Zwick Roell

Intelligent Testing

Digital Image Correlation With videoXtens und laserXtens

Coloured Mapping Of Strain And Deformation

testXpo 2017

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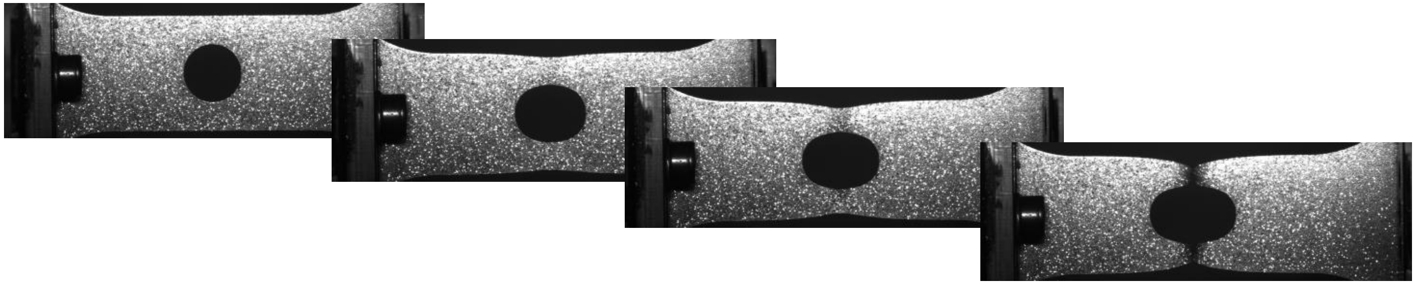
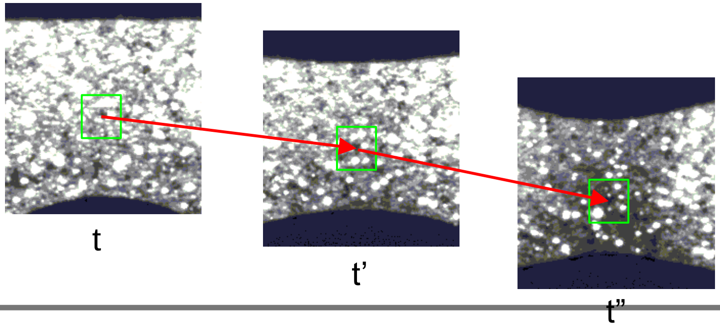
What is Digital Image Correlation?

- Digital Image Correlation (short: DIC) is an optical non-contacting method to measure full-field deformations on the surface of a specimen.
- During testing a digital camera captures a series of images of a specimen which has been marked with fine-grained pattern.

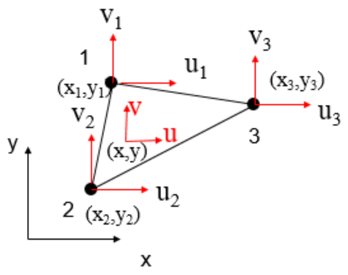


- Image by image the X- and Y-displacements of small regions ("facets") are obtained by the so-called correlation algorithm.

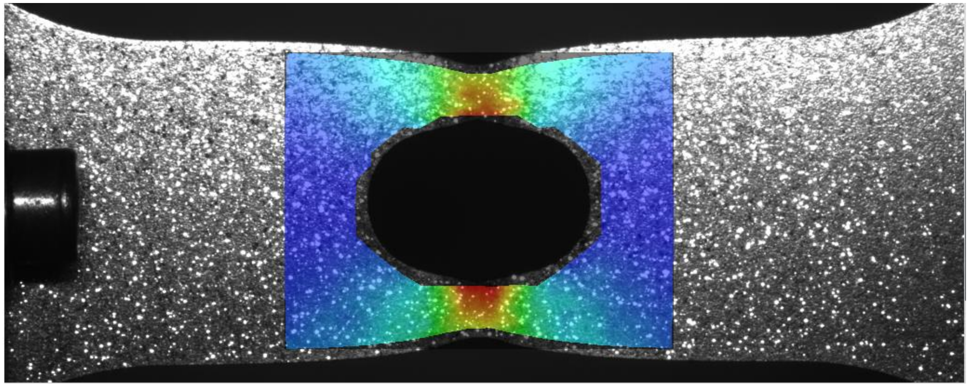


How are strain maps generated?

- Local strains εx, εy, εxy are calculated by means of displacement values of a multitude of facets by means of Constant Strain Triangles (simple finite 2D-elements).



- That way strain values can be calculated for each and every pixel and a colour values assigned to them.



A brief overview

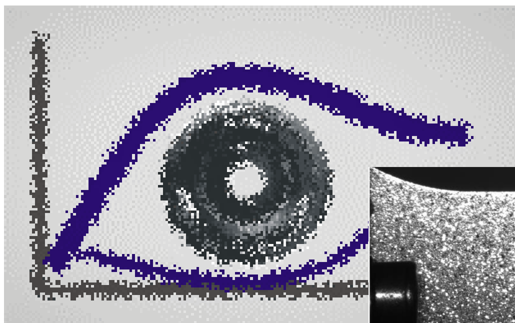
- DIC has „come of age“ during the last few years and is fast becoming an important and versatile tool in the field of destructive materials testing.
- DIC has not yet found its way into international standards. But ASTM is working on developing or amending its standard for calibration and classification of DIC systems – focussing on 2D-applications.
- 2D-systems cover approx. 80% of all uni- and biaxial tensile, compression or flexural testing applications.

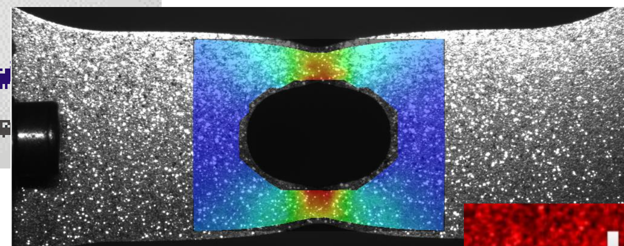
DIC with videoXtens and laserXtens

New feature for videoXtens and laserXtens

Easy to use

Test Rerun
Synchronized with all channels



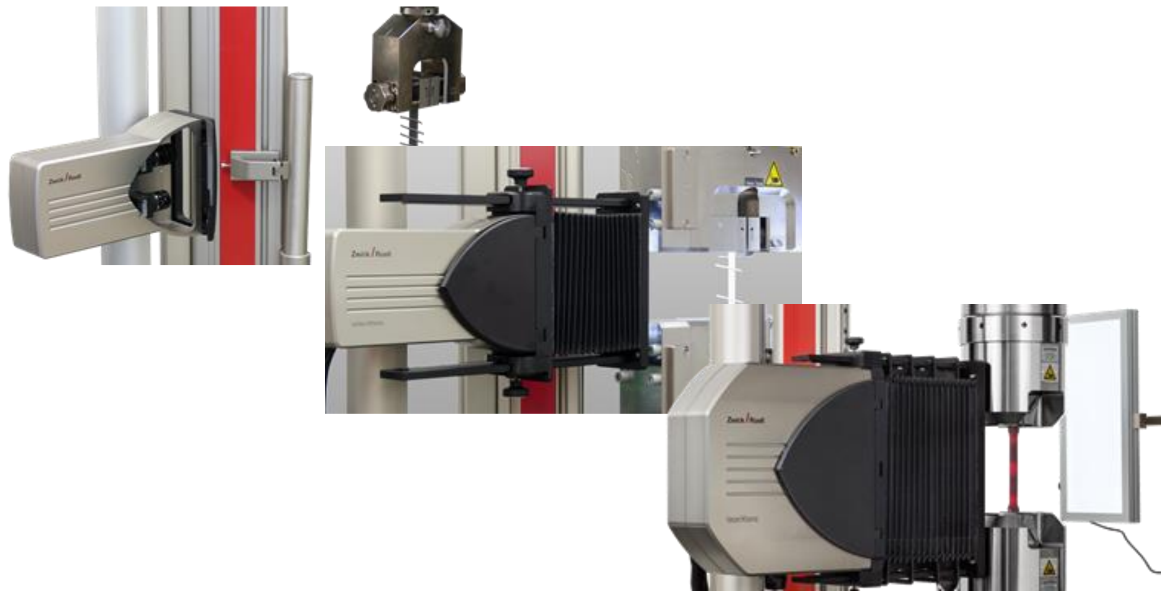


Higher resolution
with Array systems

Without marking
with laserXtens

DIC with videoXtens and laserXtens

Ease of use: Utilizing existing hardware

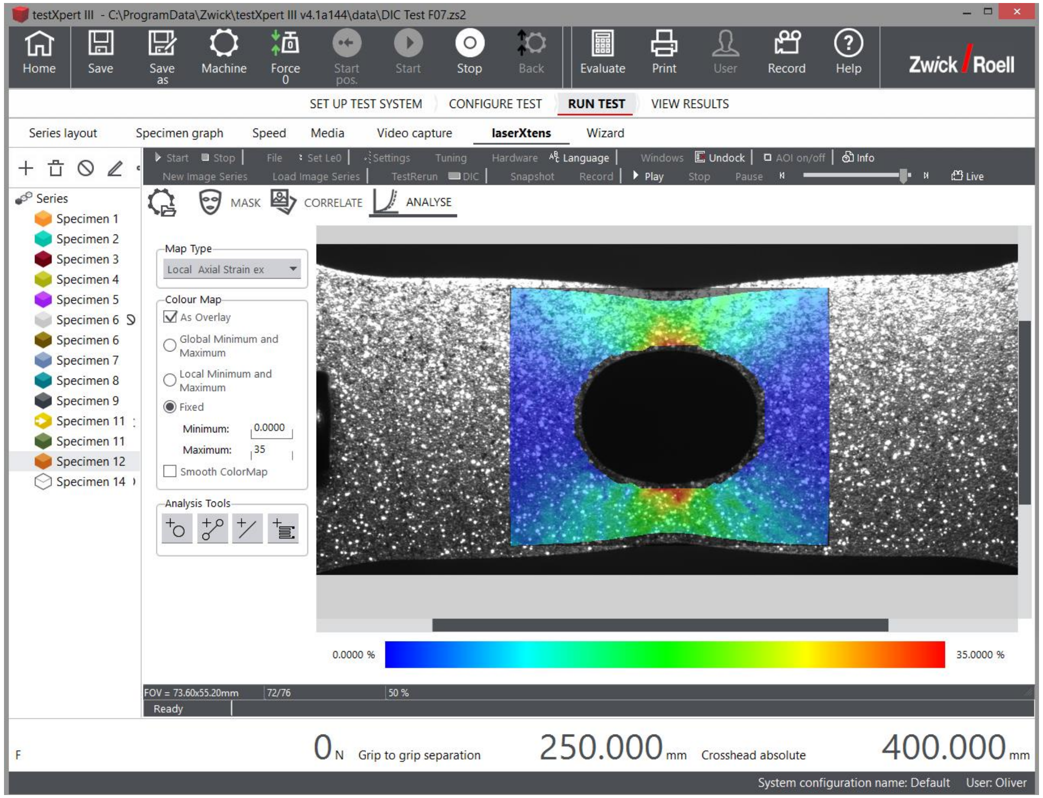


- No time-consuming positioning of tripods, illumination units, setting-up and calibration of cameras necessary
- The measuring heads of videoXtens und laserXtens are rigidly mounted to the test frame, optimized for the application and always ready for DIC.

DIC with videoXtens and laserXtens

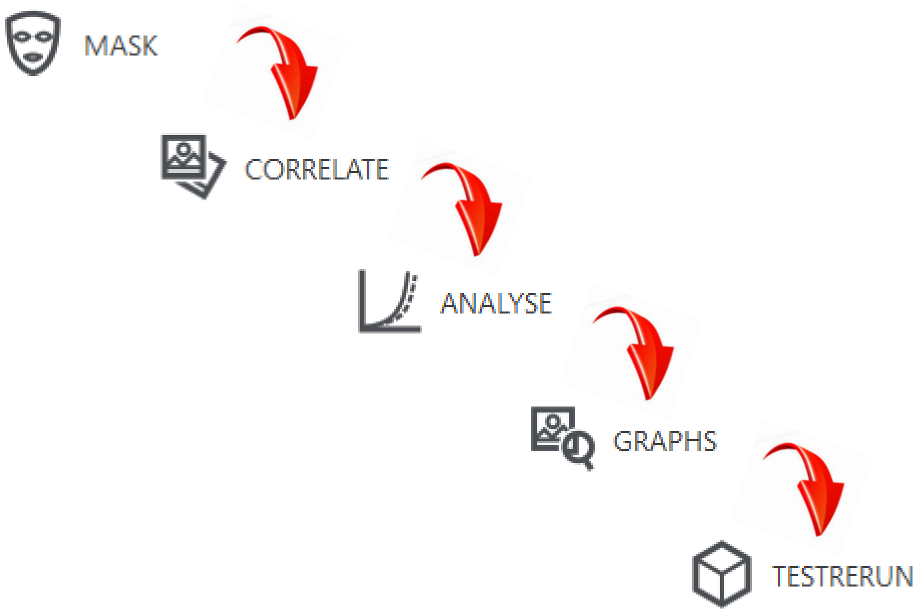
Ease of use: Fully integrated into testXpert III

- Only one single programme to operate
- Starting a test also triggers the capturing of images
- Images and readings are perfectly synchronized
- Data, images and parameters are managed by testXpert.



Ease of use: User guidance by workflow

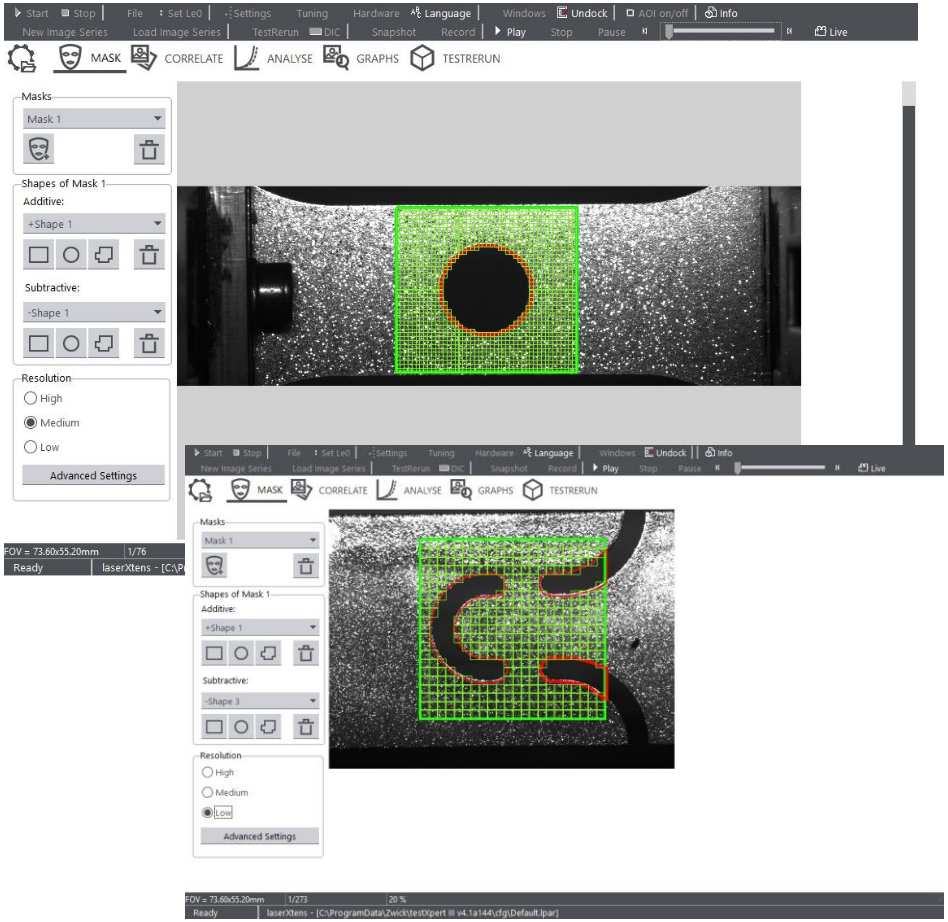
- Easy to use, step-by-step operation
- In a few steps from start to finish
- Clearly arranged, intuitive
- Avoids operating errors



DIC with videoXtens and laserXtens

Masks – Regions Of Interest

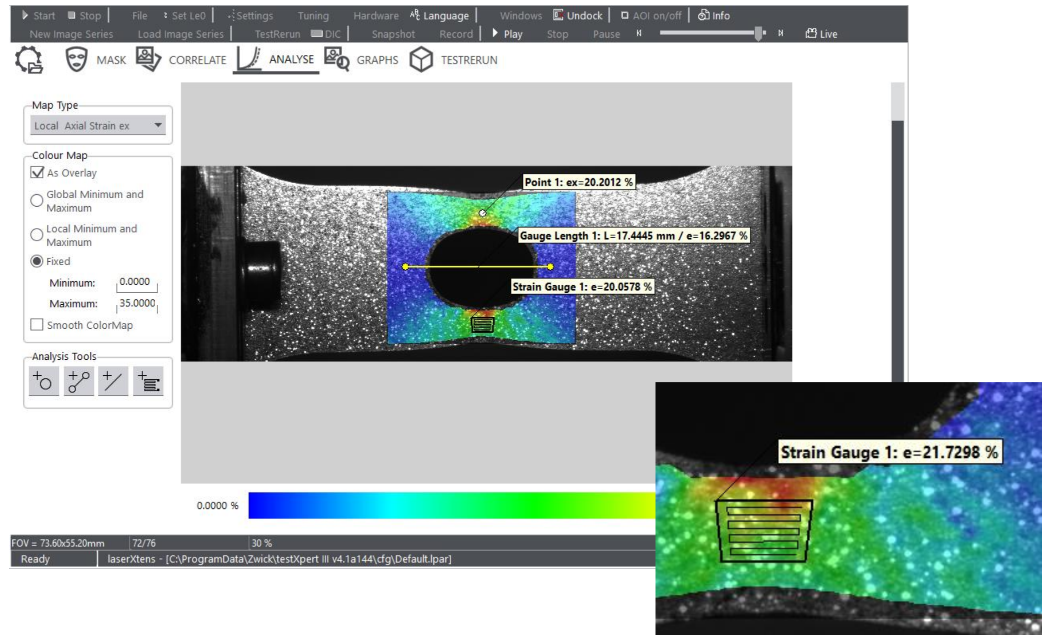
- Masks define the regions of the image to be analysed
- One or several masks
- Simple to complex
- Definition of accuracy by varying the size of the facets.

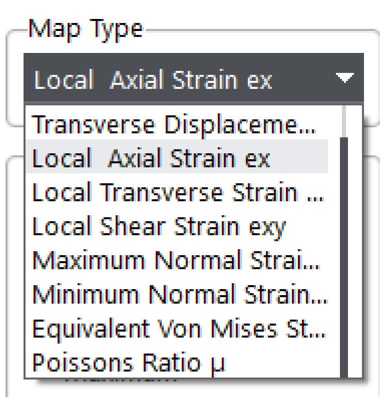


DIC with videoXtens and laserXtens

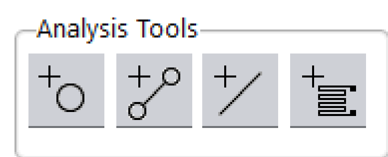
Analyse

- Display and configuration of various strain maps
  - Axial and transverse displacements
  - Axial and transverse local strains
  - Shear strains
  - Maximum and minimum normal strains
  - Equivalent Von Mises strains
  - Poisson's ratio





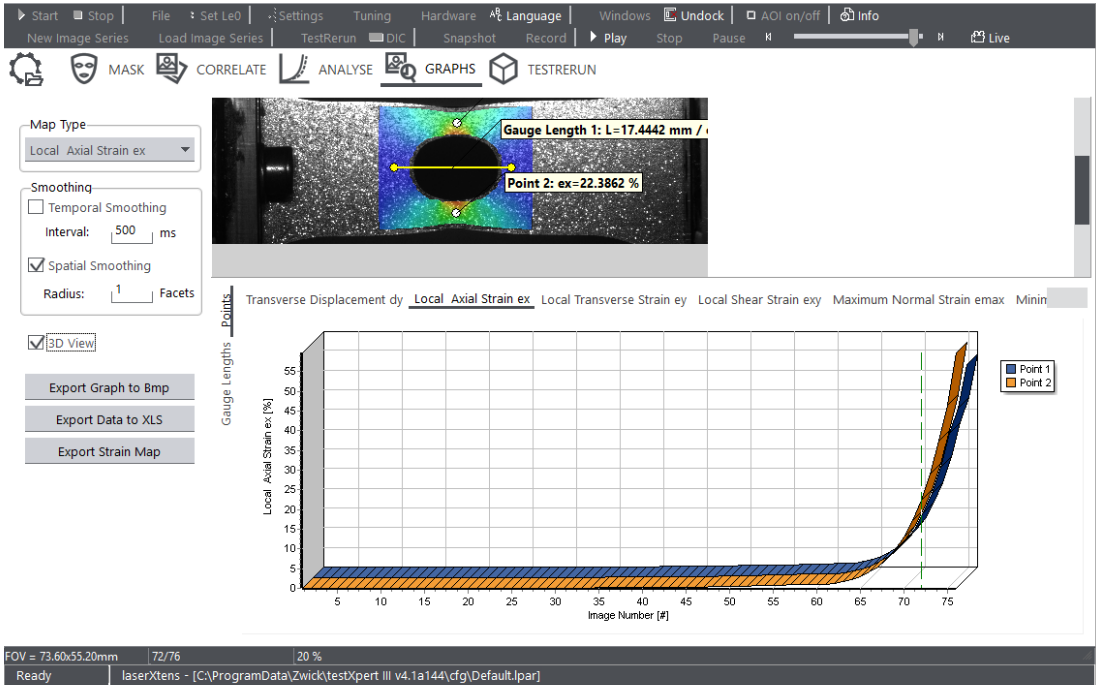
- Creation of analysis tools
  - Points
  - Gauge lengths
  - Cutting lines
  - „virtual" strain gauges



DIC with videoXtens and laserXtens

Graphs

- Selection of various graphs for each analysis tool.
- Export functions
  - Graph to Bitmap
  - Graph to Excel-Table
  - Strainmap to Bitmap

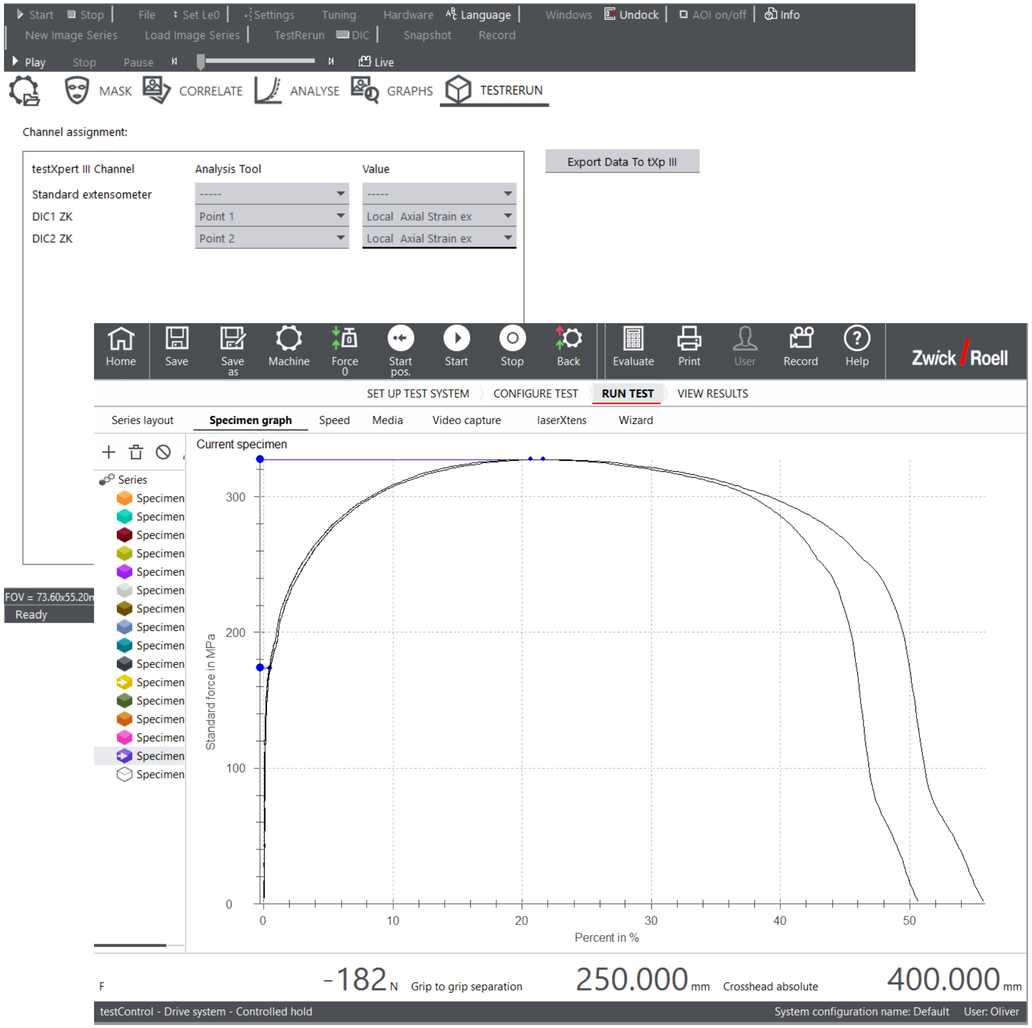


DIC with videoXtens and laserXtens

Test Rerun

- Assignment of DIC readings to testXpert III channels

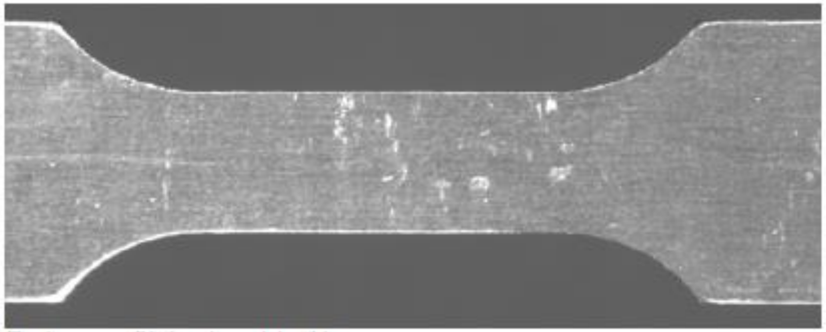
- Creation and evaluation of a “new” specimen based on those DIC readings

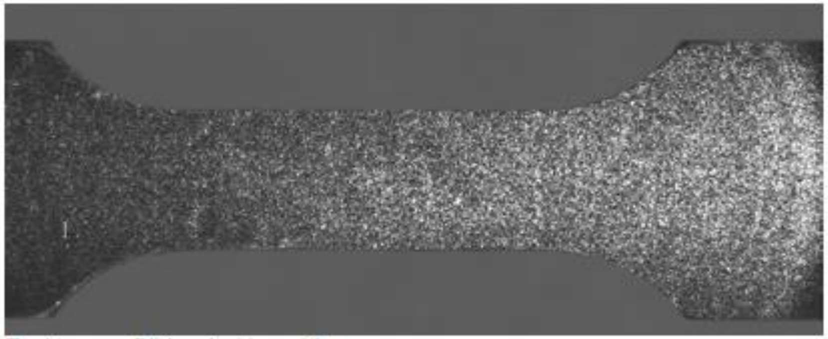


DIC with videoXtens and laserXtens

DIC with laserXtens – NO MORE MARKING THE SPECIMEN!

- In most cases a fine-grained pattern has to be applied to the specimen's surface (e.g. by spraying or stamping)
- With the laserXtens the laser light „marks“ the specimen with a speckle pattern.
- No specimen preparation, no influence on the specimen whatsoever





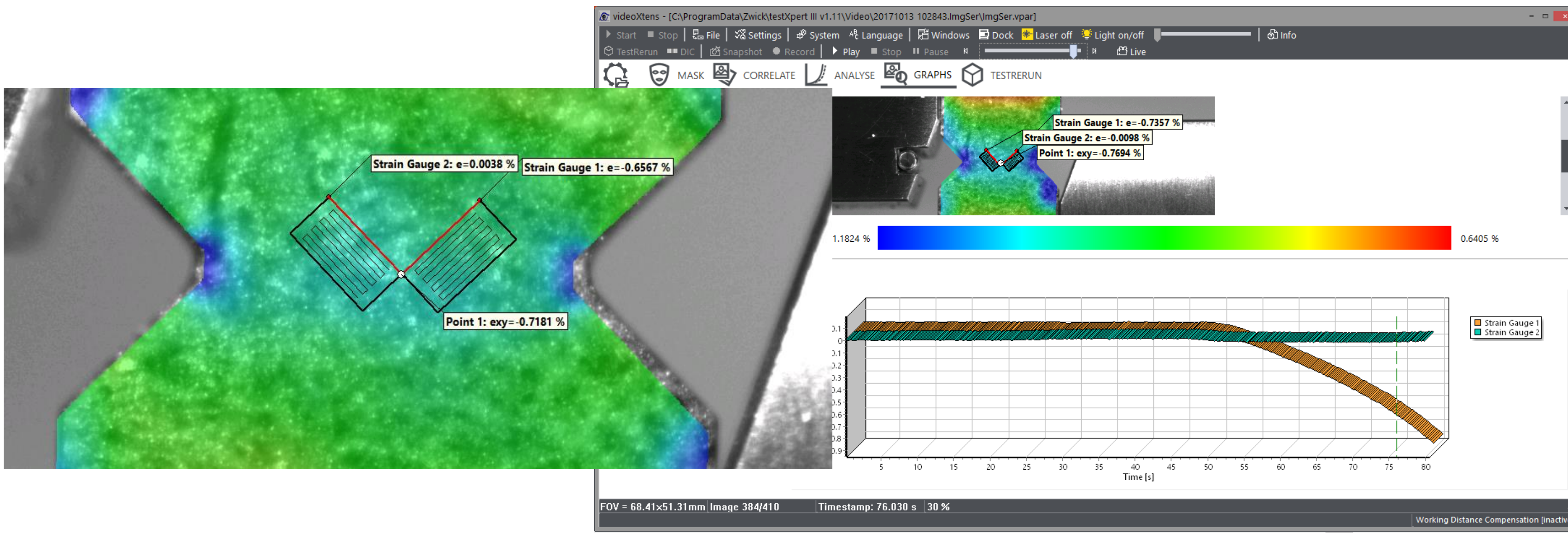
DIC with Array-Systems

- videoXtens Array and laserXtens Array use multiple cameras to increase resolution. The images of these cameras are „stitched“ together to obtain a big, high resolution image of the specimen
- This advantage also applies to DIC! This increases resolution several times.

DIC with videoXtens and laserXtens

Virtual Strain Gauges – the smarter strain gauge

- Strain Gauges are highly accurate devices, but each gauge requires its own amplifier and they are difficult and time consuming to apply.
- Virtual Strain Gauges can be positioned – and re-positioned - anywhere within the region of interest with a simple mouse click.



Example: Iosipescu test (shear test on v-notched composite specimen) with 2 virtual strain gauges.

DIC with videoXtens and laserXtens

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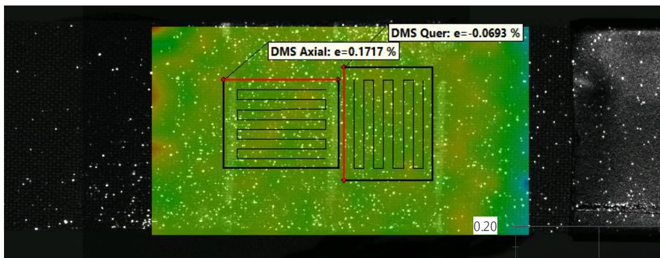
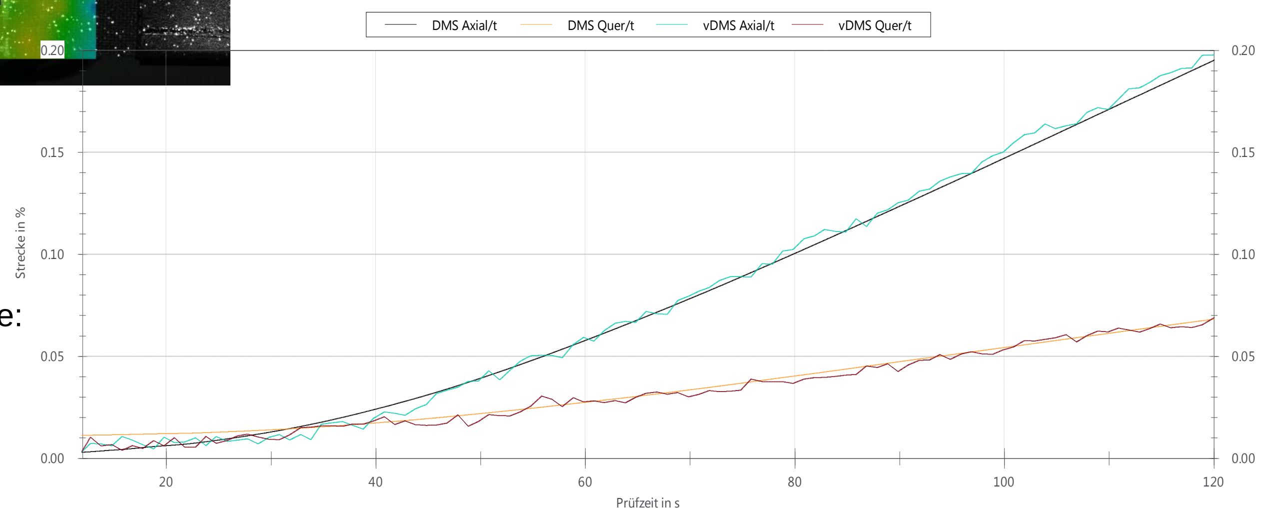
Virtual Strain Gauges – are they accurate?

- For comparison specimens with physical strain gauges on one side and virtual strain gauges on the opposite side were loaded in tensile direction.



SG-Type: 1-XY1x-6/120
Size: 6 x 6.5 mm²

Uncertainty, mainly due to noise:
±70με



DIC with videoXtens and laserXtens

DIC has the same resolution as the extensometer used for the test

Extensometer	Resolution (short working distance)	Resolution (long working distance)
videoXtens with lens f=8mm	1.3µm	1.6µm
videoXtens with lens f=16mm	0.7µm	0.9µm
videoXtens with lens f=25mm = videoXtens 1-120	0.5µm	0.6µm
videoXtens with lens f=50mm	0.25µm	0.35µm
videoXtens HP = videoXtens 2-120 HP	0.15µm	0.15µm
videoXtens 3-300	0.5µm	0.5µm
laserXtens Compact HP	0.04µm	---
laserXtens HP = laserXtens 2-220 HP	0.1µm	0.1µm
laserXtens Array HP	0.1µm	0.1µm
videoXtens AddOn	0.2µm	0.2µm

- These values have been obtained with typical parameter settings.
- Some settings while achieving higher spatial resolution will result in lower displacement resolutions. Class 0.5 / Class 1.0 can therefore not be guaranteed with every combination of parameters.

Thank you!