Zwick / Roell

Intelligent Testing

Simply see more:
ZwickRoell 2D DIC

testXpo 2021

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Your lecturer

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Product Management

ZwickRoell in Ulm, Germany

- @ZwickRoell since 1998
- Product Manager for extensometers (contact & non-contact)
- Product Manager for testing systems for metal industry (series division)

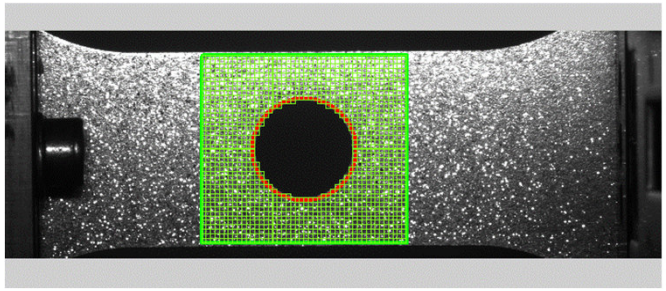
Agenda

- **What is DIC?**
- **2D DIC vs. 3D DIC**
- **2D DIC: applications, functions, ..**
- **2D DIC factory calibration**
- **Customer Value proposition**
- **Video presentation of 2D DIC**

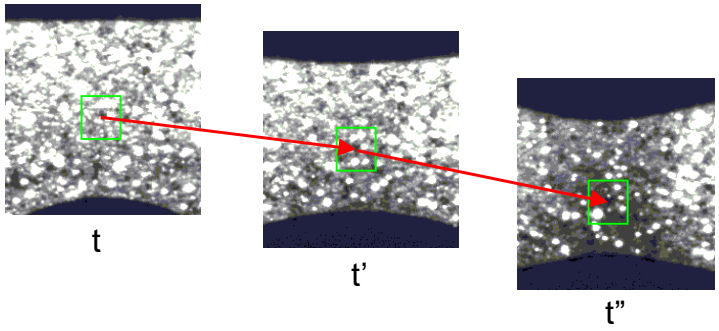
DIC Overview

How are strain maps generated?

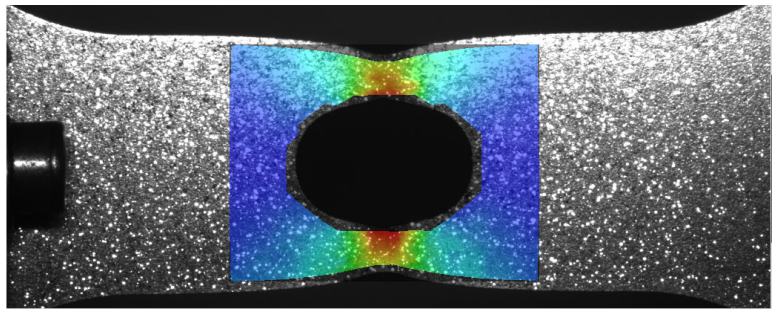
- Define small regions = facets



- Pictures are generated, stored and evaluated
- X- and Y-displacements of facets are calculated by image-to-image comparison using a correlation algorithm
- Displacement values of a multitude of facets are calculated and then the local strains εx, εy, εxy are calculated



- Color values were assigned to the strain values. strain map and strain results are calculated and displayed

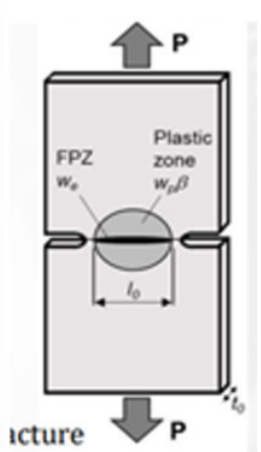


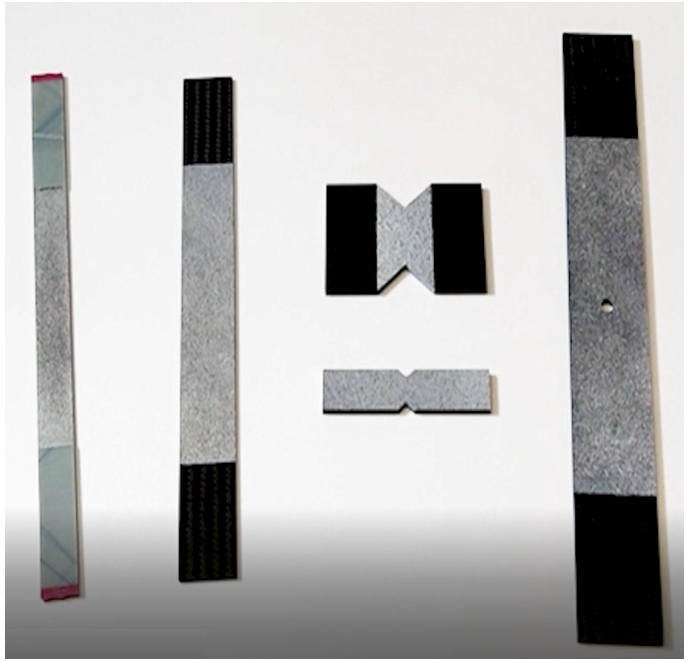
- Stress strain curve are calculated by test re-run

2D DIC vs. 3D DIC Applications and Limitations

2D DIC is essentially used on flat specimens with sprayed on patterns, such as metals, stiff plastics and composites, carried out with videoXtens systems

3D DIC is used for component testing with spatial strain (3 dimensional)





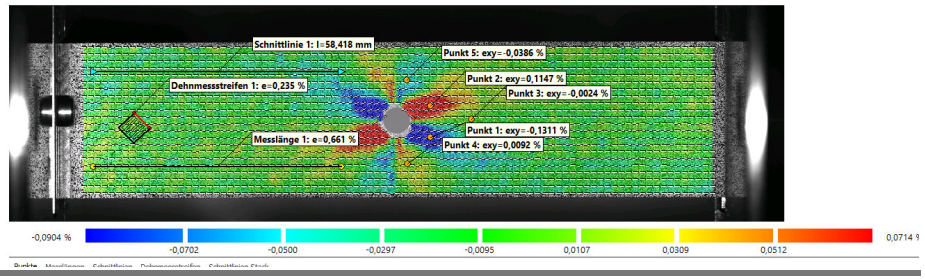
Applications for 2D DIC

Some application examples for 2D DIC on flat specimens

- Tensile specimens & notched tensile specimens/punched specimens: Determination of stress-strain curves (true, technical)
- Strains via virtual strain gauge and virtual gauge length
- Local strain via cutting line and point measurements
- Smiley specimen: Determination of local shear strains through virtual strain gauges
- FE (finite element) model validation: Comparison of the displacement and strain field through the FE simulation

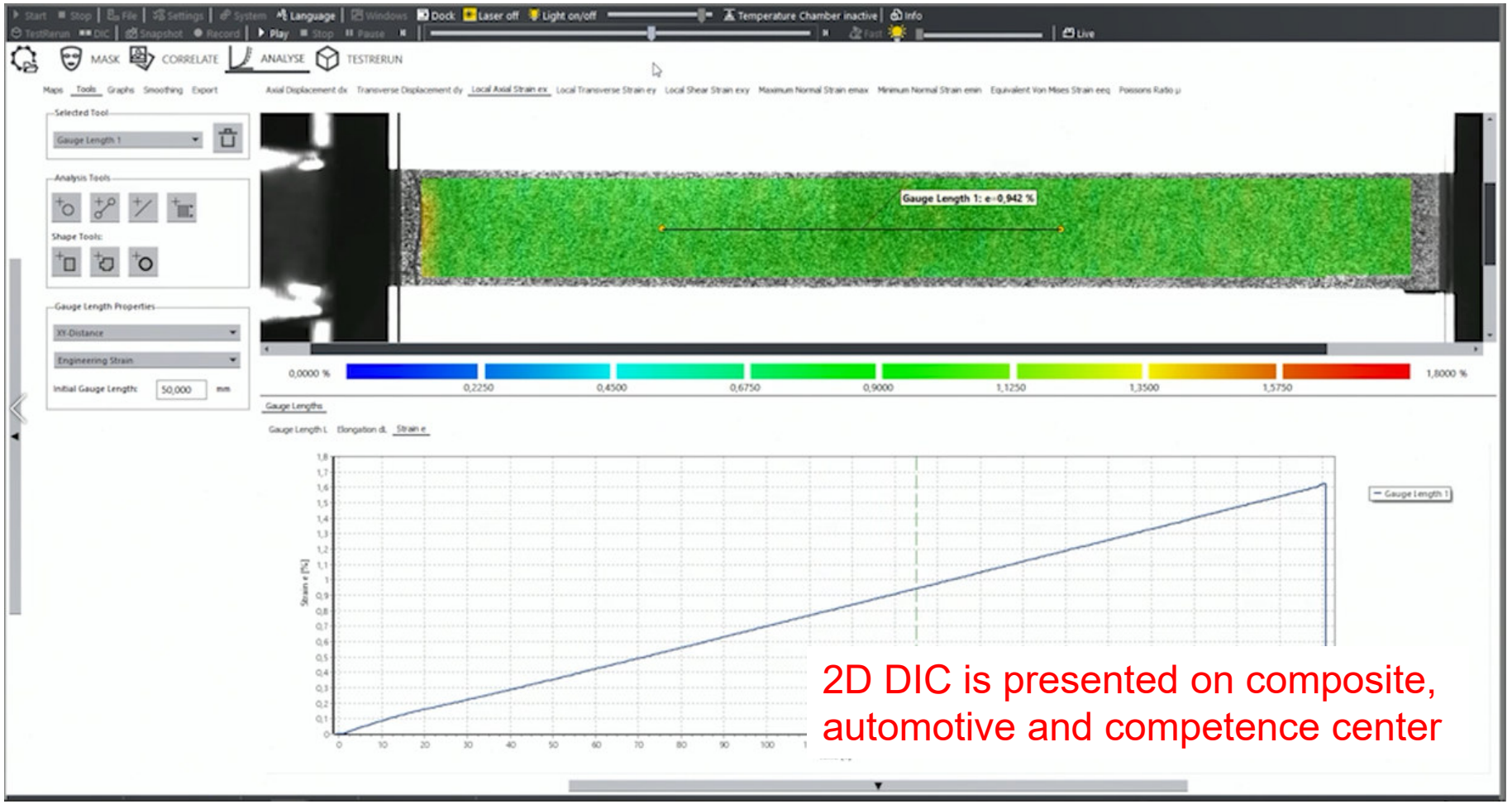
Test methods applied:

- Tensile test to ISO 6892-1, ISO 527-1, ISO 527-4,-5 and ASTM D3039
- In-plane shear test to ISO 14129 and ASTM D3518
- Shear test with notched specimens to ASTM D5379 and ASTM D7078
- Open-hole tensile (OHT) test to ASTM D5766



2D DIC software

The 2D DIC software is fully integrated in testXpert III, with clear workflow and intuitive operation.



2D DIC Functions

ZR provides added value for the 2D DIC user in all aspects. Maps, measured values & diagrams are linked.

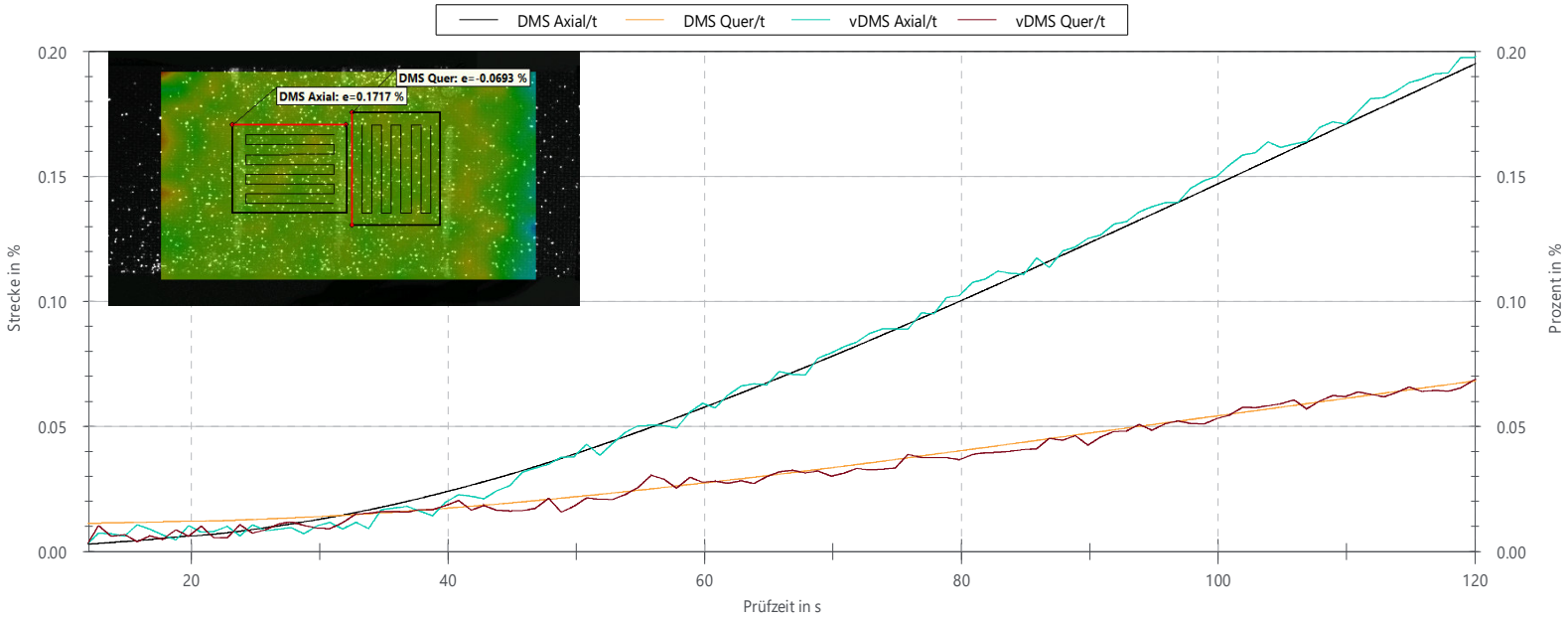
ZwickRoell:

- Analysis tools:
  - Point
  - Virtual gauge length
  - Virtual strain gauge
  - Cutting line
- Maps:
  - x, y displacements
  - x, y strain, shear strain, normal strain
  - Poisson's ratio
  - Equivalent Von Mises strain
- Presentations in the maps:
  - Overlay/superimpose of the raw images
  - Overlay of measuring point grids
  - Overlay of main strain directions
  - Configurable color settings
- Diagrams:
  - Point strain (temporal progression)
  - Virtual gauge length (temporal progression)
  - Virtual strain gauge (temporal progression)
  - Cutting line
  - Cutting line stack (temporal progression, plotted on top of each other)

2D DIC: Virtual Strain Gauge vs. Physical Strain Gauge

Is a virtual strain gauge comparable to a physical strain gauge?

- A specimen with a physical (adhered) strain gauge on one side, and a virtual strain gauge on the other was tested in tensile direction and the strain signals were recorded.
- ➢ The strain signals for both strain gauges (adhered and virtual) indicate a good level of consistency in axial and transverse direction.



Source ZRF: Strain gauge type: 1-XY 1x-6/120; size: 6 x 6.5 mm²; Uncertainty, mainly due to noise: ±70με

Source: ZRF - Mr. Winkelmayer from 2D DIC Basic Training

2D DIC Calibration

For the 2D DIC option we offer factory calibration in combination with a DAkkS calibration of the basic functionality of the extensometer.

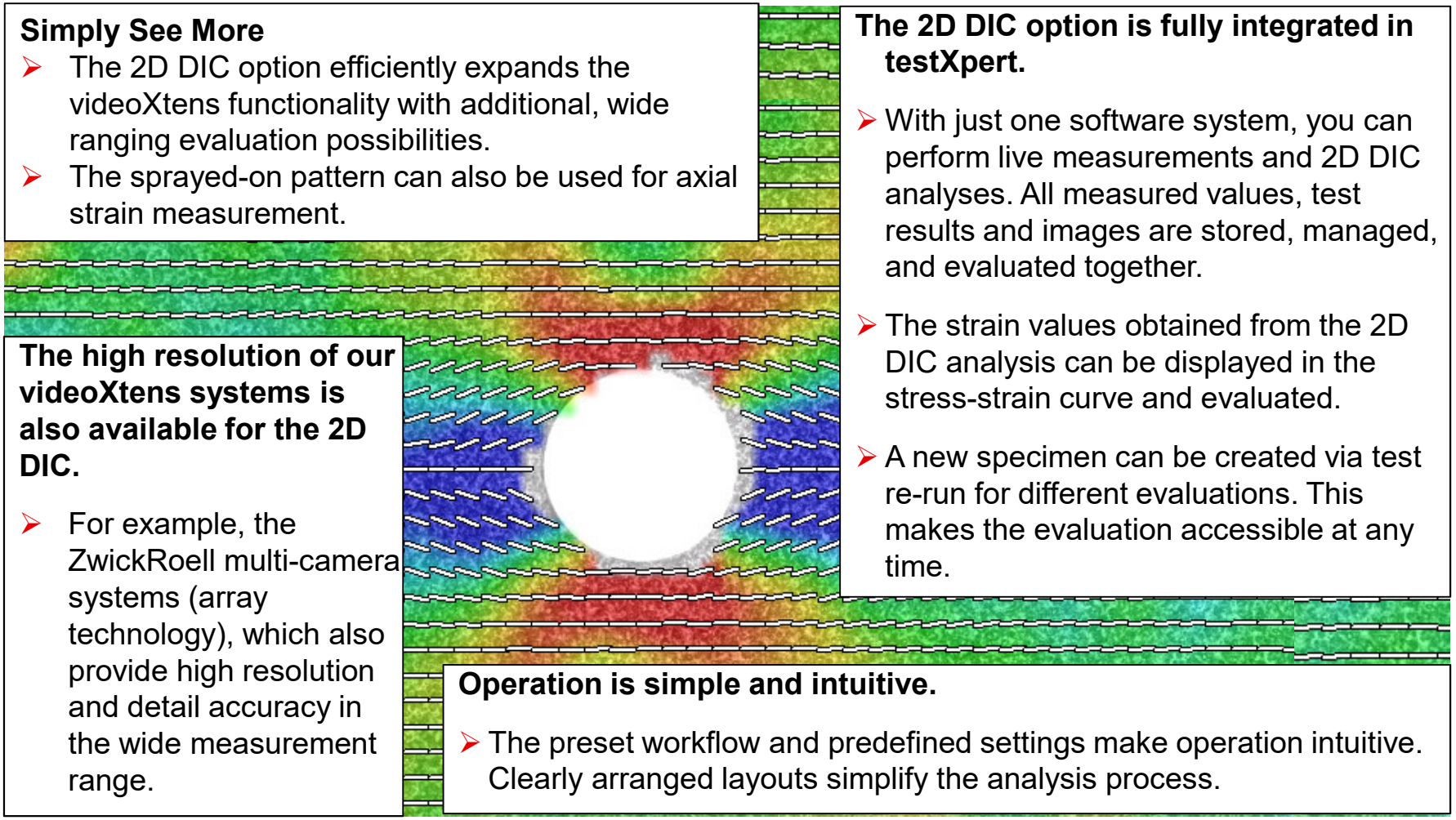
- Currently there is no set of rules and no traceable standard for the calibration of image correlation methods
- We offer factory calibration in accordance with DIN EN ISO 9513 and VDI/VDE 2626 for the verification of distribution data for virtual gauge lengths and virtual strain gauges in axial and lateral direction:
  - Calibration of the 2D DIC can be combined with the calibration of the extensometer: During calibration of the extensometer, the 2D DIC image series is also recorded and subsequently evaluated.
  - The displacement deviation is determined according to our standard calibration method for extensometers to DIN EN ISO 9513 for virtual strain gauges and accordingly for virtual strain gauges.

CVP Slide I

The 2D DIC option is a powerful analysis tool.

Simply See More

- The 2D DIC option efficiently expands the videoXtens functionality with additional, wide ranging evaluation possibilities.
- The sprayed-on pattern can also be used for axial strain measurement.



The high resolution of our videoXtens systems is also available for the 2D DIC.

- For example, the ZwickRoell multi-camera systems (array technology), which also provide high resolution and detail accuracy in the wide measurement range.

The 2D DIC option is fully integrated in testXpert.

- With just one software system, you can perform live measurements and 2D DIC analyses. All measured values, test results and images are stored, managed, and evaluated together.
- The strain values obtained from the 2D DIC analysis can be displayed in the stress-strain curve and evaluated.
- A new specimen can be created via test re-run for different evaluations. This makes the evaluation accessible at any time.

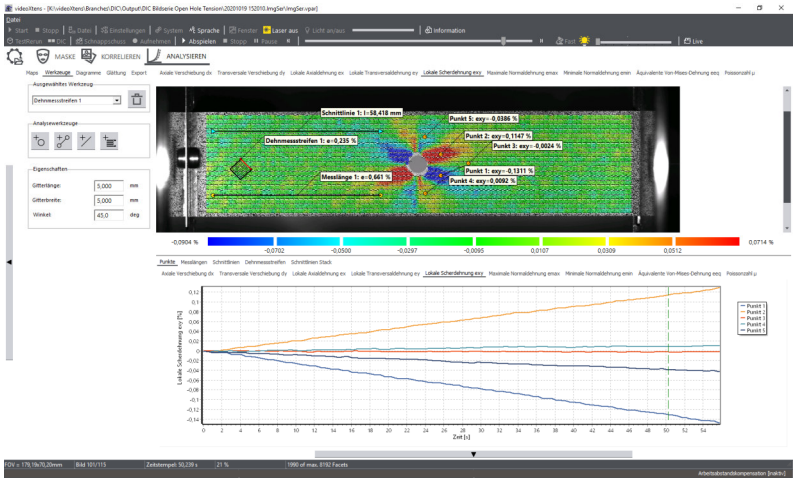
Operation is simple and intuitive.

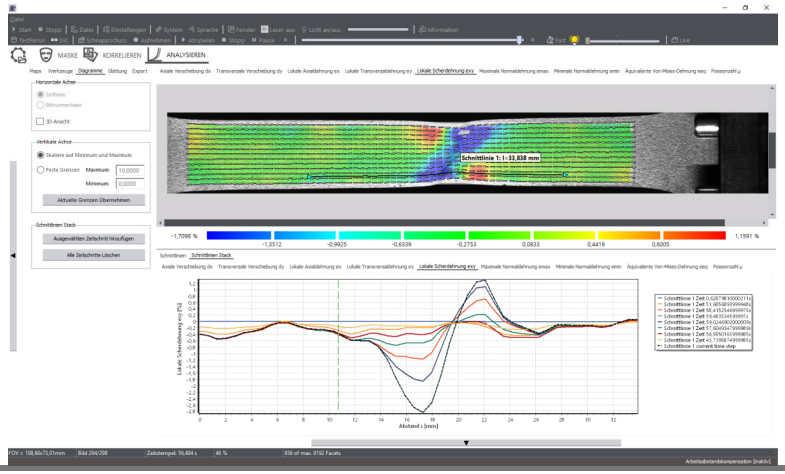
- The preset workflow and predefined settings make operation intuitive. Clearly arranged layouts simplify the analysis process.

CVP Slide II

The analysis tools of the 2D DIC option provide special functions and possibilities.

- The corresponding diagrams are simultaneously displayed by clicking on the analysis tool.
- Vector maps show the main strain directions.
- The cutting line analysis tool deforms analogously to the specimen and its development over time can be displayed.
- Virtual strain gauges are flexible and cost effective. They can be moved, their size and angle can be adjusted, and they can be placed on top of each other.





Thank you for your attention!