DANTEC DYNAMICS

Material and Structural Testing

with state of the art optical measurement methods.

Today's challenging test requirements

The need for testing complex material and structures with often anisotropic material behavior and the economic demands to increase the work efficiency, forces the traditional testing away from labor intensive point focused measurement techniques, into more efficient and robust optical non-contact technologies.

Optical measurement solution

We provide cost efficient and innovative solutions for material testing and structural analysis of complex components.

The Digital Image Correlation (DIC) is a 3D, full-field, non-contact optical technique to measure shape, deformation, vibration and strain on almost any material and shape. Its flexible design opens a wide range of applications from microscopic investigations up to large scale civil engineering measurements, with resolutions down to μ-meters.

The DIC method is based on pattern recognition on the object to be measured, the so-called "speckles". Those speckles pose an optical fingerprint that is identifiable in 3D space and is tracked by the DIC algorithm as long as the surface is in the view of the DIC cameras.

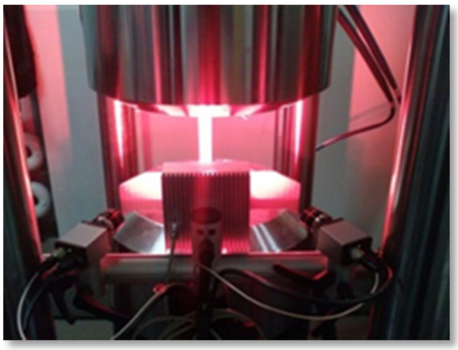


Figure 1 - Tensile test with DIC

Detect hot spots in real time

The determination of tensile testing hotspots is dependent on the clamping of the specimen and the sometimes complex behavior of the material, the consequence of this is that the strain hot spot and subsequent rupture area may not be at the predicted position. The DIC technique can be quickly and easily deployed as a strain hotspot detector, helping with the correct strain gauge positioning which will save valuable time and resources.

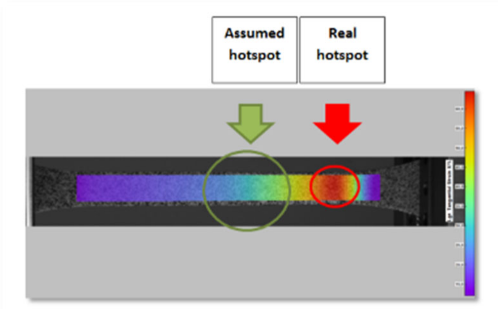


Figure 2 - Tensile test

Solve the out-of-plane alignment problem

Existing point and two dimensional measurement solutions have problems with out-of-plane movements during tensile testing. The misalignment issue causes, that measurement results get inaccurate or are even invalid and consequently the whole measurement has to be redone.

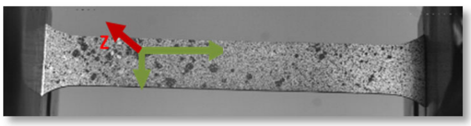


Figure 3 - Problem out-of-plane alignment during tensile test

The 3D DIC solution measures in all dimensions and per se has no issues with misalignment, but even can help to detect this problem easily.

Still living in a flat world?

Structural test requirements of shaped components force the use of three dimensional measurement methods. The 3D DIC measures high precision three dimensional surface displacements and strain vectors.

With the unique DIC multi-camera solution, even real stress calculations are possible by measuring the actual cross sectional area at the sample necking.

Our 3D DIC also solves the problem of rigid body movements of the object under test during the loading process. Those movements could be filtered away by our advanced 3D algorithms and thus real displacements and strains can be measured.

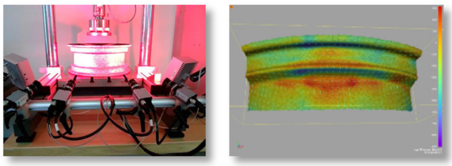


Figure 4 - 3D strain measurements on a car rim

Crack Propagation analysis

DIC enables not only following a crack propagating into the material, but also detects the strain peak and follow its propagation into the material before the real rupture has taken place.

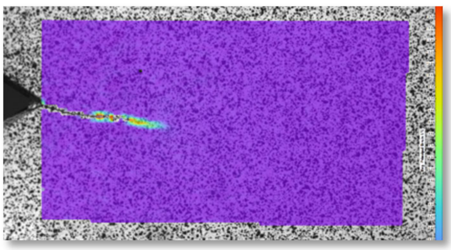


Figure 5 - Crack Propagation

Overcome strain measurement constraints

DIC goes beyond the application limits of classical two dimensional measurement methods, e.g. like strain gauges. For example with DIC it is possible to measure on top of the welded areas in order to derive the exact strain measurement.

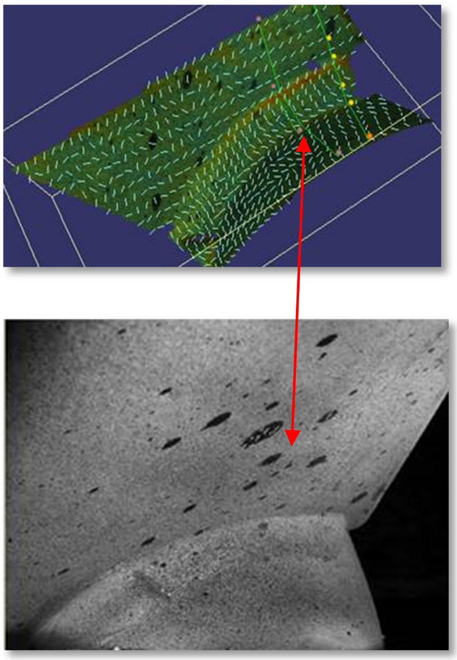


Figure 6 - High strain concentrations had been measured on the edge of the welded area

Enlarge strain measurement limits

With DIC it is possible to measure from 0.01% of strain up to several 100% of strain.

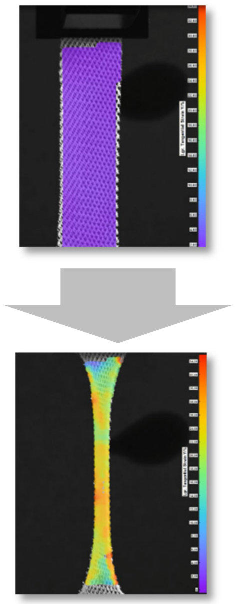


Figure 7 –Tensile testing with high strain material

Fatigue testing and vibration analysis

With the advanced DIC trigger possibilities high frequent phase-locked measurements can be easily executed. Our fully integrated medium and high speed cameras enable DIC to analyze the full dynamic behavior of components, like vibration and modal shape analysis as shown below.

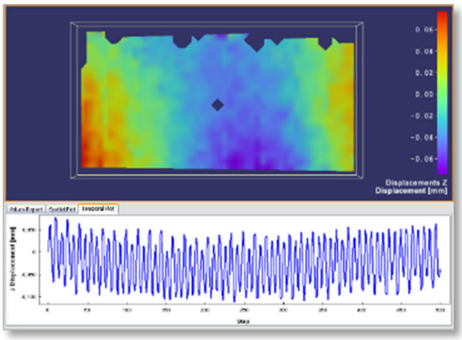


Figure 8 – Out of plane displacement of a composite panel

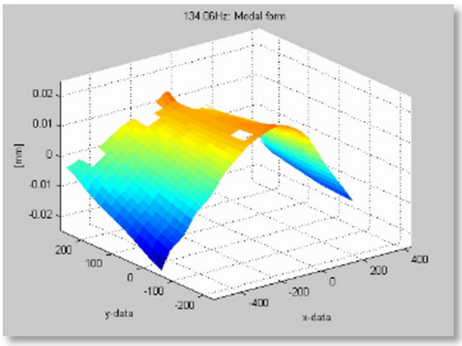


Figure 9 - Modal Shape Analysis of a composite pane

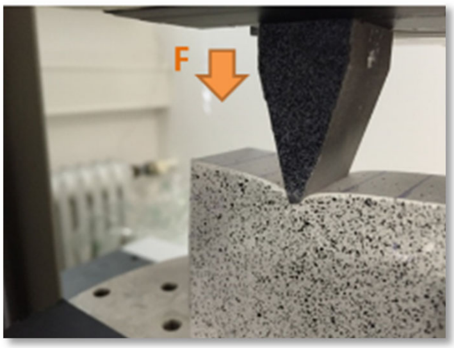


Figure 10 - Component loaded in the indicated direction

FEM Simulations of components exposed to stress

Simulation does not always reflect reality. Therefore a comparison between simulation and experimental results is vital for the improvement of R&D cycles and the prediction of the reliability of the material / component. Our ANSYS FEM plugin easily allows FEM simulation and DIC experimental comparisons with just a few clicks directly in the FEM Software.

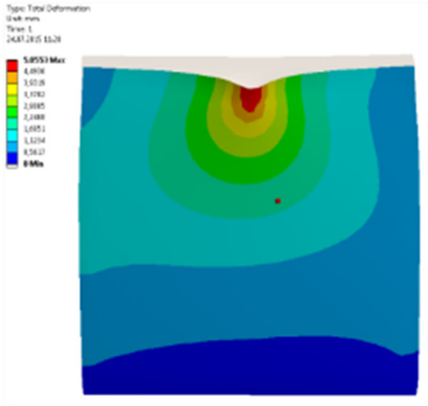


Figure 11 - Imported experimental measurement result

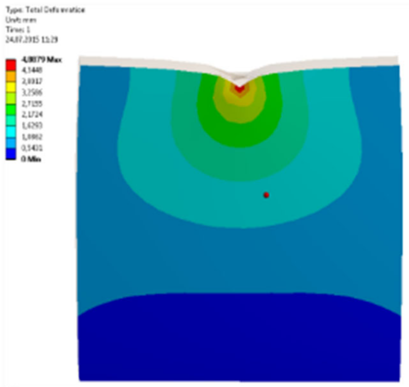


Figure 12 - ANSYS FEM calculation of the component

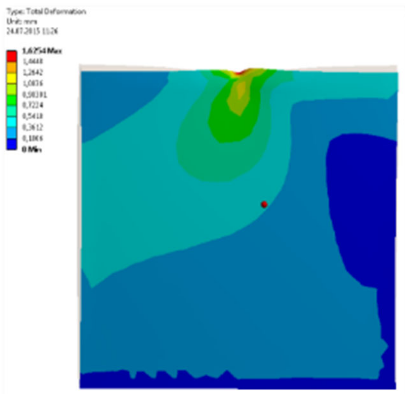
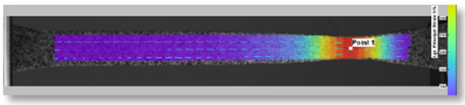


Figure 13 - Comparison experimental results and FEM

Known measurement uncertainty

Our DIC does not only provide highly accurate measurement values, but also indicates the measurement precision for each measured value in real-time.

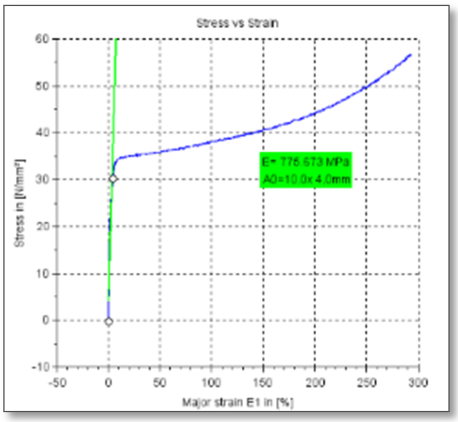


Point 1 - Lgr. Tangential Strain x/%: -23,18 ± 0,05
Point 1 - Lgr. Tangential Strain y/%: 490,1 ± 0,2
Point 1 - Lgr. Tangential Shear Strain/%: -6,65 ± 0,13
Point 1 - Lgr. Principal Strain 1/%: 490,1 ± 0,2
Point 1 - Lgr. Principal Strain 2/%: -23,27 ± 0,05

Figure 14 – Measurement values with accuracy

Material parameters on the fly

Our DIC includes numerous application modules, allowing the calculation of material parameters like Young's Modulus, Poisson ratio with just a key stroke. Application modules can be easily customized to the needs of the end user.



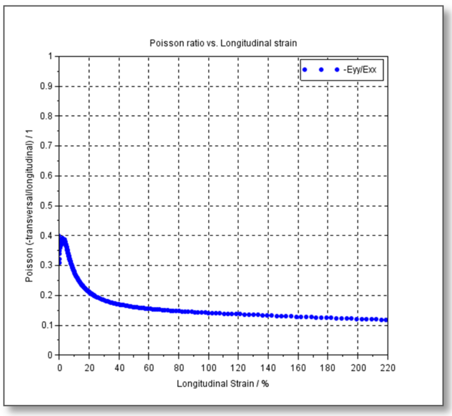


Figure 15 - Young's Modulus and Poisson Ratio graphics

Easy and quick calibration

The user friendly and fast calibration procedure, based on holding a calibration target by hand (as shown below), gives a calibration in typically 10 seconds which will significantly reduce the measurement time.

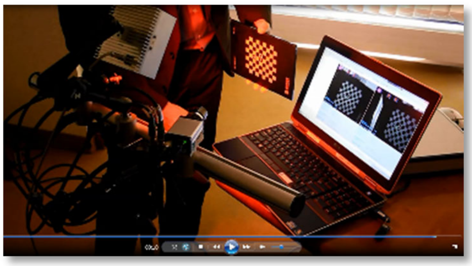


Figure 16 - Calibration done - 10 Seconds

Standardization / Certification

Dantec Dynamics is a member of all major international standardization committees for DIC and Shearography. Country and company specific standardization procedures / certificates similar to strain gauge, video extensometers accuracy classes are available on request (e.g. ISO 9513 / JIS B7741). The DIC calibration targets can be certified according to DAkkS K041B.

Measure beyond the capabilities of DIC

While DIC is sufficient in most of the areas of material testing, some test applications need much higher resolutions, e.g. materials with very high Young's modulus. Our Electronic Speckle Pattern Interferometry (ESPI)

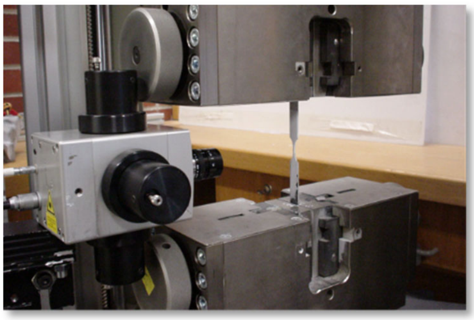


Figure 17 – Tensile test of a weld specimen with Dantec's Q-300 ESPI system

measurement equipment is ideally suited for such ultra–high resolutions, allowing the measurement of displacements in range of 10 to 100 nm in out-of-plane and in-plane direction.

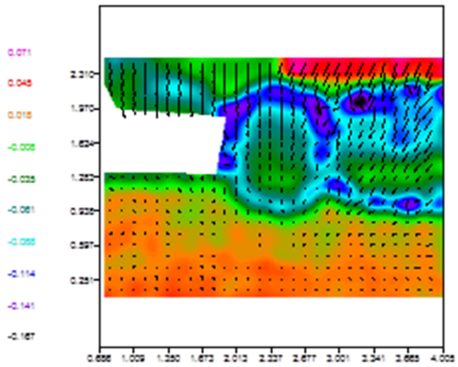


Figure 18 - Deformation of a single solder joint – resolution scale is µm

Benefits of Digital Image Correlation measurement solution – Save time/money

- Full-field, 3D quantitative analysis on displacements and stress. Unlimited data points.
- Non-contact measurement. Quick and easy setup and calibration.
- Effective tensile testing with DIC hot spot detection.
- Eliminate the limits of point and two dimensional measurements, do not care about sample alignment and rigid body movements.
- Make your tensile / material testing products unique. Attractive offers on the OEM DIC solution are available on request.

Explore innovative measurement techniques

Measurement on any material/component also with uneven surfaces.

- Investigate anisotropic material behavior.
- Explore advanced materials and structural testing areas with DIC, such as:
    - Strain measurement
    - Fatigue Testing
    - FEM validation
    - Vibration Analysis.
- Measure over welded spots or entire welded seams.
- Stress determination by measurement of sample necking.
- Flexible measurement areas: from mm² to m² dimensions.
- Indication of measurement accuracy always available.
- Accuracies down to 1µm displacement for smaller areas.
- Measure beyond the capabilities of DIC with our proven ESPI technology.

Easy to use – Built-in "Sensor intelligence"

- Deformation, Displacements (x,y,z), Strains (exx, eyy, exy, e1, e2), etc.
- Material parameters: Poisson ratio and Young's Modulus.
- Vibration analysis and modal shape analysis modules are available.
- Various export formats to support post processing for country specific procedures and standards are provided.
- End user customizable procedures for complex calculations are supported and can be initiated with a single keystroke.

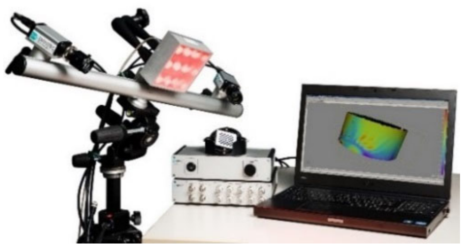


Figure 19 – Dantec Dynamics Q-400 DIC System with two cameras and illumination option

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DANTEC DYNAMICS Turn Measurements into Knowledge

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