



3D METROLOGY
CONFERENCE

2024 - Loughborough

VIOPRO – In-line geometric control of metal components in real time

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AUTOKVAL

CHALMERS
UNIVERSITY OF TECHNOLOGY

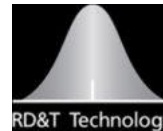
Gestamp

VINNOVA



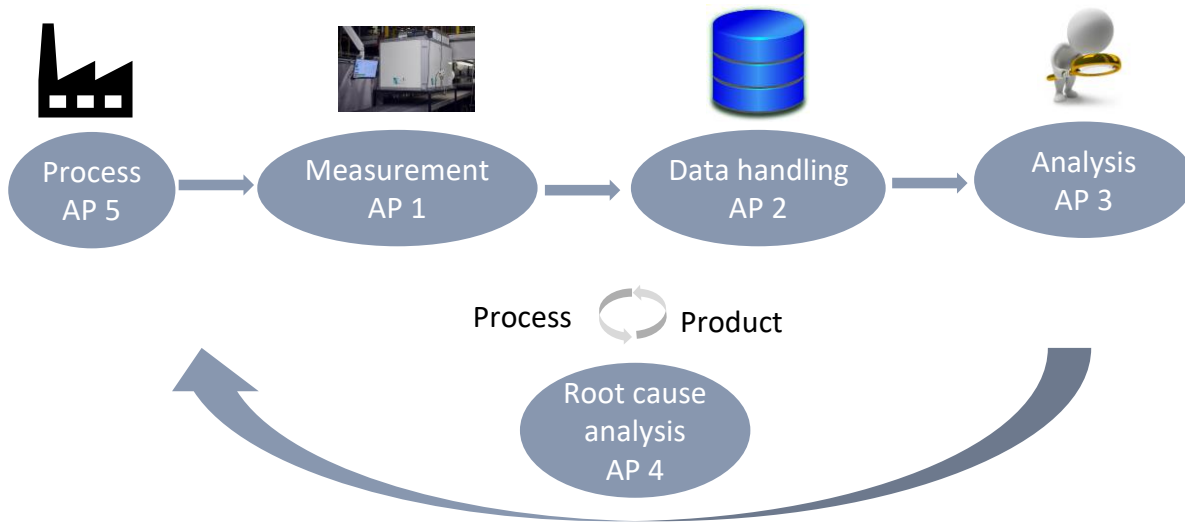
Fordonsstrategisk
Forskning och
Innovation

V O L V O

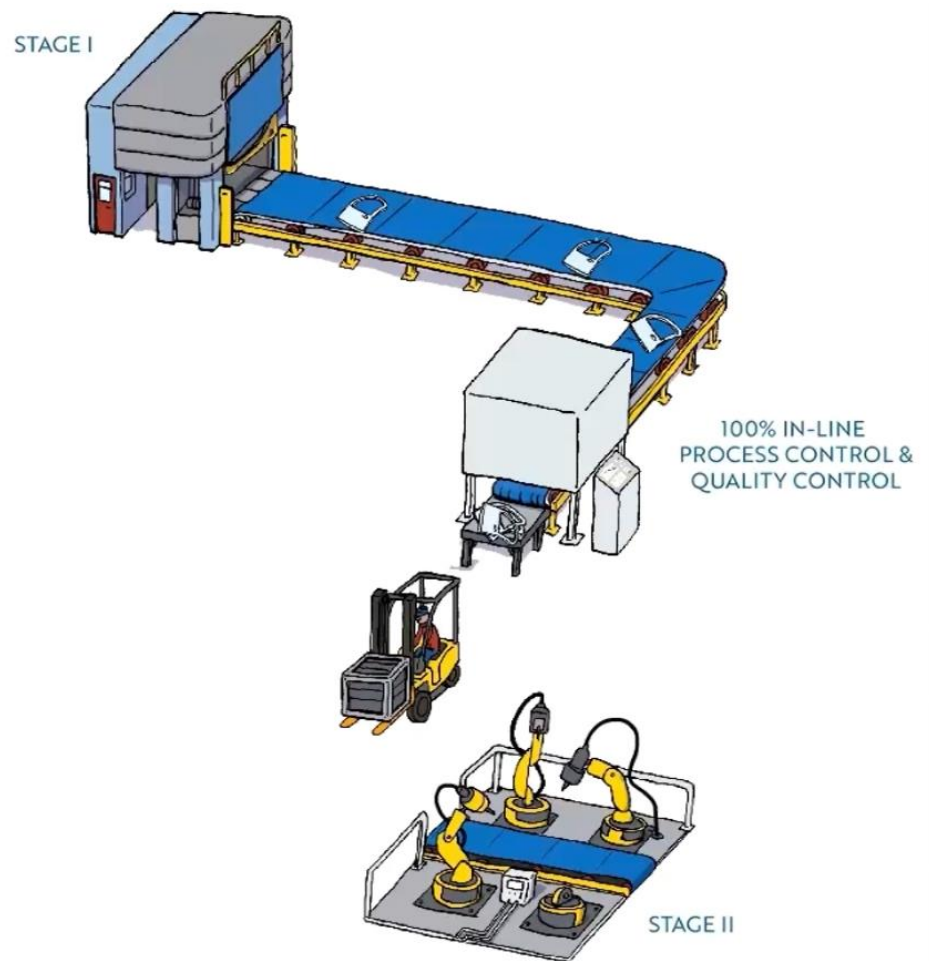
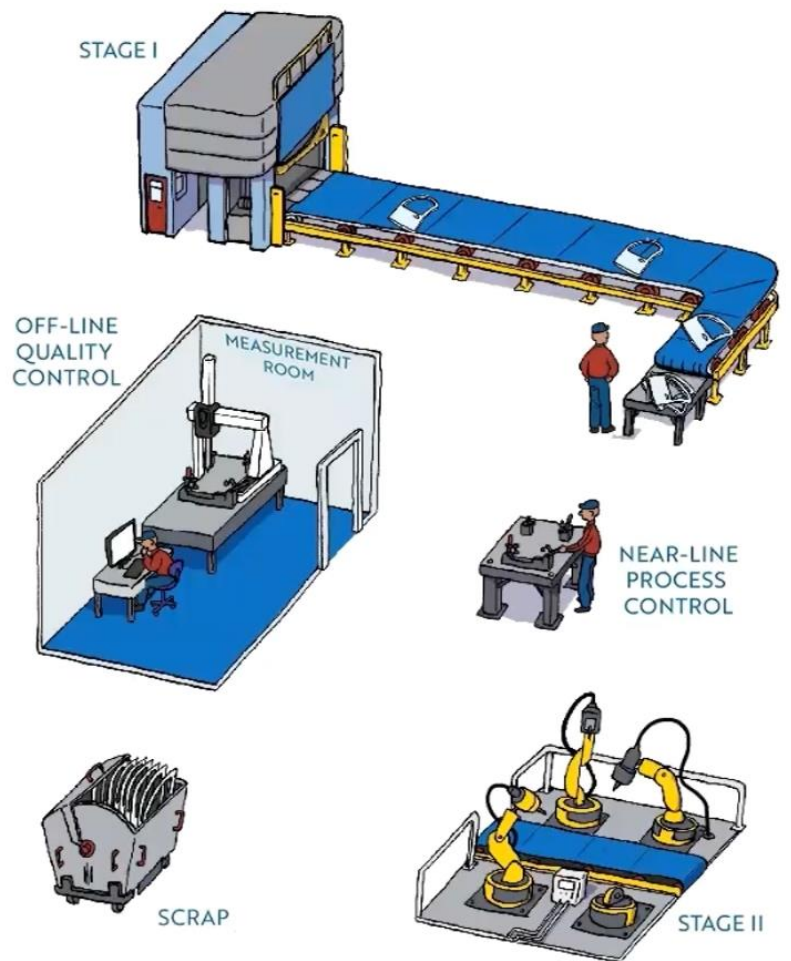


LIDHS
PROCESS FOR SOLUTIONS

Automatic quality assurance and root cause analysis in running production – AutoKval



- AP 0: Administration
- AP 1: Measurement system for moving flexible and rigid parts
- AP 2: Data handling - fast handling of large data sets (scanned parts – analysis - presentation for operator)
- AP 3: Analysis of geometry deviance for parts
 - Cold forming
 - Press hardening
- AP 4: Root Cause analysis – Connect process parameters to quality and learning to next project
- AP 5: Industrial test case
- AP 6: Communication of results



FIRST STAGE OF AUTOMOTIVE PRODUCTION

L2
459

L2
460



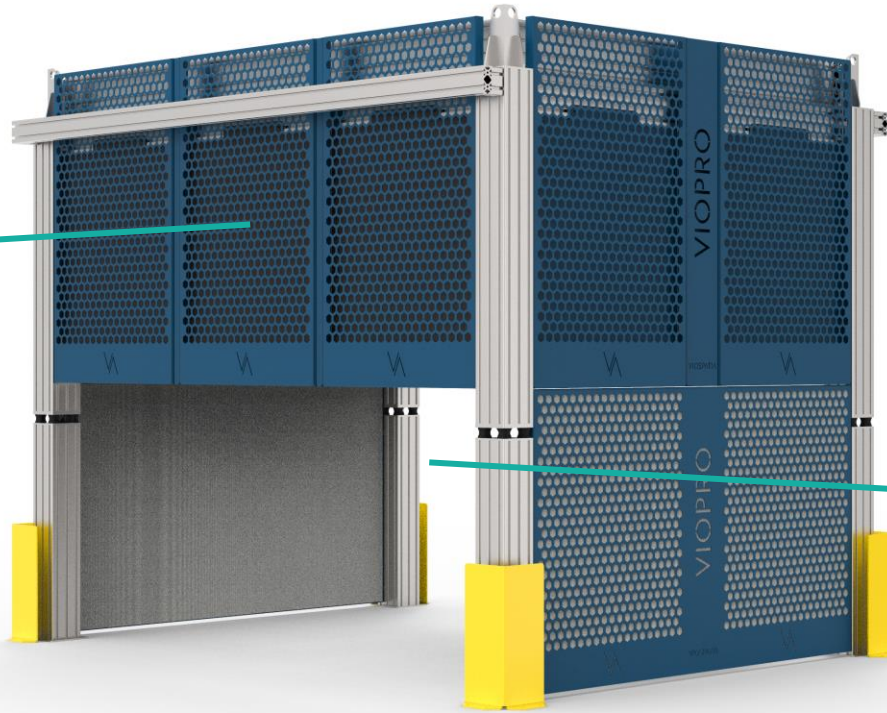
VIOPRO



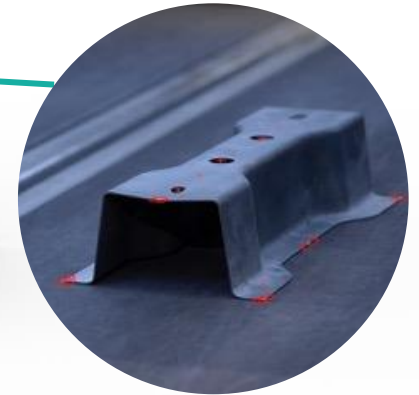
Viopro automatically inspects parts in 3D and matches them directly to their CAD models in real time

Designed for **expandability** and **flexibility**:

- **No** mechanical interaction needed
- Carbon-fibre construction for **stability**
- Industrial cameras for **durability**
- Aluminium profile construction for **scaleability**

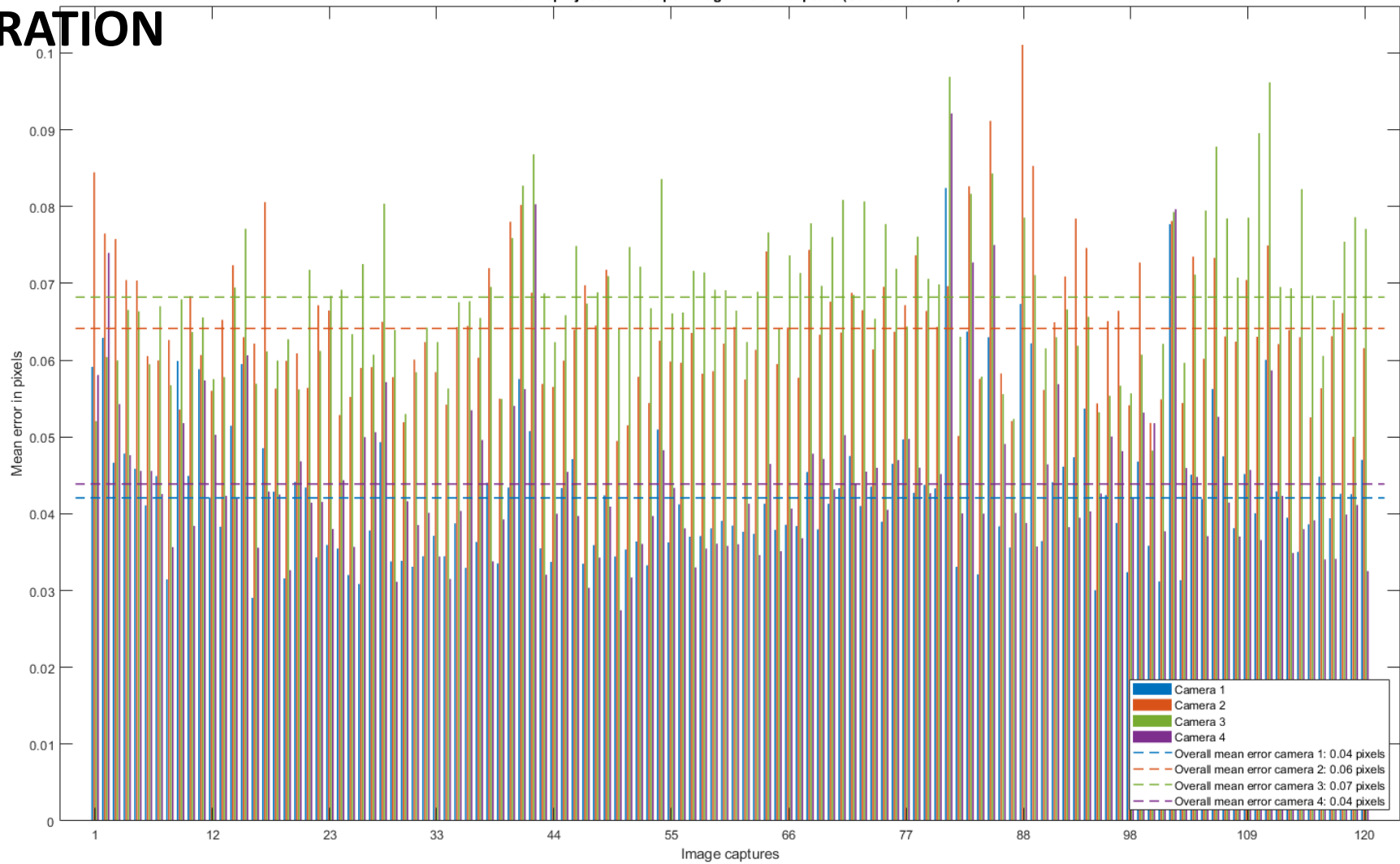


Our unique **high-speed image capture** can inspect moving components directly on production lines

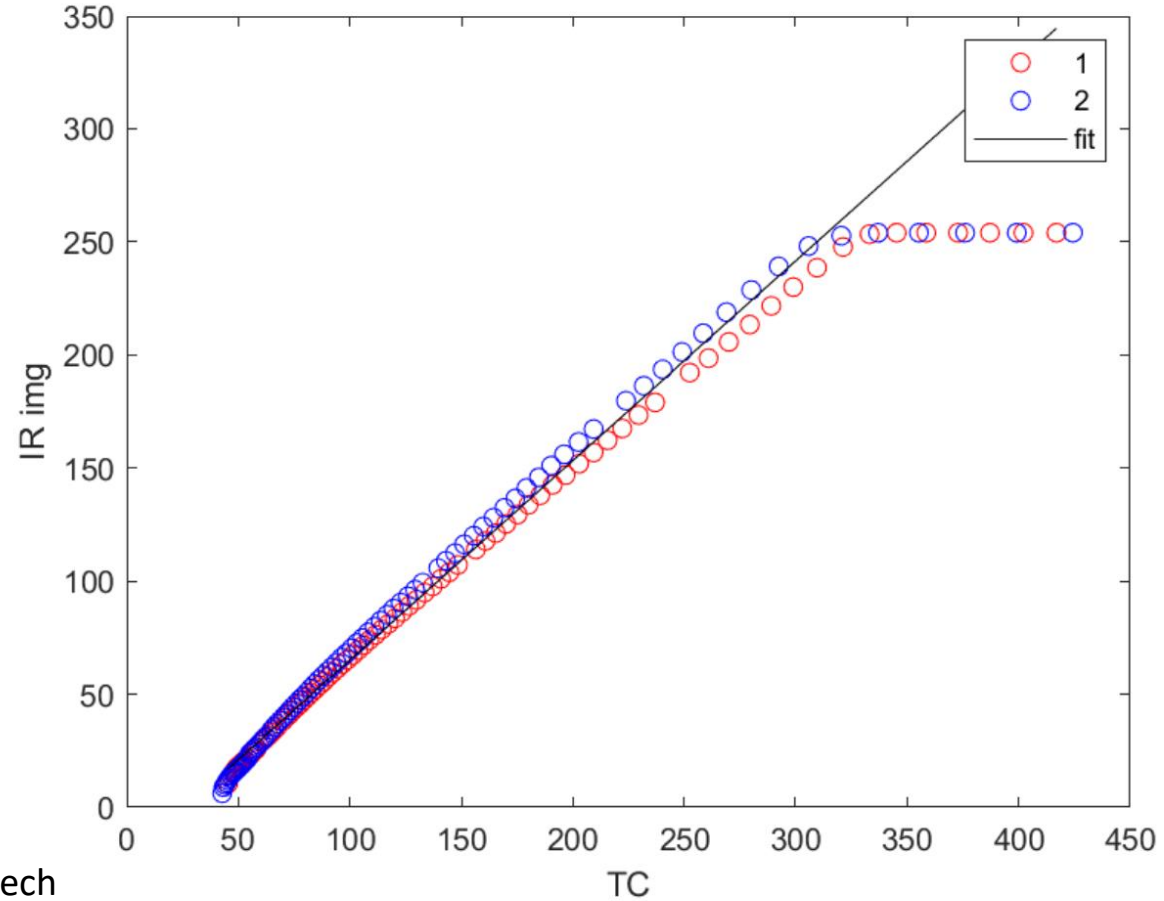
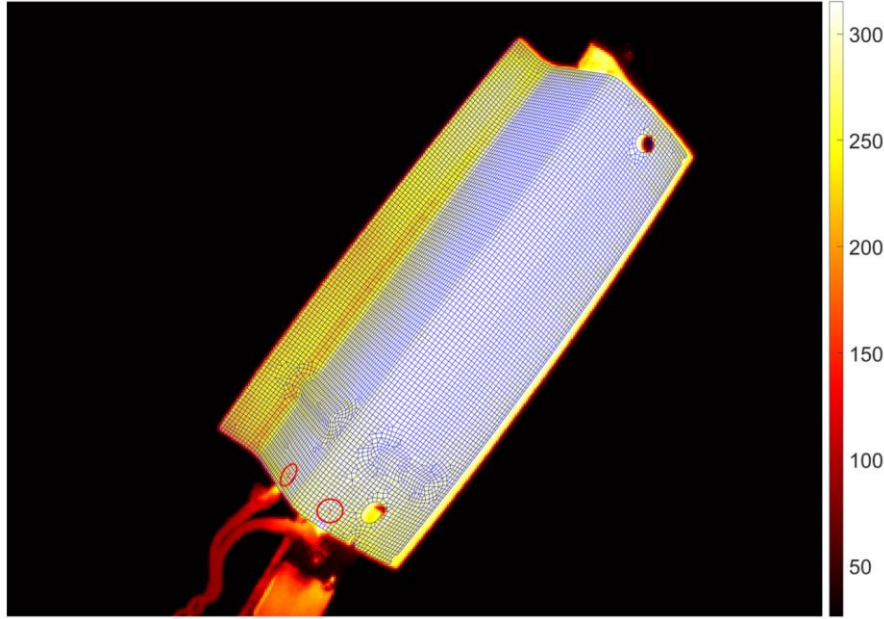


CALIBRATION

Mean reprojection error per image in each capture (Camera model 9)



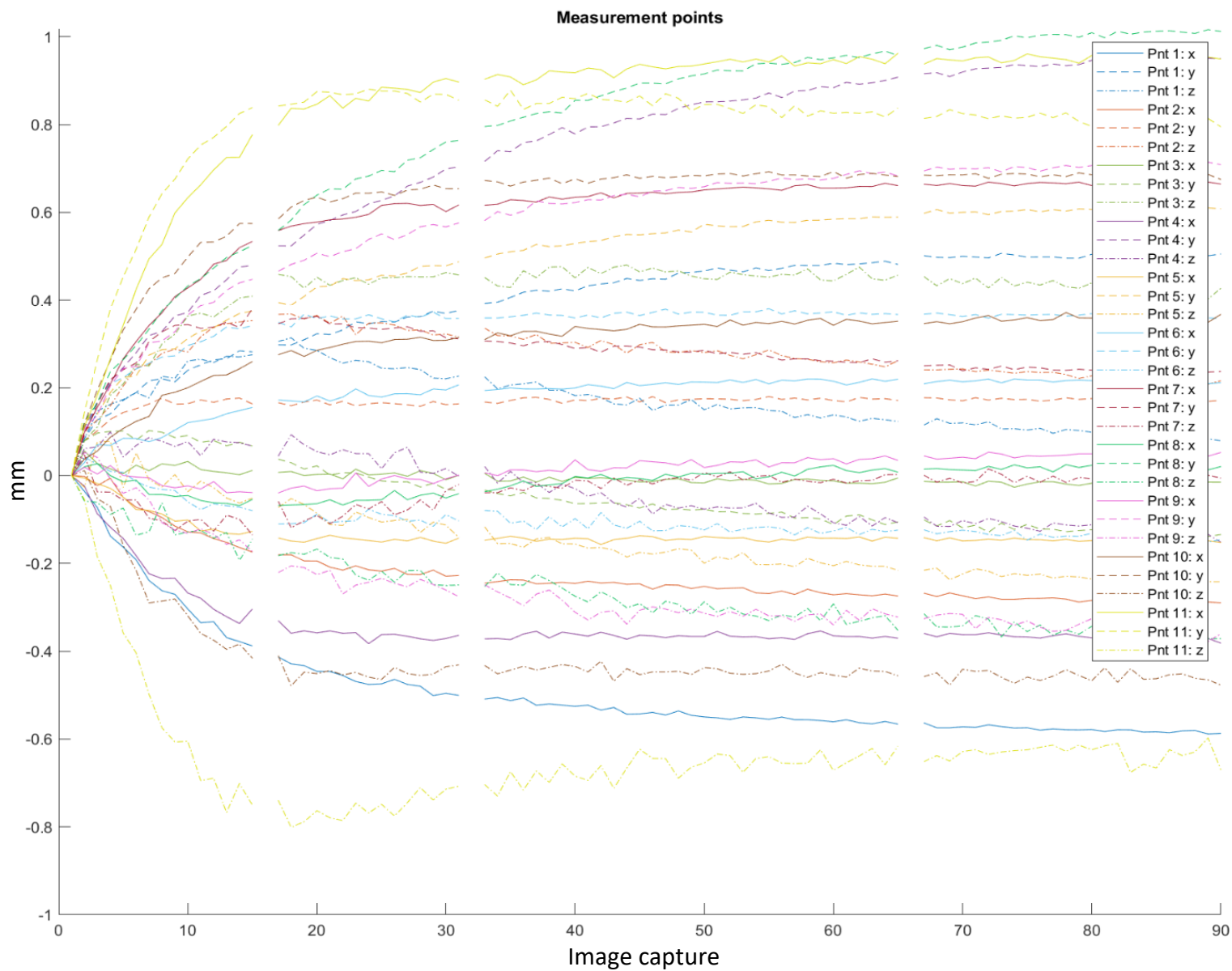
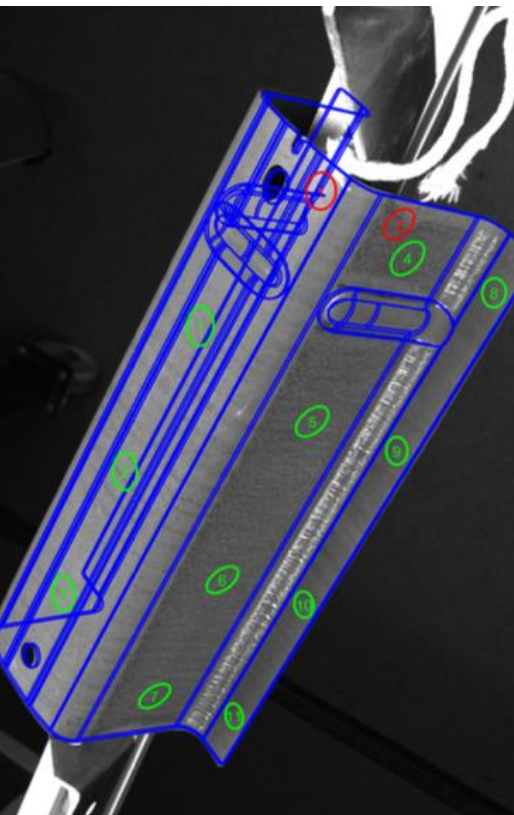
THERMAL MAPPING



IR temperature vs thermocouple temperature

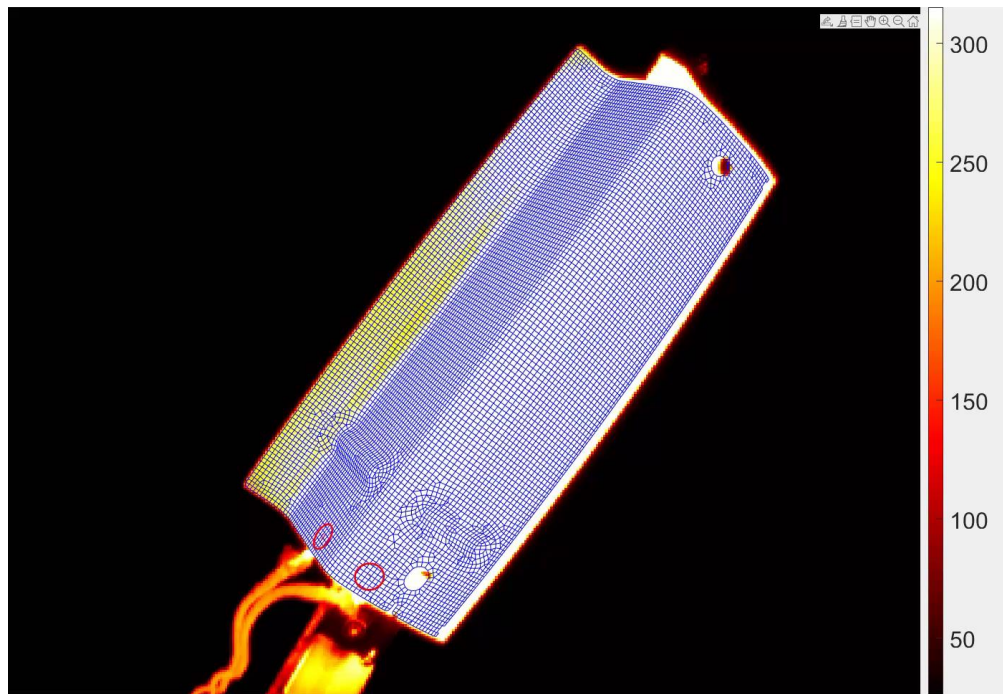
- Performed in the research line at Gestamp Hardtech
- Specially made tool
- Purposely made to cause twisting during cooling
- Component equipped with two thermocouples for calibration

RESULTS

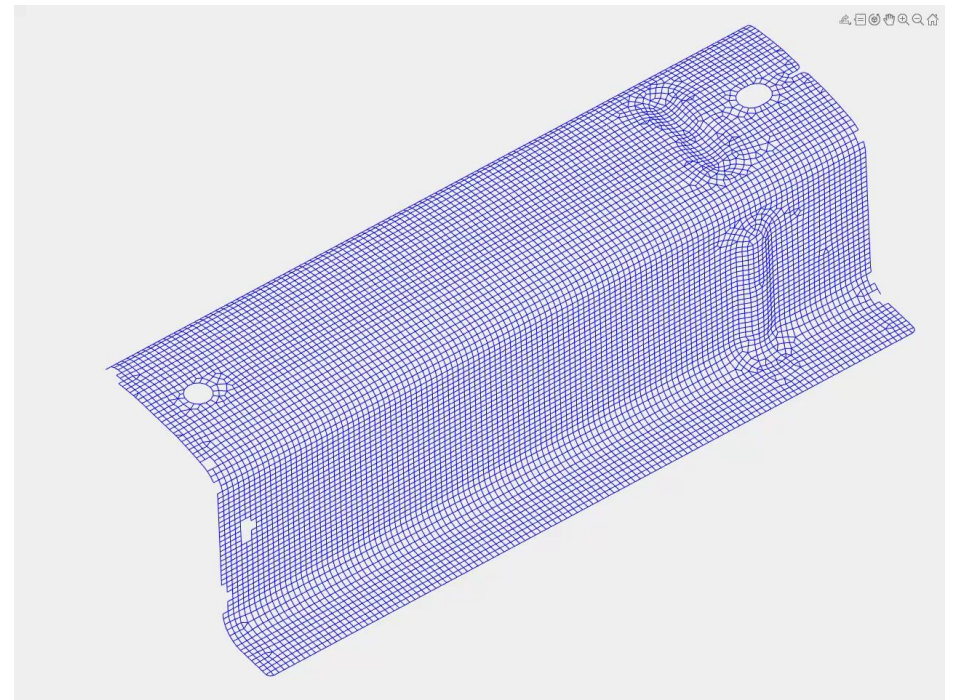


VISUALIZATION

Temperature evolution

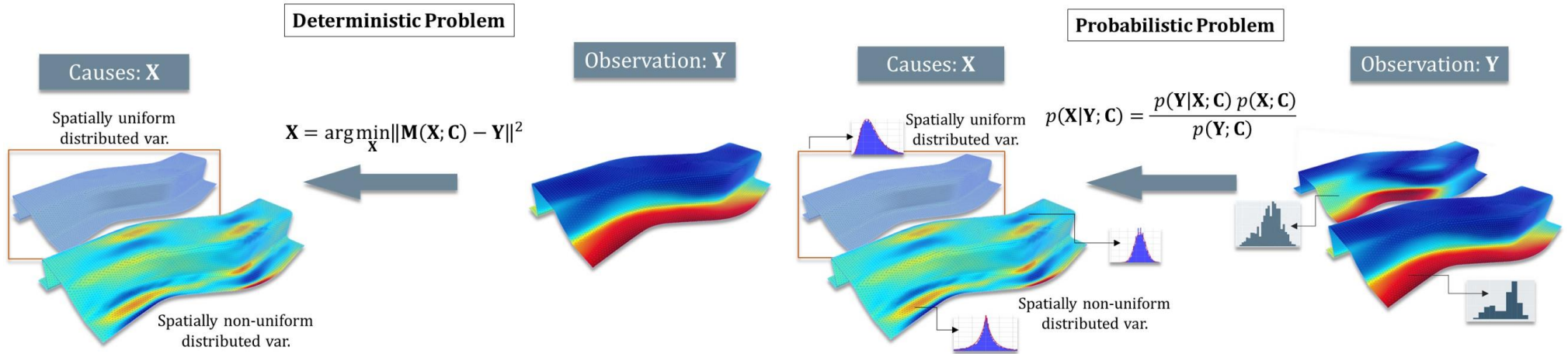
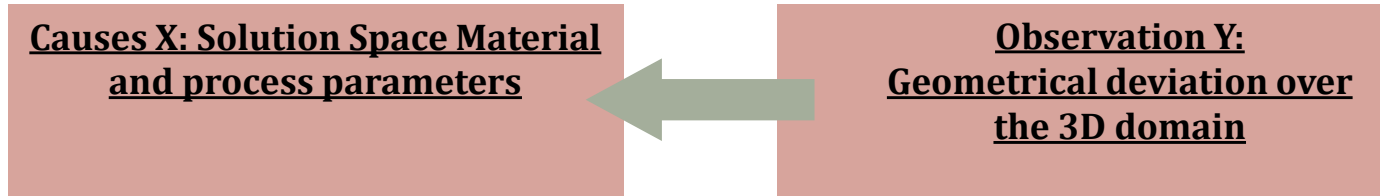


Deformation

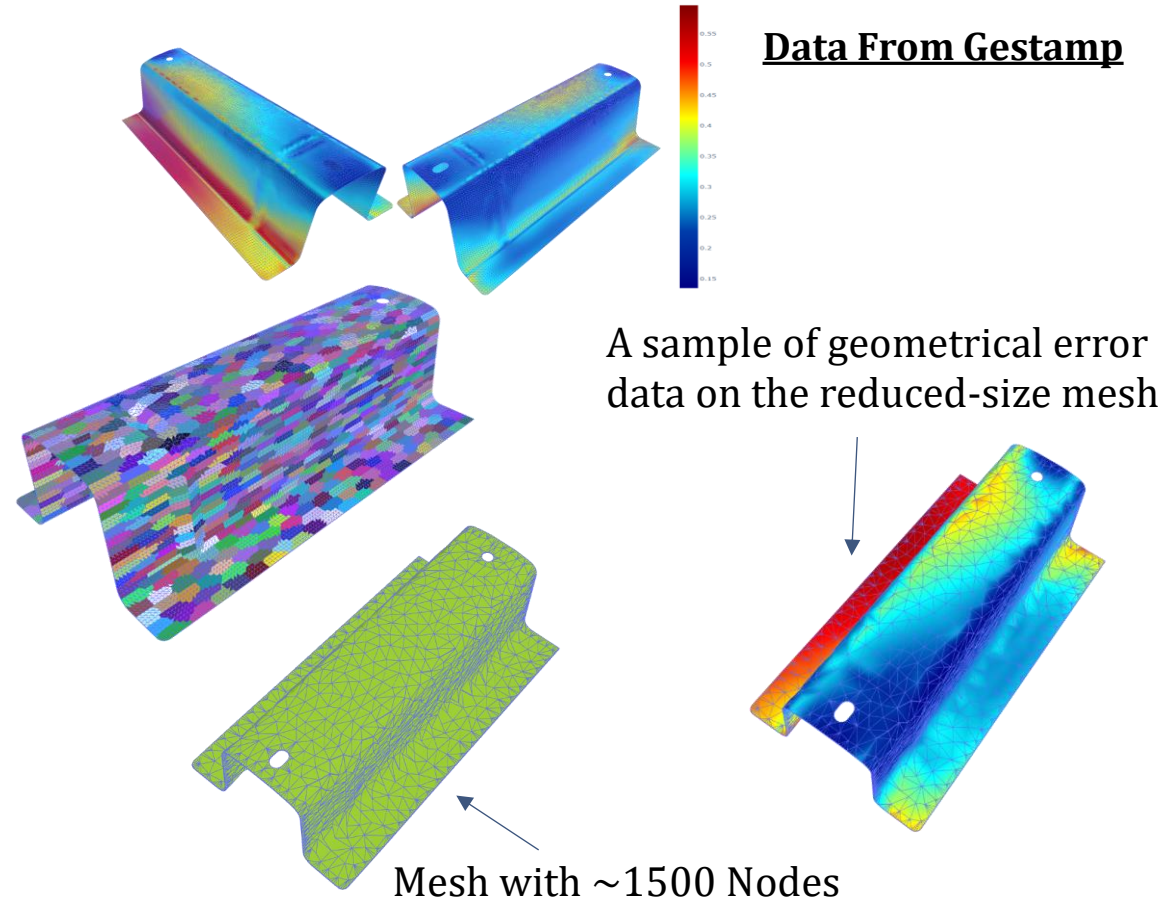
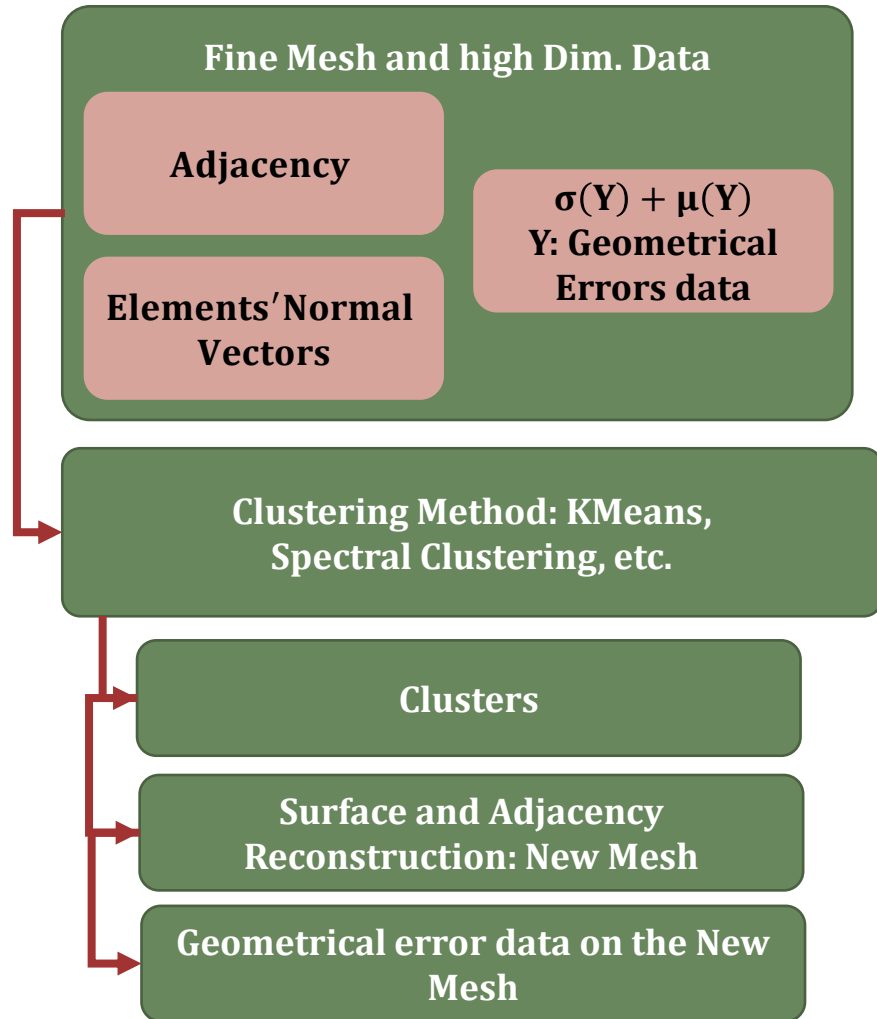


ROOT-CAUSE ANALYSIS

How can we leverage observed variations and deviations in final formed parts geometries to identify and quantify variations and deviations in key variables, such as material properties and process parameters, within a production process?



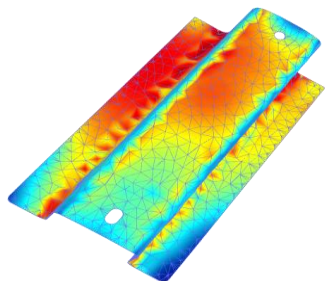
TESTING CURRENT MODEL ON AN SMF PROBLEM



PREDICTOR PERFORMANCE (PRELIMINARY RESULTS)

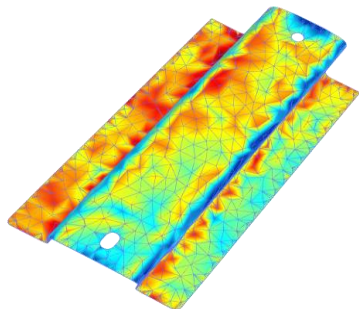
Original

417 : x1 : 0.00419999985024333 , x2 : 0.9151999950408936



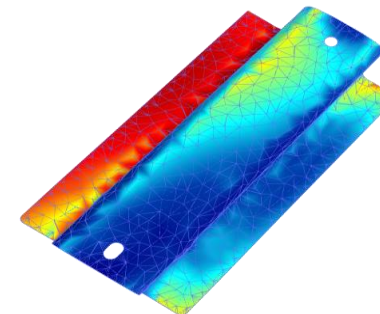
Flow

417 : x1 : 0.00419999985024333 , x2 : 0.9151999950408936



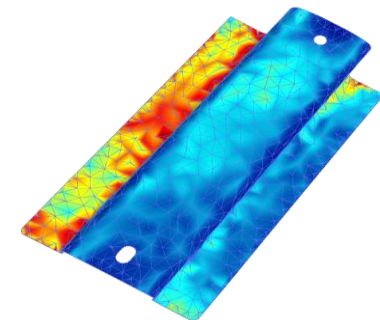
Original

442 : x1 : 0.8324999809265137 , x2 : 0.8683000206947327



Flow

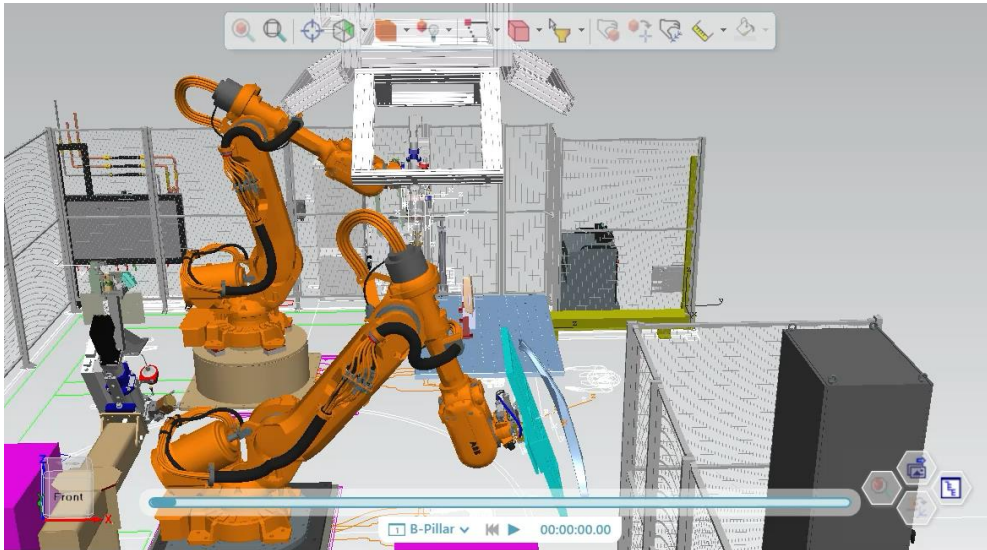
442 : x1 : 0.8324999809265137 , x2 : 0.8683000206947327

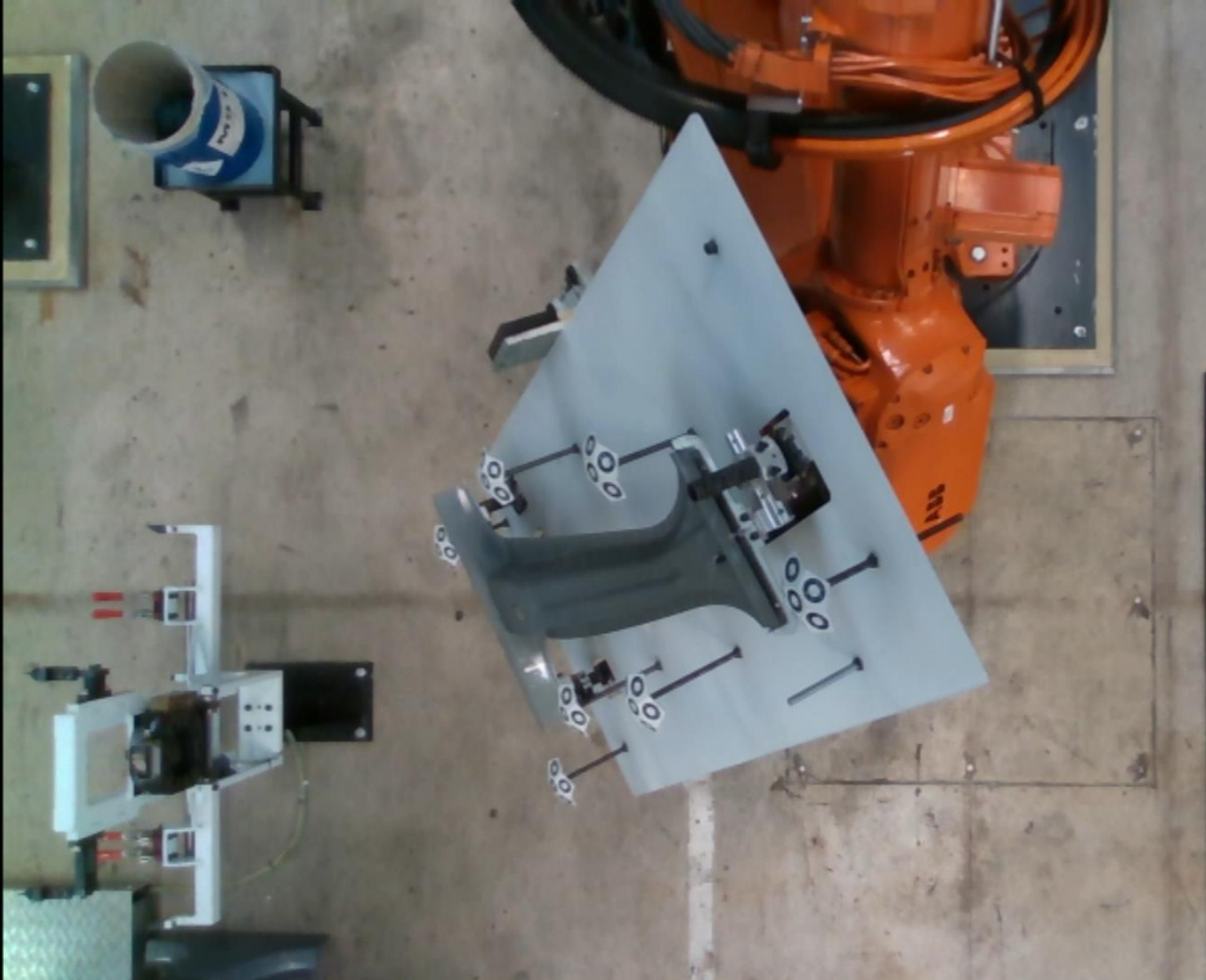


A large batch of simulations has recently completed, so new results are forthcoming

TEST CASE – ROBOT CELL

- Performed in robot cell in Olofström plant
- Gripper with coded targets for initial orientation
- Path optimized for geometry of component



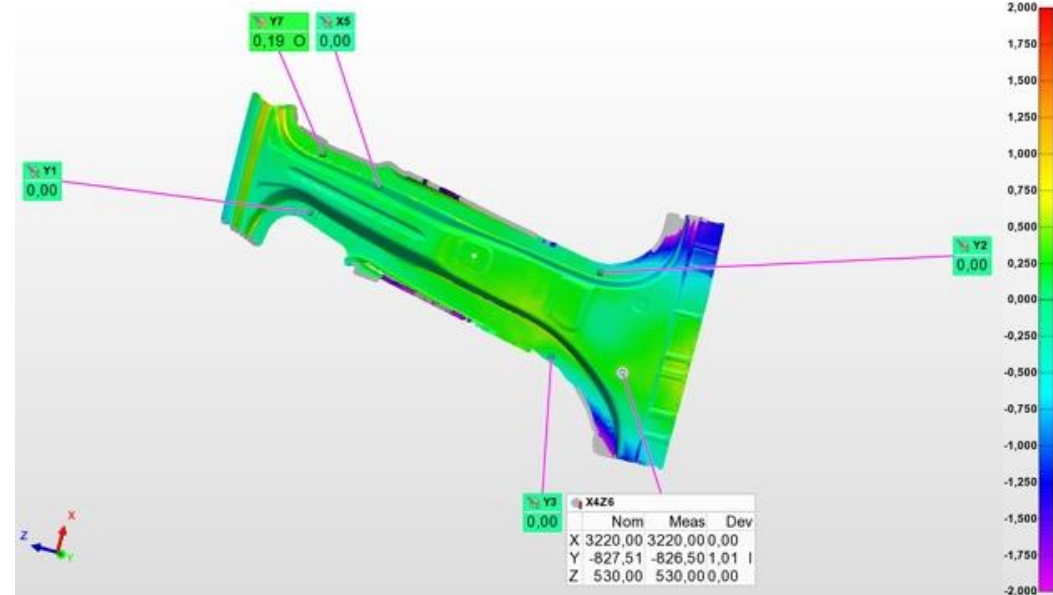


LARGE COMPONENT MEASUREMENT - STITCHING

Results from test with stitching with Viopro



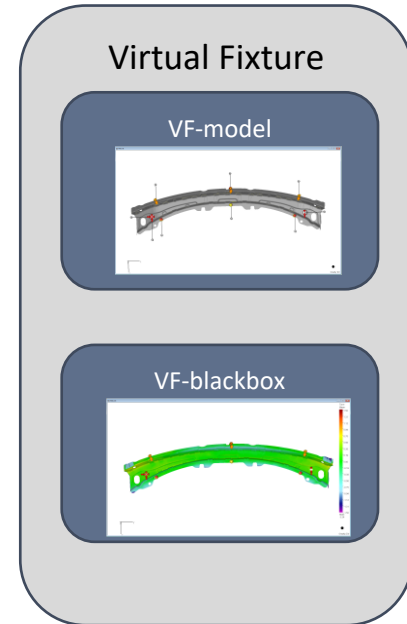
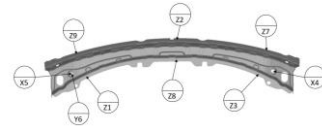
Results from scanning at VCBC 220118



Note: Scale is reversed between the pictures (red in Viopro corresponds to blue in scanning VCBC)

VIRTUAL FIXTURE – DIGI-Q

- No need of measurement fixtures
- Saves TIME & money
- A sustainable solution that can be used internally by VCC and also by their suppliers

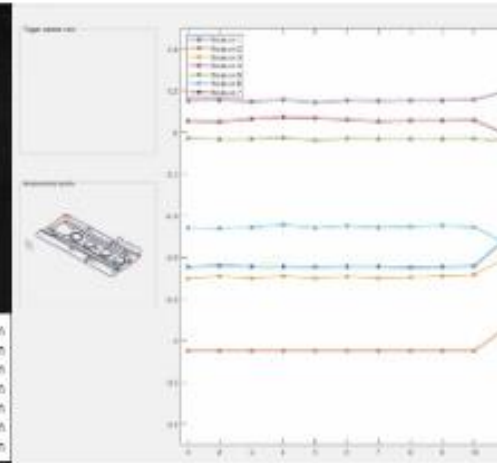
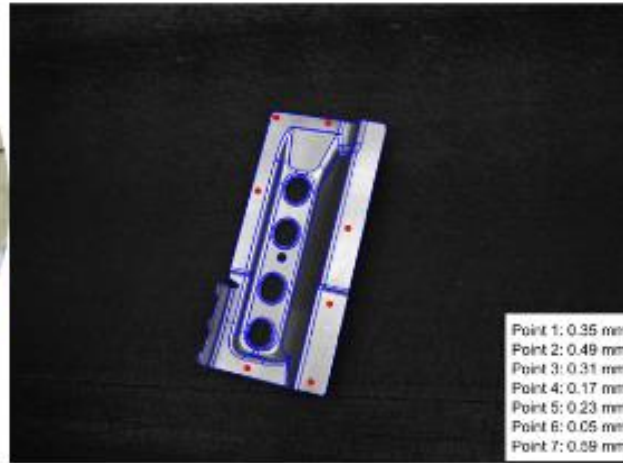


TEST CASE - IN-LINE



Performance

- System can capture and analyse moving parts (30 parts min)
- Measurement volume – 0,5x0,5m²



CONCLUSIONS

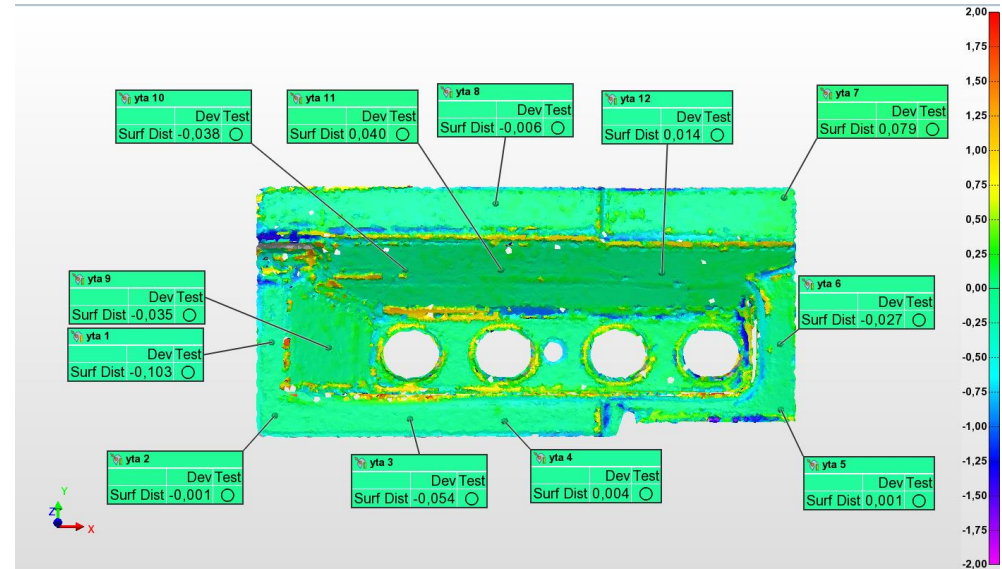
No control fixtures necessary

- No investments
- No space required for storage
- No maintenance required
- No lead time for logistic handling of fixtures

In-line measurements

- Control of all parts – decrease scrap, rework, lead time for error tracing, energy consumption, material consumption
- No manual handling (measurement, logistic to off line control stn etc)
- Independent of part position. Alignment based on part references – minimum demands on process for positioning of parts for verification
- Full scanning of parts give input to digital twin (assembly analysis). Today scanning of sample test is required as input.
- No manual handling of parts → ergonomiy improvements
- Direct process feedback enables fast response time for process/product disturbances
- Enabler for automatic process control which can react on process variations
- Enabler for “industry 5.0”

Comparison between scanned and measured part



PROJECT PARTICIPANTS

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