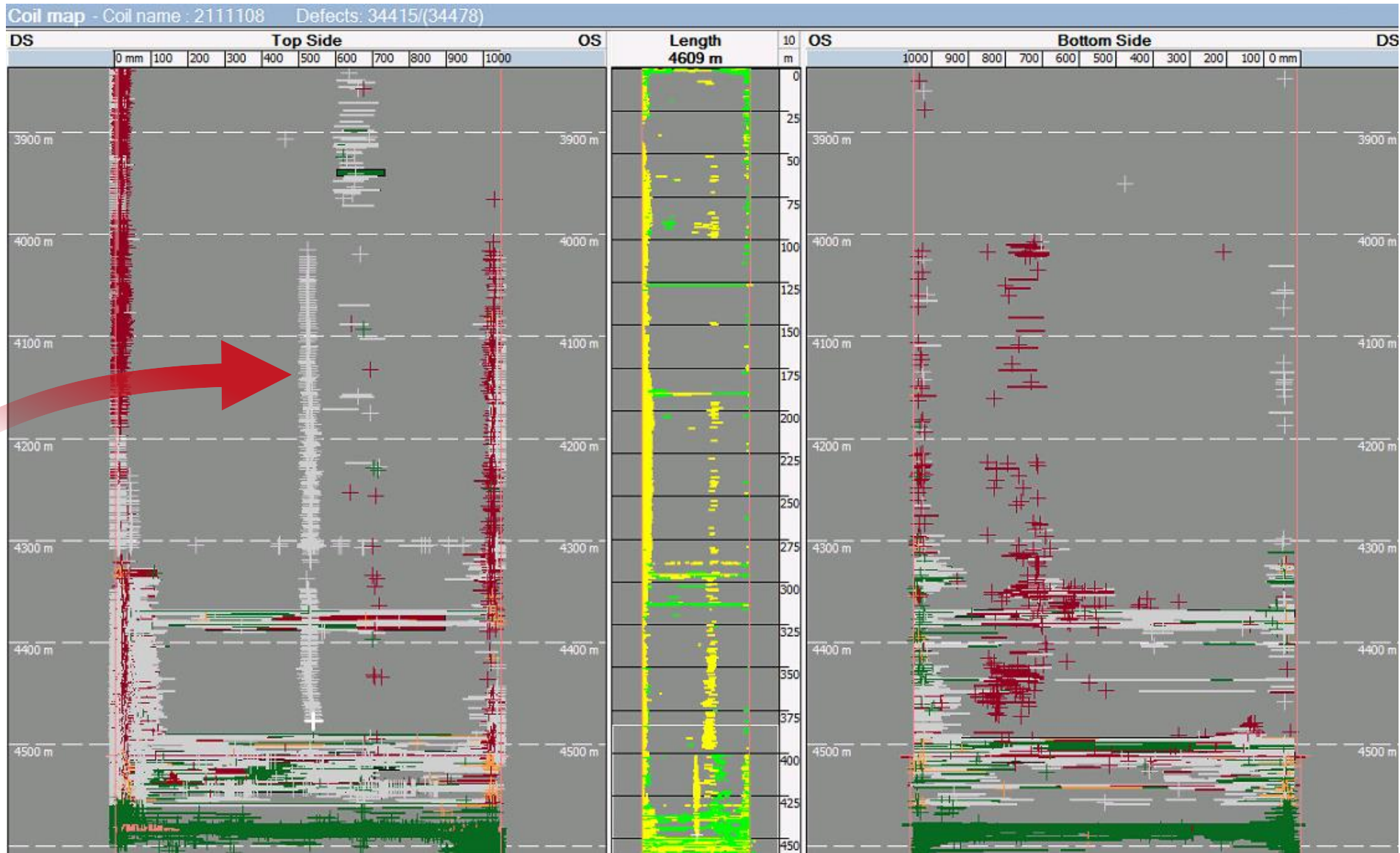
- detection & classification of 2D defects & (small) topographical defects



3D + CONVENTIONAL INSPECTION: DEFECT MAP



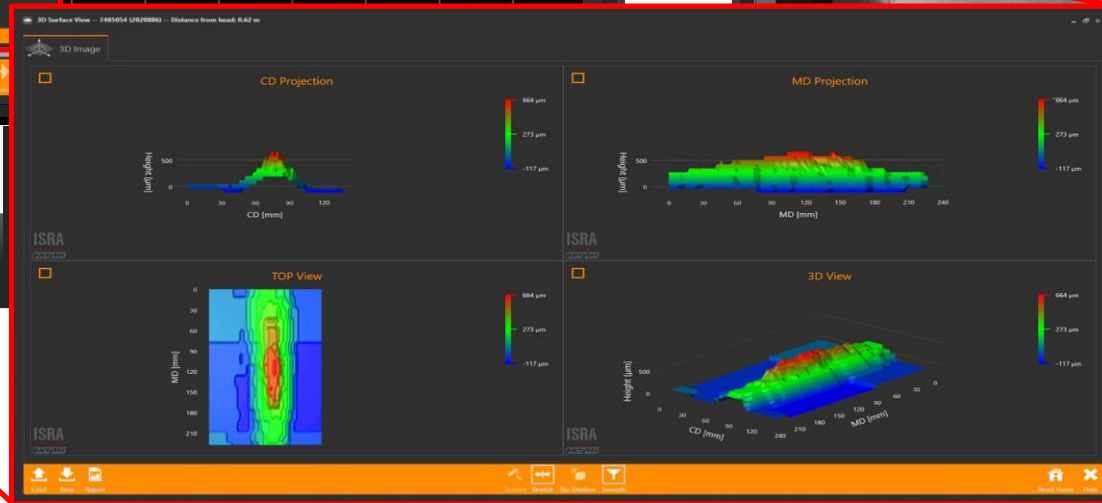
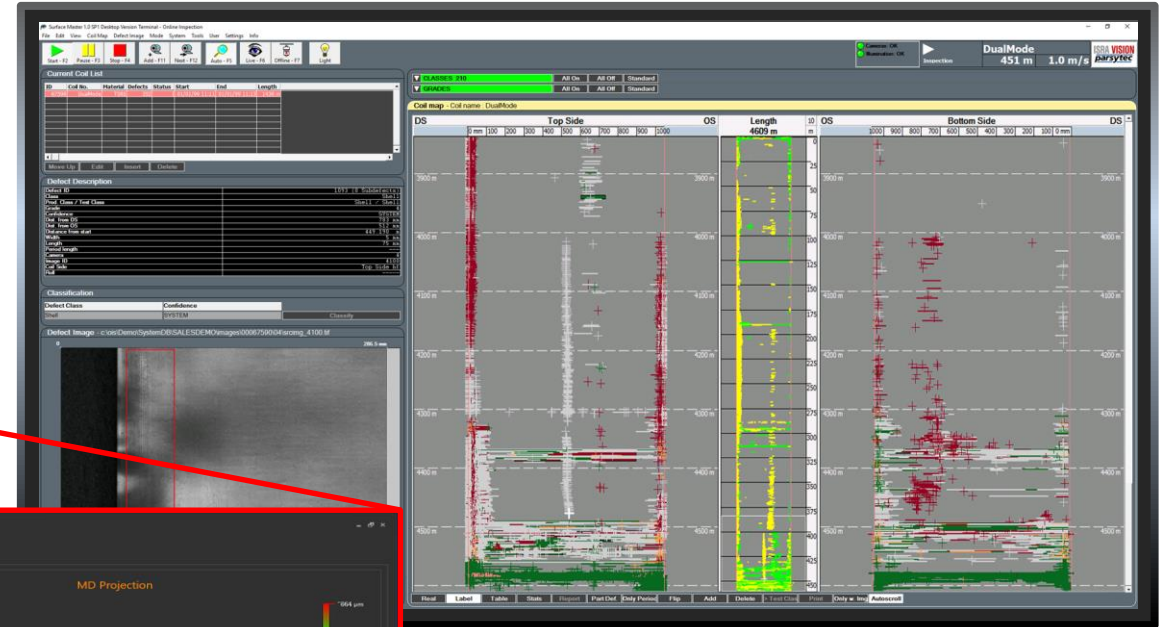
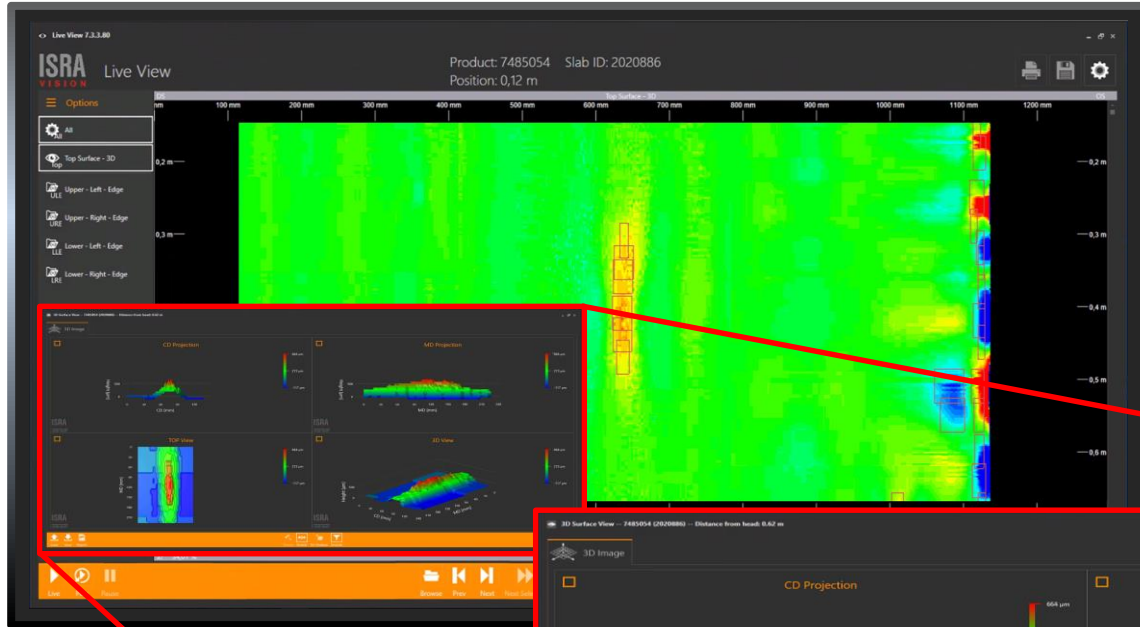
3D + CONVENTIONAL INSPECTION: DEFECT MAP



OPERATOR VIEW

LiveView

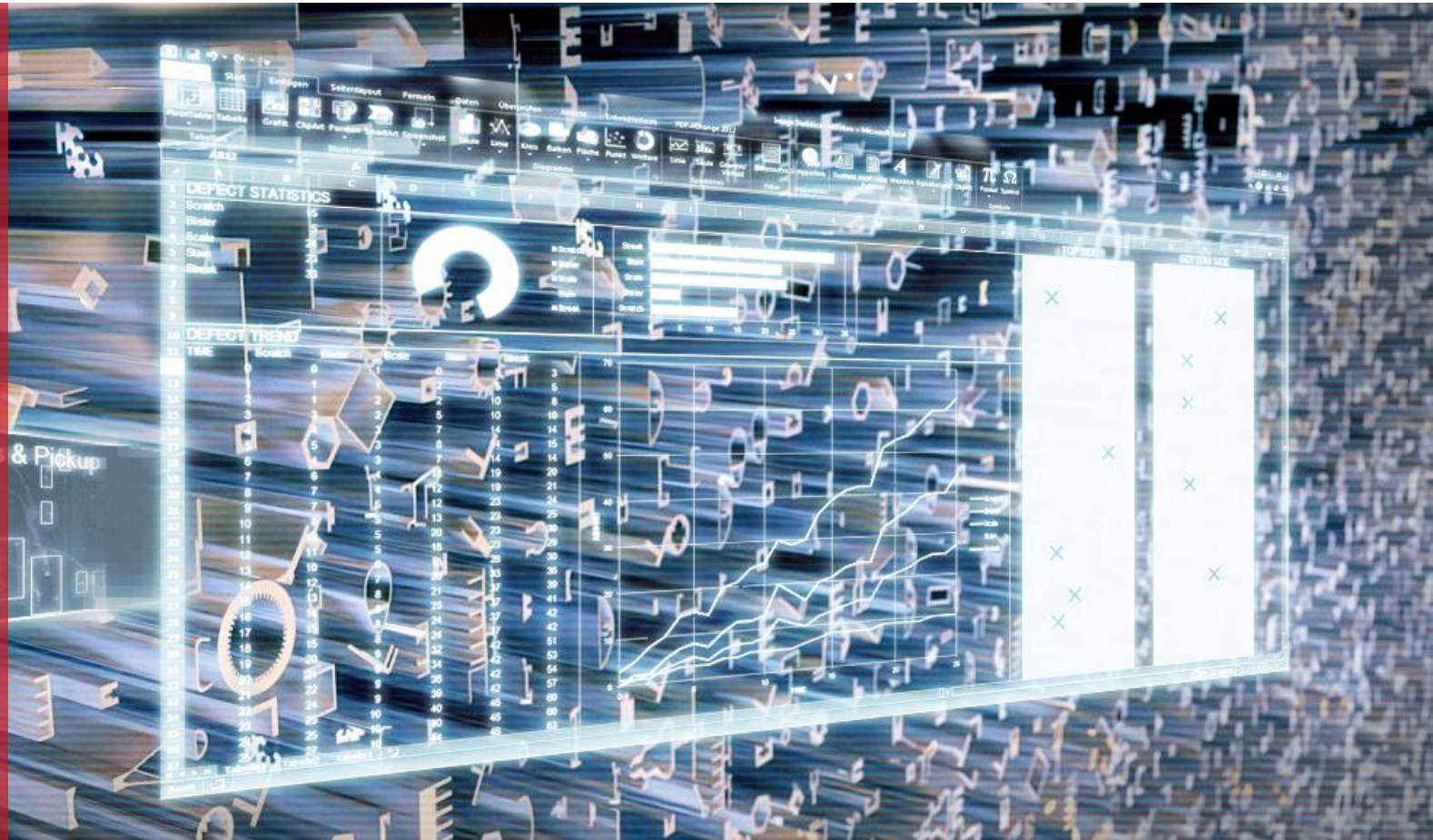
ODIS (= Operator Display)



LiveView – Detailed View

3

PROFILE (EXTRUSION) INSPECTION



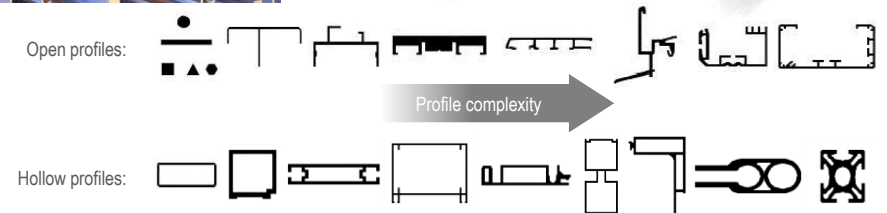
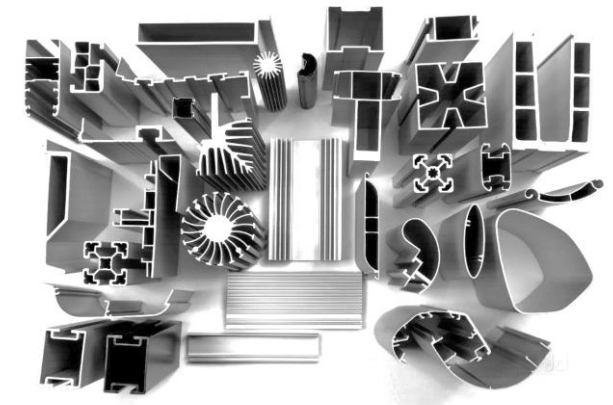
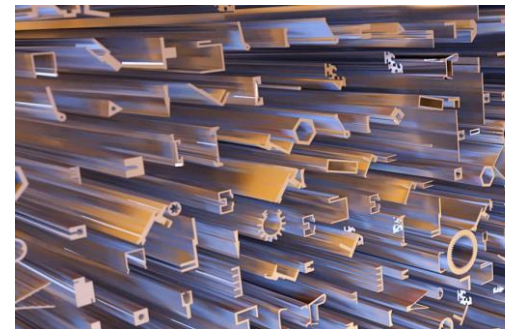
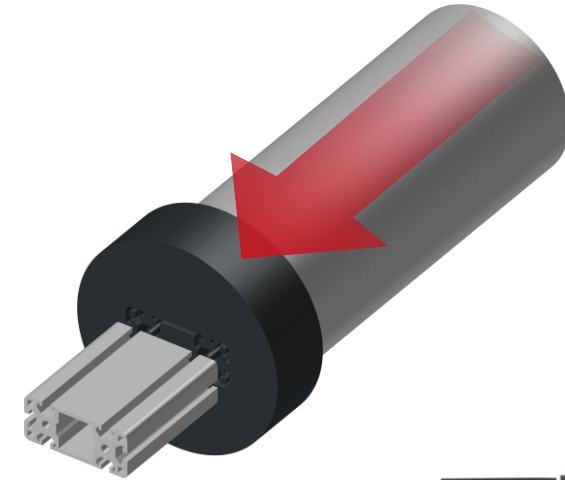
PROFILE (EXTRUSION) INSPECTION

CHALLENGE

- So far no automatic surface inspection system for the aluminium profile (extrusion) industry

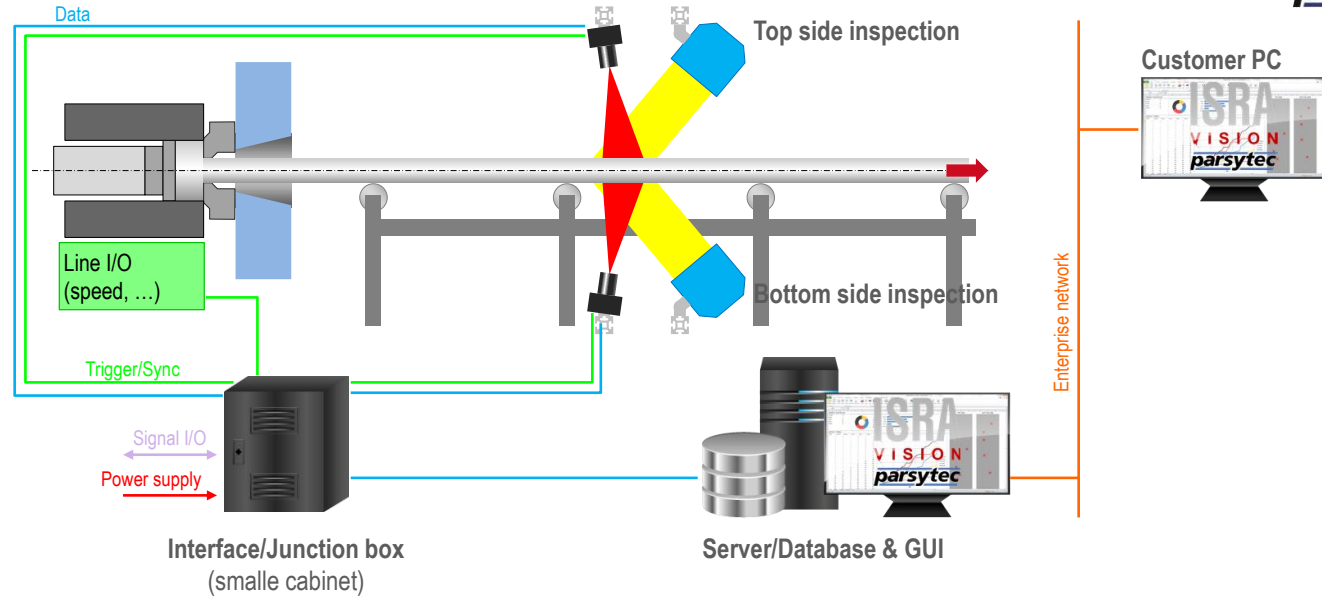
SOLUTION

- Transfer experience of 25 year strip inspection to the extrusion industry



EXTRUSION INSPECTION

- Transferring the experience of 25 years flat surface inspection to **EXTRUSION**

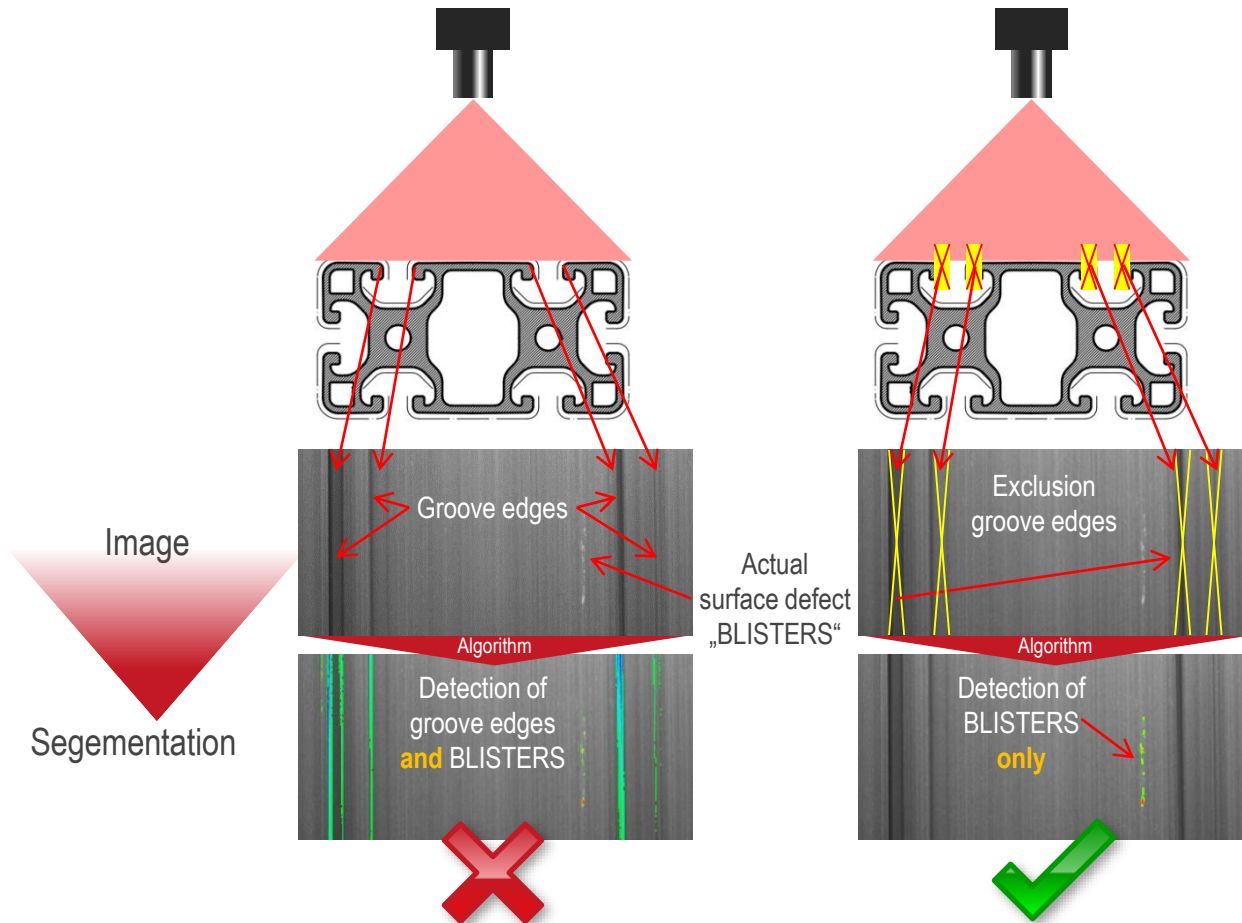


CHALLENGES TO OVERCOME

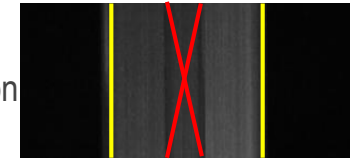
Conventional inspection

Improved inspection (masking)

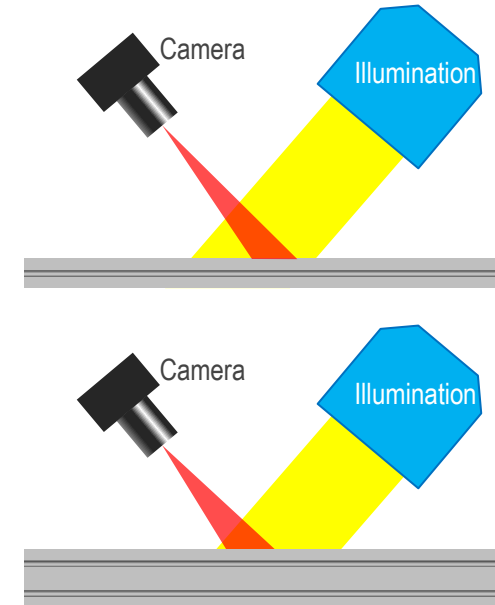
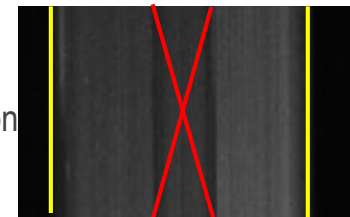
- Masking relative to detected edges
- No problems with height variations



Normal Position

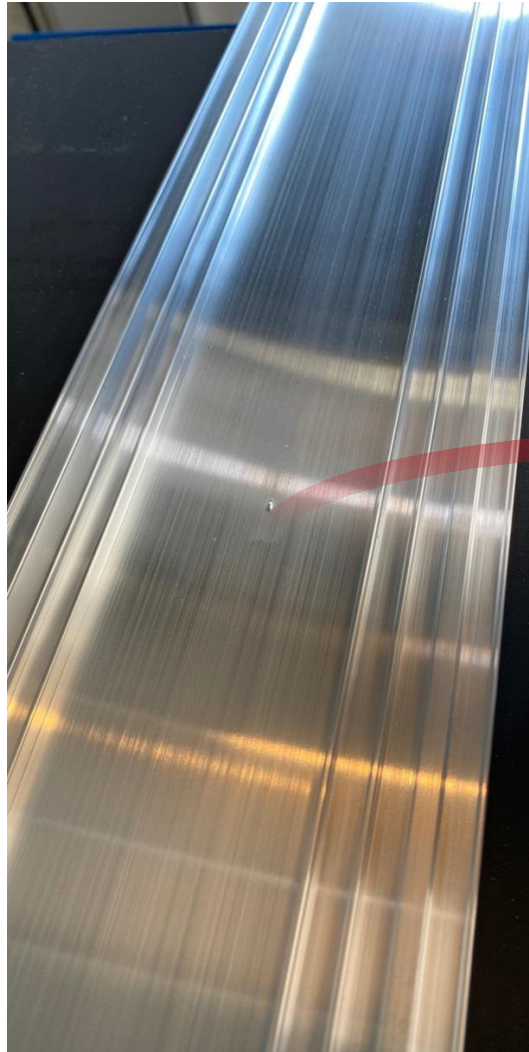


Raised Position



EXTRUSION – DEFECT DETECTION EXAMPLES

Blister



Surface Master 1.1 SP1 Terminal - Offline

Datei Bearbeiten Ansicht Coilmap Defektbild Modus System Werkzeuge Nutzer Einstellungen Info

Aktuelle Coilliste

ID	Coilname	Material	Defekte	Status	Beginn	Ende	Länge
112339	LAU_01_01	Inspizer...	2325	F	14.04.20 16:27	14.04.20 16:29	0 m
112340	LAU_02_01	Inspizer...	1469	F	14.04.20 16:29	14.04.20 16:30	0 m
112341	LAU_02_02	Inspizer...	5	F	14.04.20 16:30	14.04.20 16:33	0 m
112342	LAU_03_01	Inspizer...	469	F	14.04.20 16:33	14.04.20 16:36	0 m
112343	LAU_04_01	Inspizer...	154	F	14.04.20 16:38	14.04.20 16:38	0 m
112344	LAU_05_01	Inspizer...	0	F	14.04.20 16:38	14.04.20 16:44	1 m
112345	LAU_05_02	Inspizer...	84	F	14.04.20 16:44	14.04.20 16:46	0 m
112346	LAU_06_01	Inspizer...	344	F	14.04.20 16:46	14.04.20 16:52	0 m
112347	LAU_07_01	Inspizer...	149	F	14.04.20 16:52	14.04.20 16:54	0 m
112348	LAU_08_01	Inspizer...	84	F	14.04.20 16:54	14.04.20 16:55	0 m
112349	LAU_09_01	Inspizer...	9	F	14.04.20 16:58	14.04.20 17:00	0 m

Defektbeschreibung

Defekt Nr. 1307
 Klasse Blist
 Prod. Klasse / Testklasse Blist / Blist
 Schweregrad 5
 Sicherheit SYSTEM
 Abstand von BS 54 mm
 Abstand von AS 62 mm
 Abst. vom Anfang 0,065 mm
 Breite 4 mm
 Länge 9 mm
 Periodenlänge 1
 Kamera 70
 Seite Oberseite BF

Klassifizierung

Defektklasse Sicherheit
 Blist SYSTEM Klassifizieren

Coilmap - Coilname: LAU_04_01 Defekte: 226

AS	Oberseite	BS
0,00 m	0,00 m	0,00 m
0,02 m	0,02 m	0,02 m
0,03 m	0,03 m	0,03 m
0,04 m	0,04 m	0,04 m
0,05 m	0,05 m	0,05 m
0,06 m	0,06 m	0,06 m
0,07 m	0,07 m	0,07 m

Defektbild - g:\images\00112343\CONT\P274364_00112343_01_srcimg_0070.tif[1.1 : 1]

Qualitätsstatistik

ID	Coil Nr.	Material	Länge	Period.	Dents	Sup...	Sett...	Scra...	Pres...	Pres...Ban
112339	LAU_01_01	Inspizer...	0,0 m	Nein						
112340	LAU_02_01	Inspizer...	0,0 m	Nein						
112341	LAU_02_02	Inspizer...	0,0 m	Nein						
112342	LAU_03_01	Inspizer...	0,0 m	Nein			169			20
112343	LAU_04_01	Inspizer...	0,0 m	Nein						

Original Equal Stretch 3D Rot -> DTT

Detailansicht

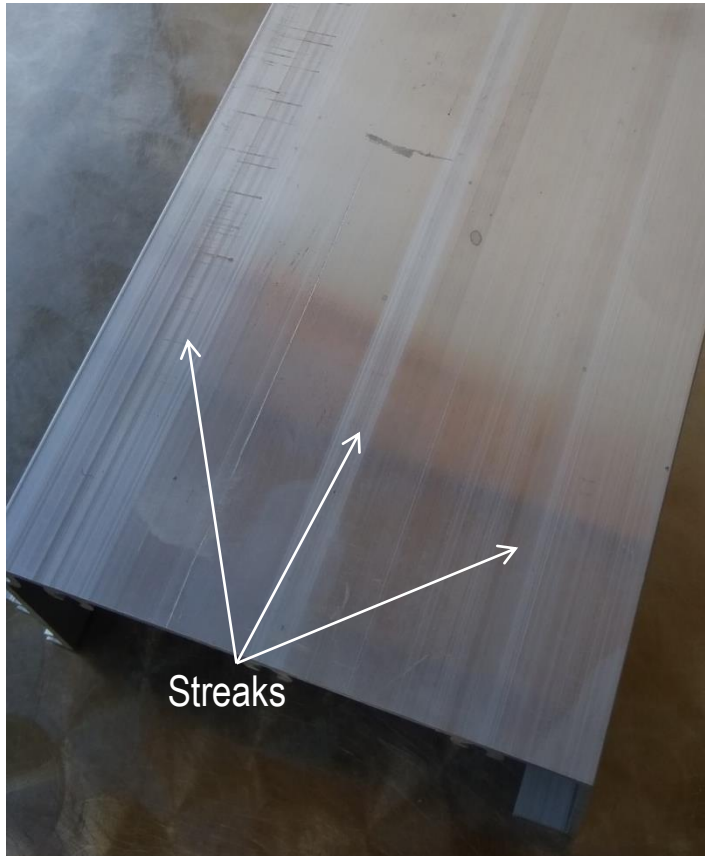
Position CD 165,9 mm
 Position RCD 90,7 mm
 Klassenname Blase
 CLProfClassID Blase
 CLProfFirstLabel Blase
 CLProfNextLabel Other
 CLProfConfidence 0,941

Detailansicht

Position CD 135,0 mm
 Position RCD 136,9 mm
 Klassenname Blase
 CLProfClassID Blase
 CLProfFirstLabel Blase
 CLProfNextLabel Other
 CLProfConfidence 0,941

EXTRUSION – DEFECT DETECTION EXAMPLES

DIE STREAKS



Surface Master 1.1 SP1 Terminal - Offline

Datei Bearbeiten Ansicht Coilmap Defektbild Modus System Werkzeuge Nutzer Einstellungen Info

ISRA VISION parsytec

Aktuelle Coilliste

ID	Coilname	Material	Defekte	Status	Beginn	Ende	Länge
112375	auto-112375	Default	0	F	21.04.20 16:56	21.04.20 16:57	0 m
112376	E92751-Mill	Inspizier...	-1	U	21.04.20 17:01	---	0 m
112377	E92751-Mill	Inspizier...	0	F	21.04.20 17:07	22.04.20 14:35	4026 m
112378	auto-112378	Default	0	F	22.04.20 14:35	22.04.20 14:47	34 m
112379	E97764-Mill	Inspizier...	186	F	22.04.20 14:47	22.04.20 14:52	13 m
112380	E92751-Mill	Inspizier...	358	F	22.04.20 14:52	22.04.20 15:00	23 m
112381	E93941-Mill	Inspizier...	1439	F	22.04.20 15:00	22.04.20 15:03	10 m
112382	E93941-Mill	Inspizier...	0	F	22.04.20 15:03	22.04.20 15:05	6 m
112383	E93941-Mill	Inspizier...	822	F	22.04.20 15:05	22.04.20 15:15	29 m
112384	E97930-Mill	Inspizier...	743	F	22.04.20 15:15	22.04.20 15:19	9 m
112385	E97930-Mill	Reve...	1729	F	22.04.20 15:19	22.04.20 15:28	27 m

Defektbeschreibung

Defekt Nr.: 3613
Klasse: NC
Prod. Klasse / Testklasse: NC / B11st
Schweregrad: 5
Sicherheit: SYSTEM
Abstand von BS: 18 mm
Abstand von AS: 93 mm
Abst. vom Anfang: 1.827 m
Breite: 6 mm
Länge: 36 mm
Periodenlänge: ---
Kamera: 1
Bild Nr.: 536
Seite: Oberseite BF

Klassifizierung

Defektklasse: Sicherheit
NC SYSTEM Klassifizieren

Coilmap - Coilname: E97930-Mill Defekte: 5208

AS Oberseite BS 1 m

Größe	Marke	Tab.	Stat.	Report	Jur Perio	tinzufüg	Bearbeit	Loschen	Testkies	Jur m. Bil
1.824 m										
1.825 m										
1.826 m										
1.827 m										
1.828 m										
1.829 m										
1.830 m										
1.831 m										
1.832 m										

Qualitätsstatistik

ID	Coil Nr.	Material	Länge	Period.	Dents	Sup...	Sett...	Scra...	Pres...	Pres...	Bam...	Abr...	Resi...	Blester	Pse...	Syst...
112379	E97764-Mill	Inspizieren	13,3 m	Nein					186							
112380	E92751-Mill	Inspizieren	23,4 m	Ja					2					356		
112381	E93941-Mill	Inspizieren	9,5 m	Ja					1	18	5	5		1410		
112383	E93941-Mill	Inspizieren	29,1 m	Ja					12	2				809		
112384	E97930-Mill	Inspizieren	9,1 m	Ja					52	3				680		

Defektbild - g:\images\00112384\{CONT}\P274364_00112384_01_srcimg_0536.tif[1.1 : 1]

DEFECT DETECTION: YES

Größe Original Equal Stretch 3D Rol -> DTT Klein

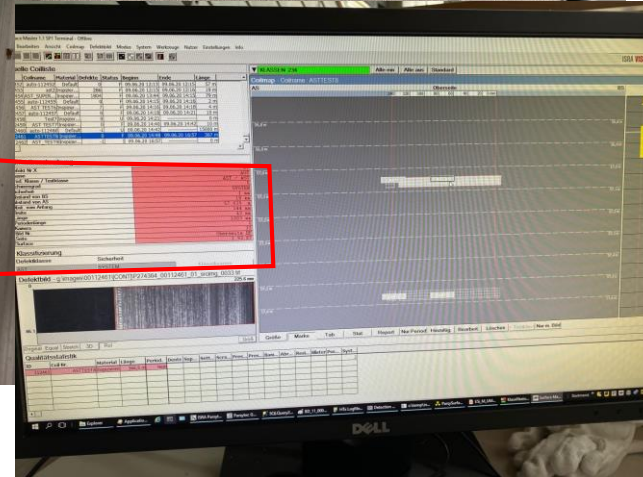
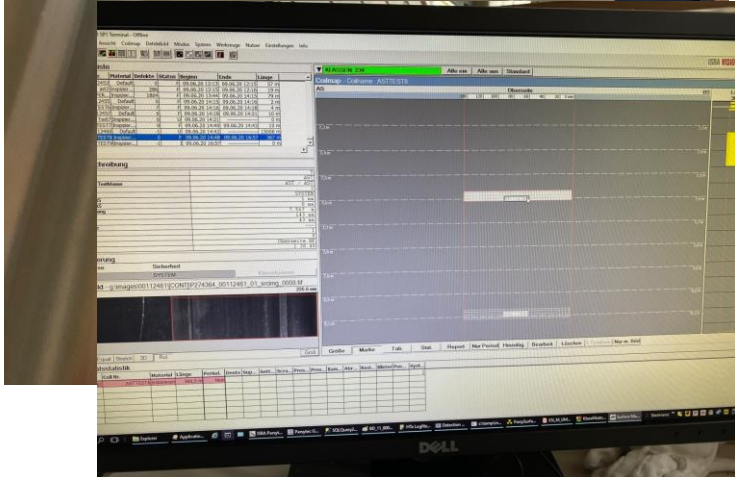
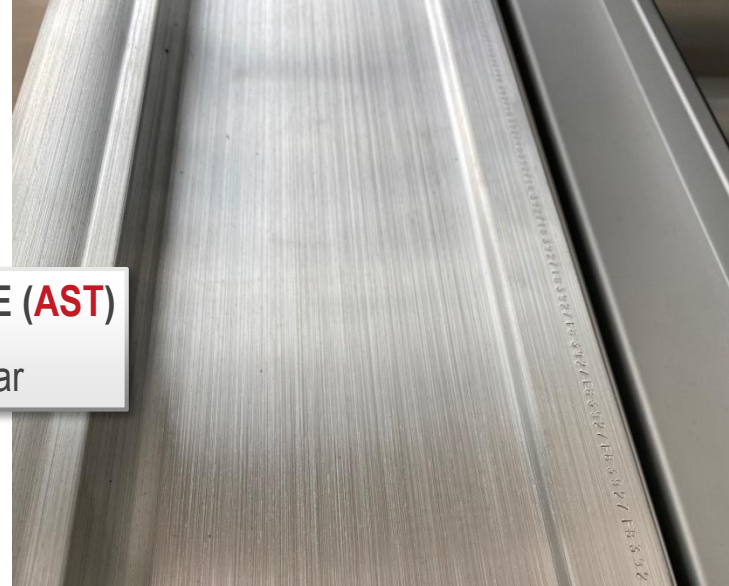
Windows taskbar: C:\vois Application St... Parsytec Gen... HTx Logfile V... P274364-SER... c:\temp\insp... Test Custom I... Parsytec Insp... Detection Tu... Surface Mast... Surface Mast... Startmenü 09:36

EXTRUSION – DEFECT DETECTION EXAMPLES

DIE STREAKS

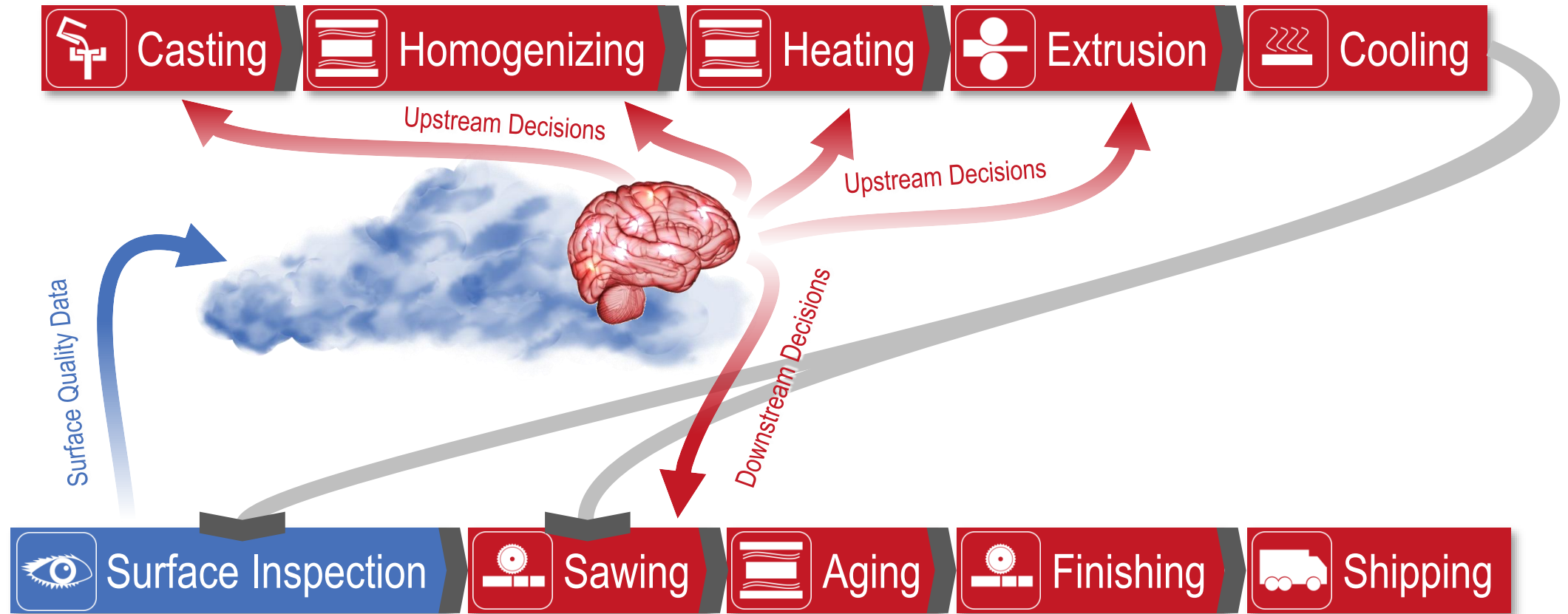


Measured **SURFACE STRUCTURE (AST)**
gives indication about die wear



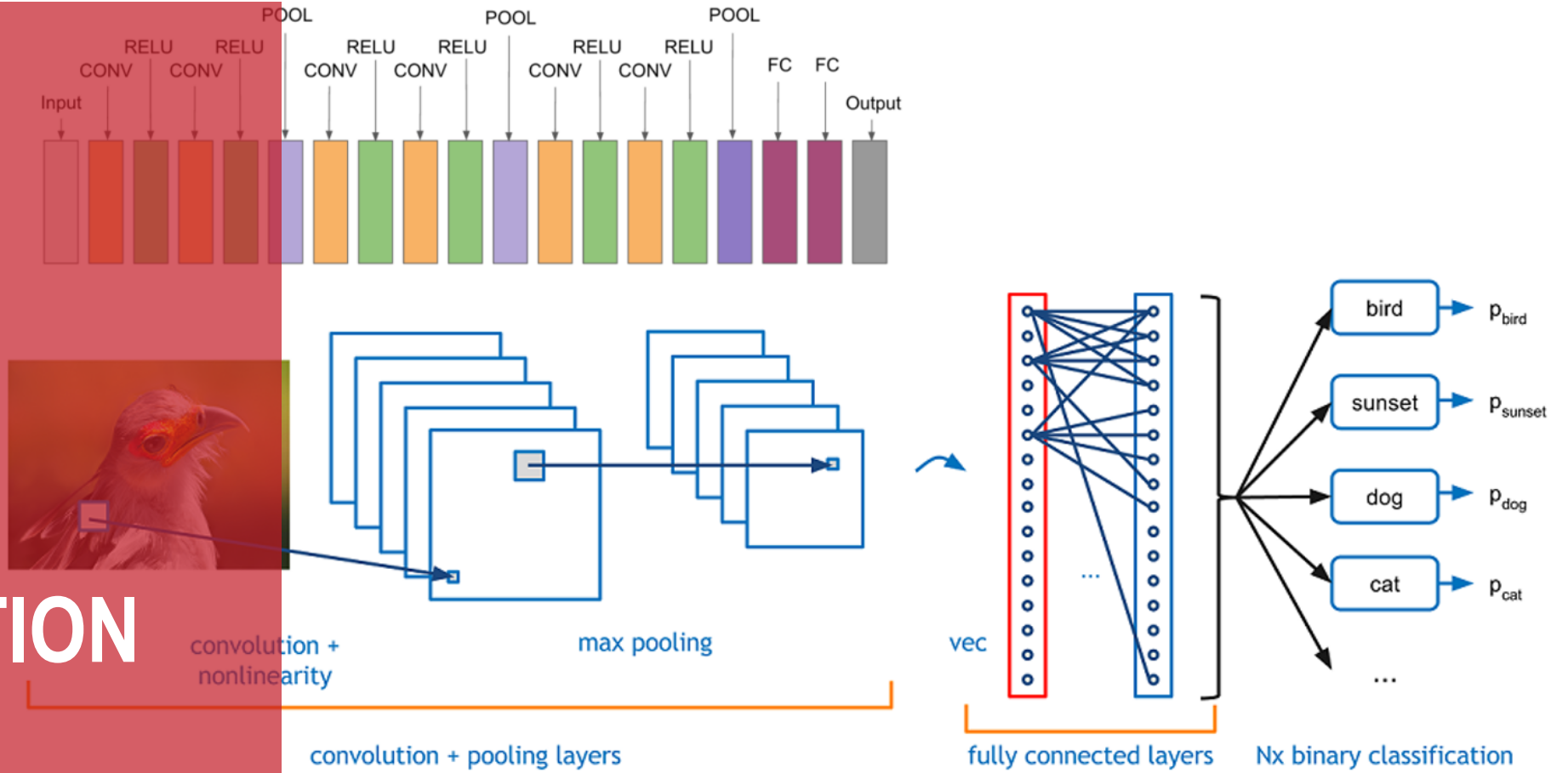
Visual Alarm

THE FUTURE EXTRUSION PLANT



4

NEURONAL NETWORK CLASSIFICATION



NEURONAL NETWORK CLASSIFICATION

CHALLENGE

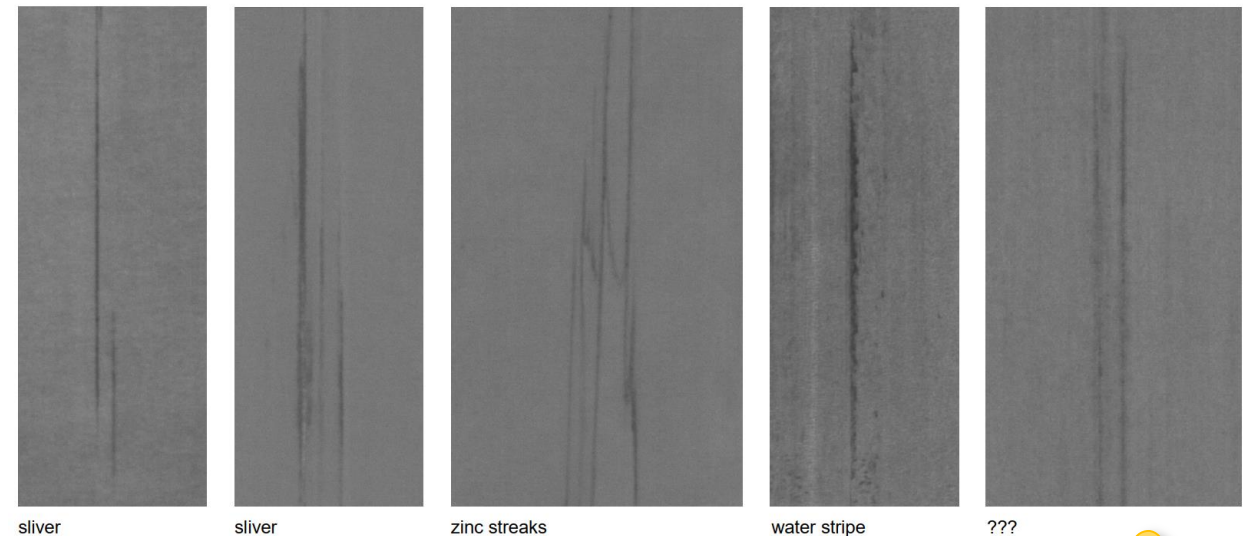
- „Conventional“ Classification sometimes struggles with challenging defects

SOLUTION

- Apply neuronal network classification to inspection system, to improve classification

SIS.EUROPE 2021

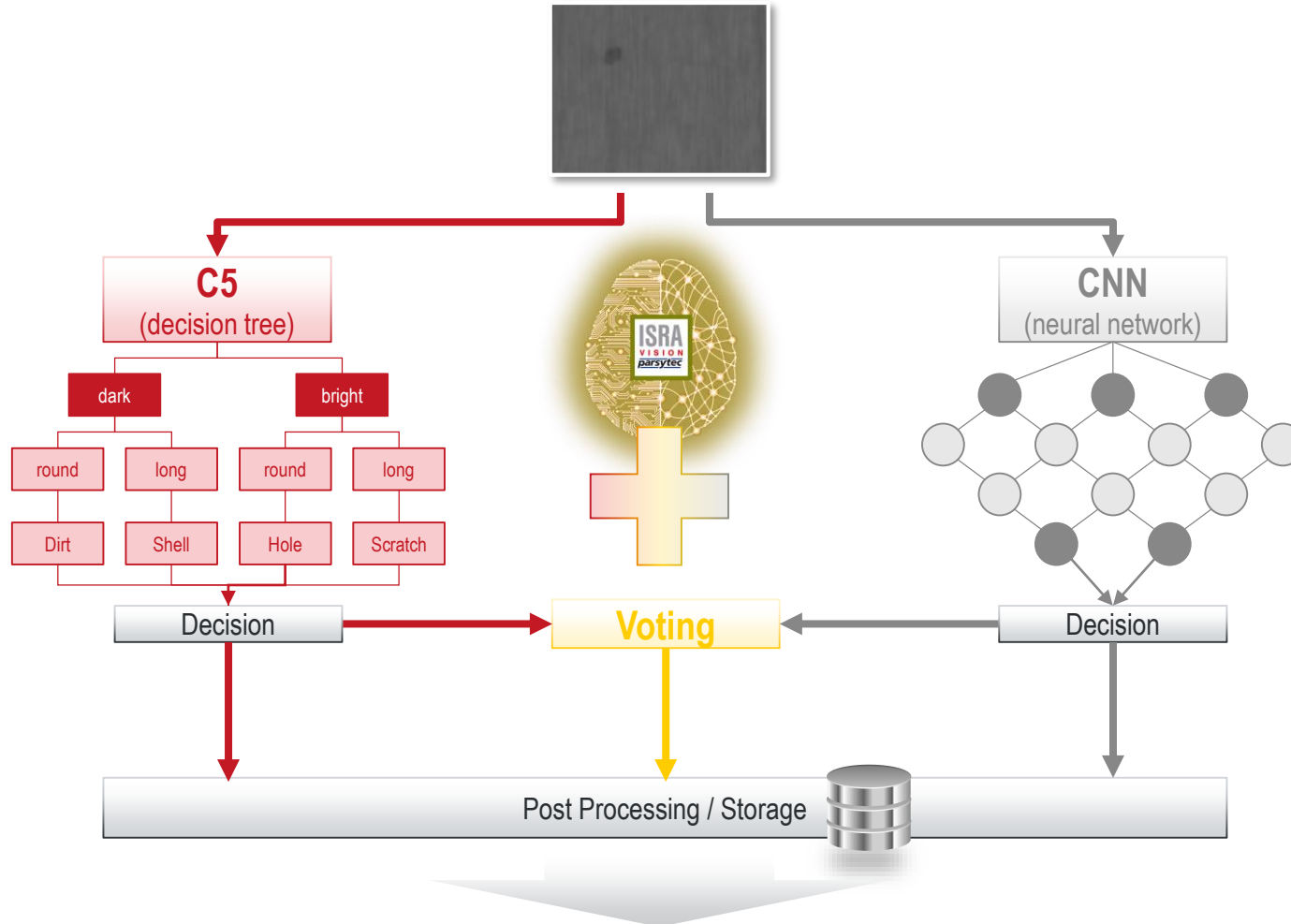
Bright field electrolytic galvanized (no detection in other views)



IMPROVING THE CONVENTIONAL CLASSIFICATION

C5 CLASSIFIER

- Strict (understandable) rules
- Sophisticated training



CNN CLASSIFIER

- Neural network ("black box")
- Simple/fast training

CNN benefit (up to) 25 %

(depending on application and pre-condition)

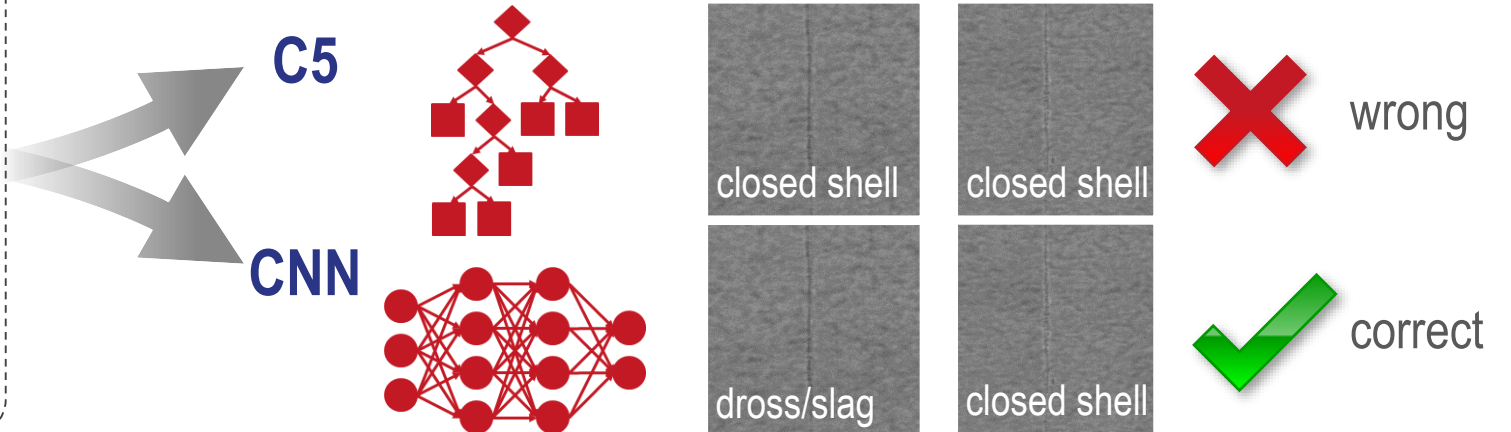
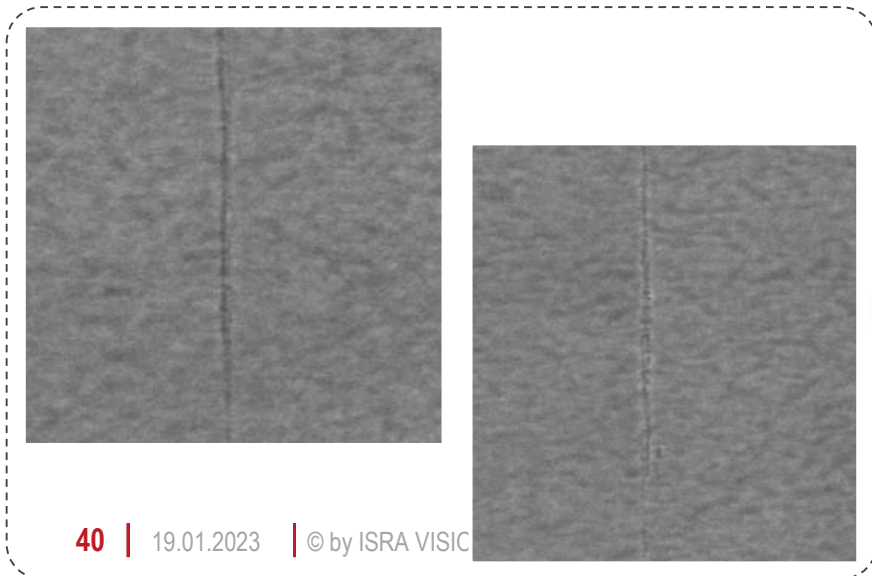
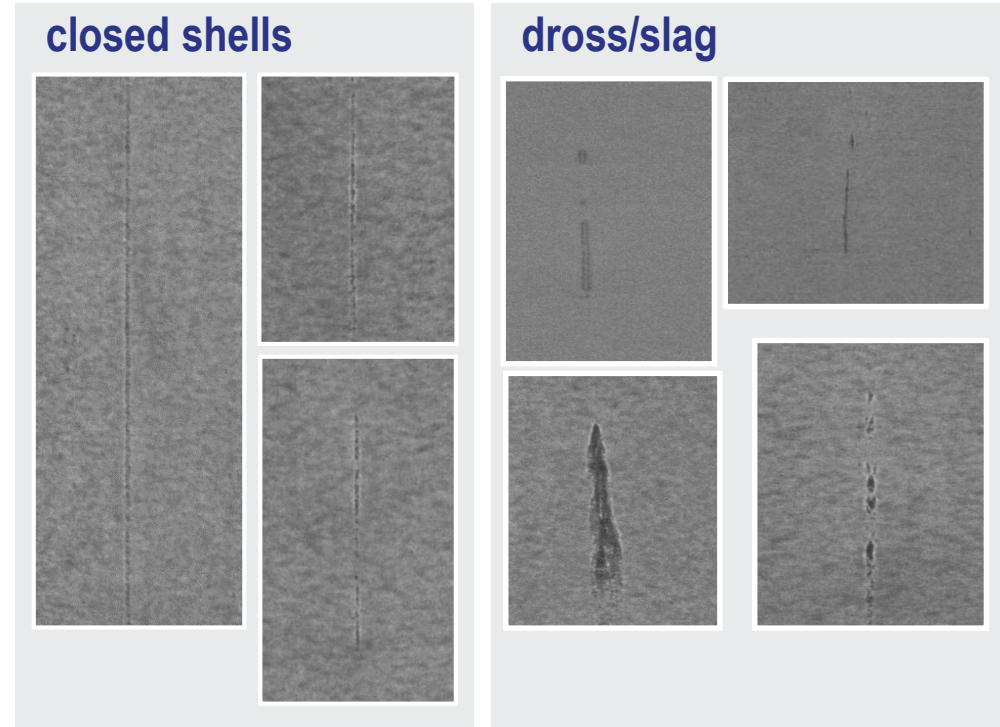
EXAMPLE – CLASSIFYING CHALLENGING DEFECTS

C5 (STANDARD-CLASSIFIER)

- in case of very similar appearances, the standard classifier has difficulties to distinguish the defects
- possible solution: post-processing (context classifier)

CNN

- the neural network is able to find features that can “easily” distinguish between both defect classes



5

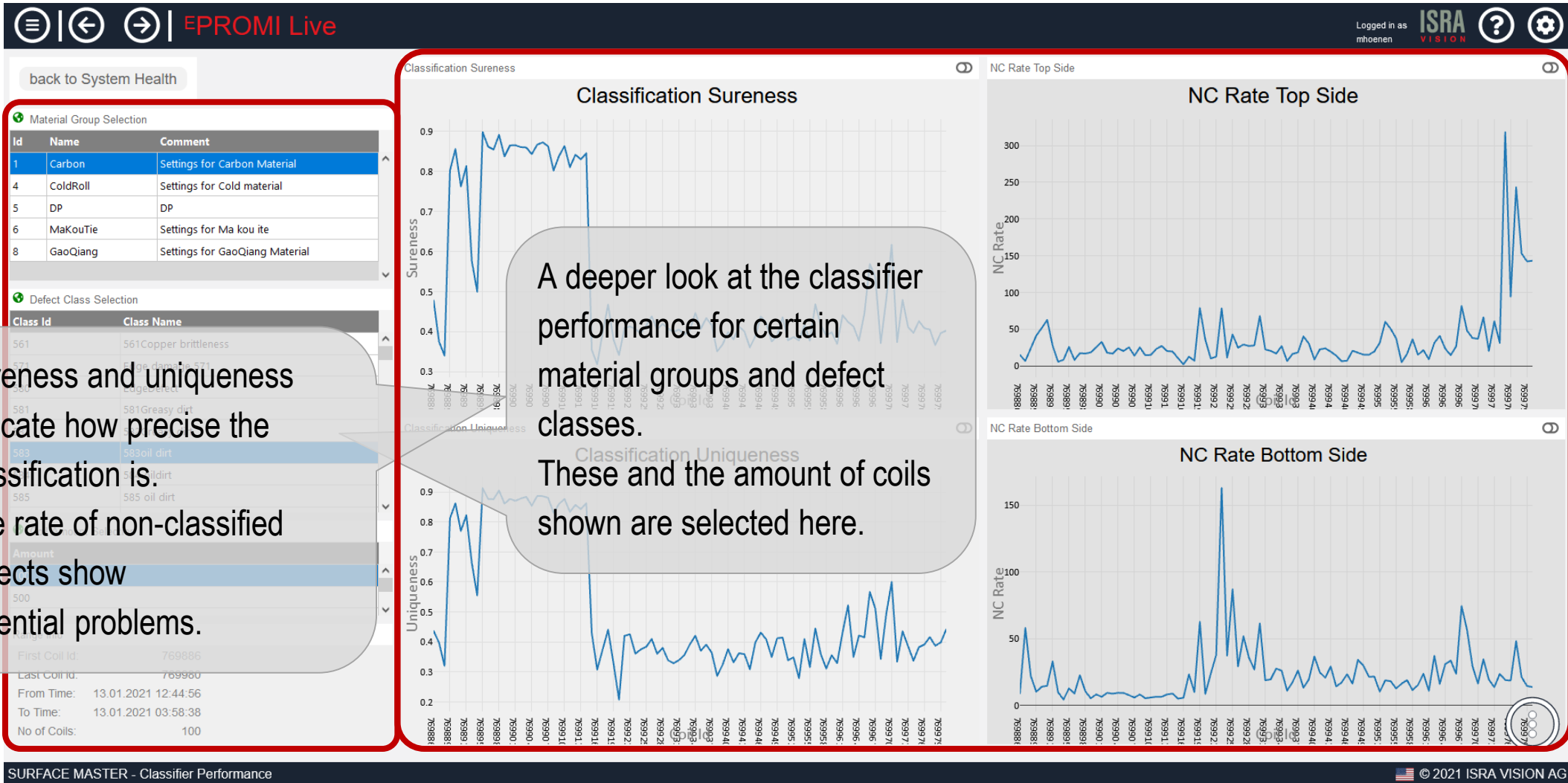
CONDITION MONITORING



Condition Monitoring enables you to permanently monitor the current state of

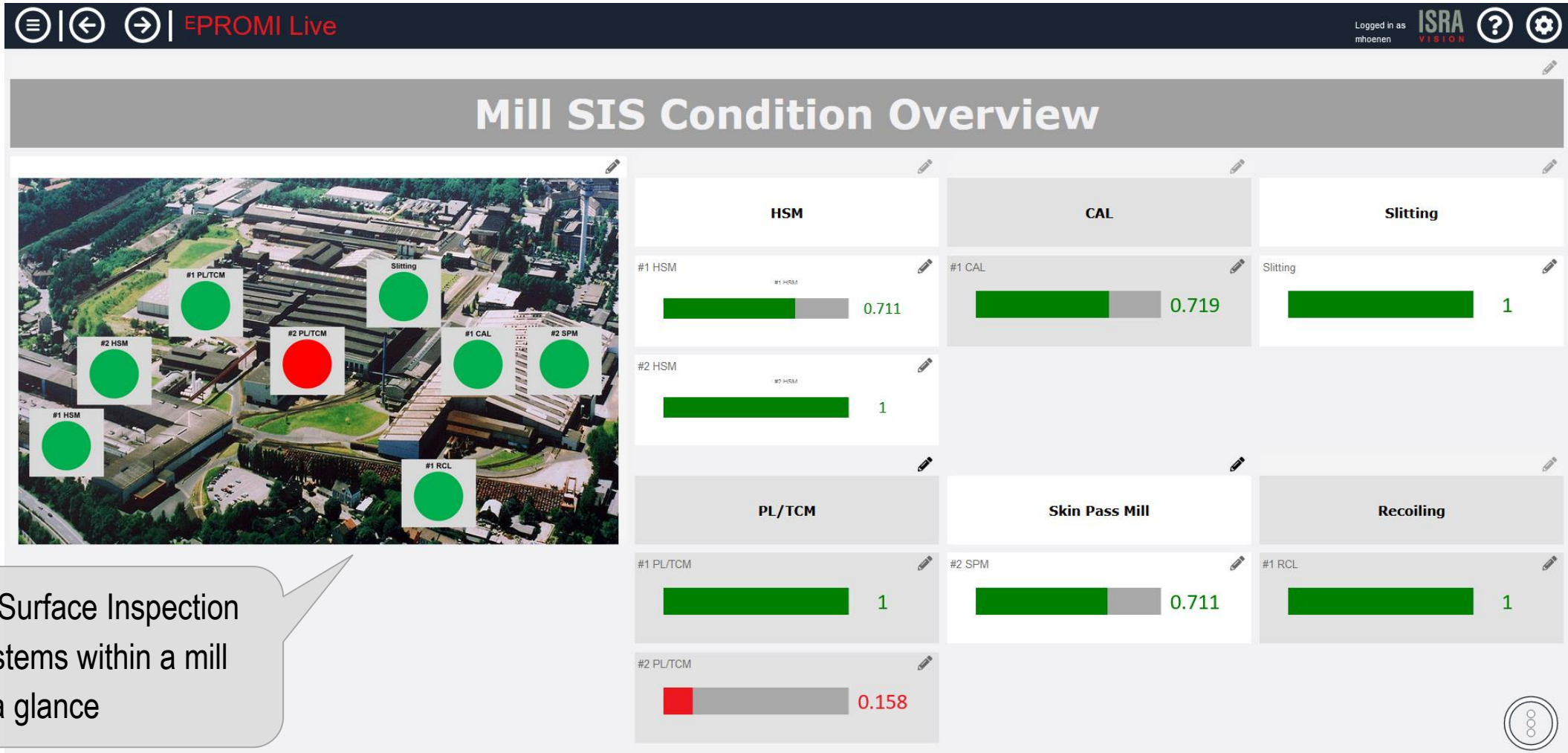
- Your Inspection System Health
 - Hardware
 - Image Acquisition (Illumination, Cameras)
 - Detection
 - Classification
- Your Produced Quality
 - Defect Class Statistics
 - Quality Decisions
- Mill-wide System State
 - All Production Lines on one Screen
- Access with any web-capable Device (PC, Smart Phone, Tablet, ...)





Sureness and uniqueness indicate how precise the classification is. The rate of non-classified defects show potential problems.

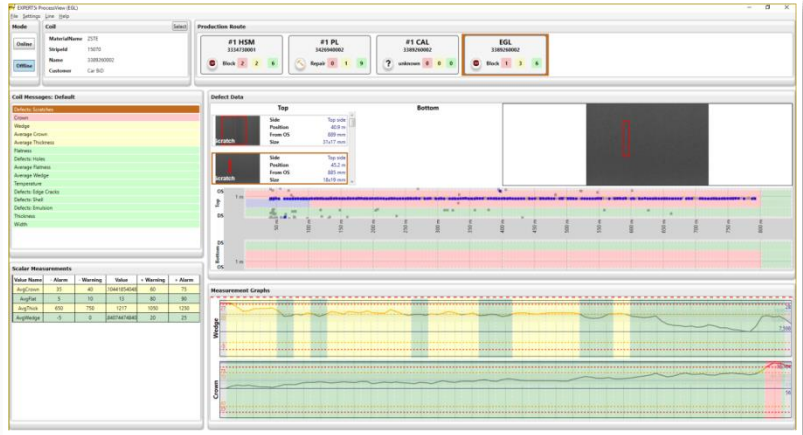
A deeper look at the classifier performance for certain material groups and defect classes. These and the amount of coils shown are selected here.



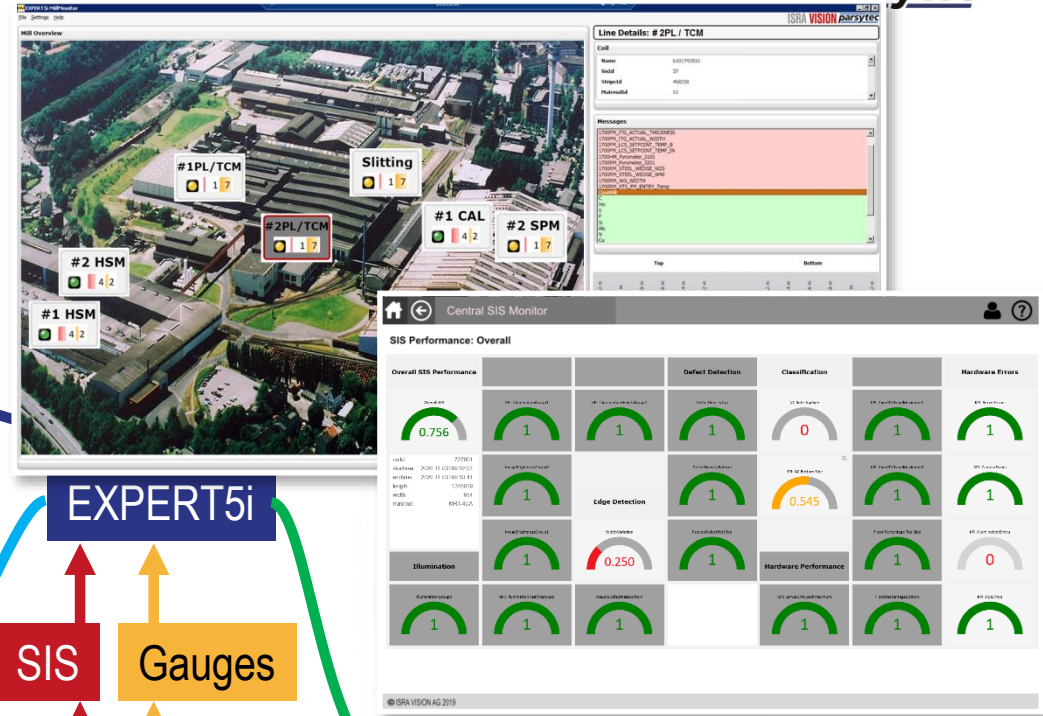
All Surface Inspection Systems within a mill at a glance

READY FOR SMART FACTORY

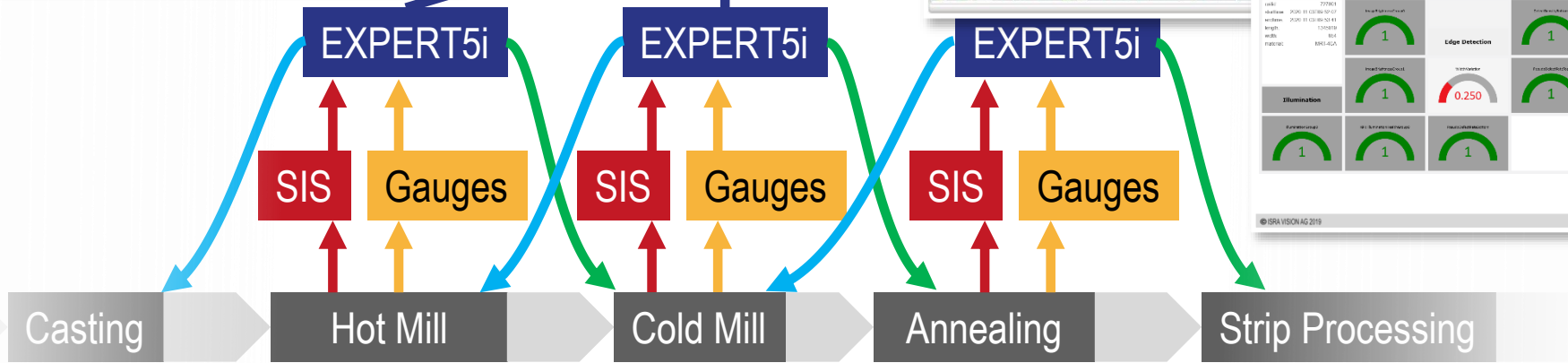
Process view



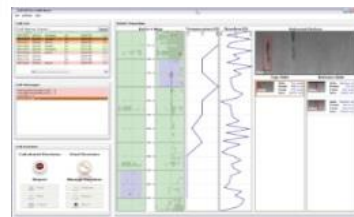
Mill monitor



Central Monitor



➔ Upstream decisions
➔ Downstream decisions



Coil release



Coil release



StructureAnalysis

THANK YOU



Fastest Cameras

Fastest Cameras

- Color & Monochrome
- Matrix Scan
- Line Scan
- Up to 16k

Brightest Illumination

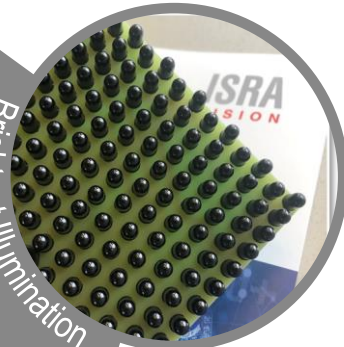
- Infrared, White, Blue, ...
- Line Illumination
- Matrix Illumination
- Smart



Robust Design

ISRA VISION

Brightest Illumination



Reliable Computing

- Specialized FPGAs
- Robust Detection
- Accurate Classification
- Deep Learning

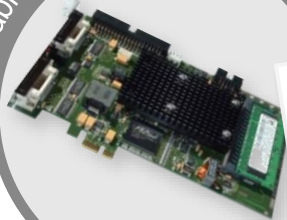
Sophisticated Software

- Smart GUIs
- Automatic Tuning
- Quality Management
- Industry 4.0 ready

Sophisticated Software



Reliable Computing



The right solution
for **YOUR** application

Robust Design

- For tough applications
- Easy to integrate
- Simple setup