Photogrammetric 3-D Digitizing for Deformation Analysis – New Developments and Applications

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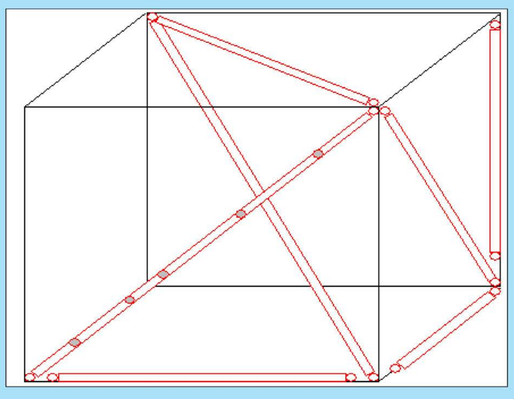
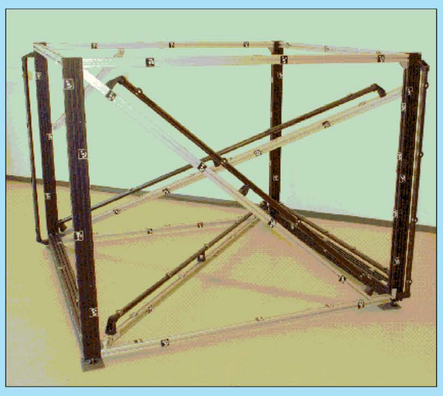
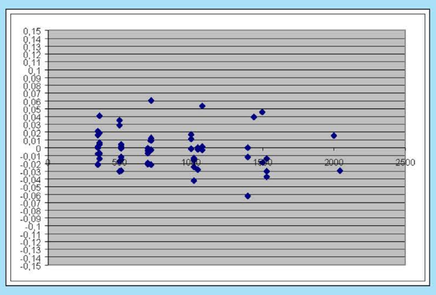
Photogrammetry

- Optical triangulation to virtually reconstruct object surfaces
- Object movements and deformations obtained from the differences of repeatedly measured point fields
- State-of-the-art: Data acquisition using digital (high resolution) cameras (CCD or CMOS type), automatic measurement of image points (targets), very fast and robust self-calibrating bundle adjustment
- Recent advances in camera technology and calibration, automatic measurement of "natural" features (contour lines, boreholes, etc.), test procedures (VDI/VDE guideline 2634 "Optical 3-D measuring systems - Imaging systems with point-by-point probing")



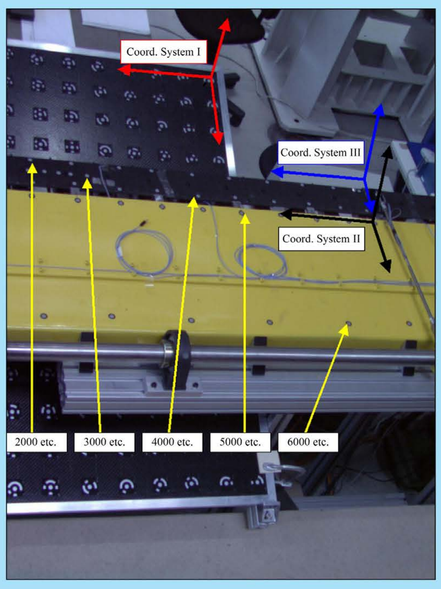




Recommended configuration of a 3-D test field with 7 measuring lines and targets. Comparison of distances derived from photogrammetric measurements with their calibrated values results in 3-D length measurement errors. The maximum permissible length measurement error is a criterion for the quality of the measurement system.

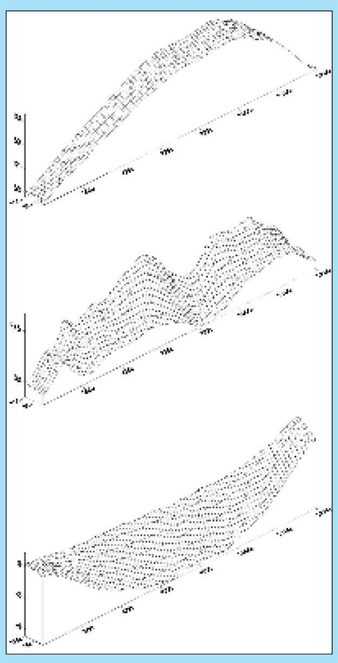
Deformation Measurement of an Aircraft Wing

Deformations caused by different load conditions at different positions/rotations of the trailing edge of an aircraft wing. Results suitable for verifying numerical finite element simulations.



Test set-up with pre-stressed cantilever and trailing edge

Rollei d7 metric[5] (5 Megapixel CCD)
Approx. 30 deformation measurements
Bundle adjustment with AICON DPA-Pro software (s_X = 0.015 mm, s_Y = 0.017 mm, s_Z = 0.030 mm)



Deformations of the trailing edge:
- at the beginning
- with differently pre-stressed cantilever
- after 45° rotation

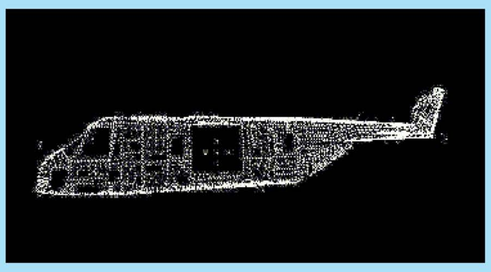
Fatigue Test of Helicopter NH90

Structural tests of a helicopter mounted in a jig equipped with hydraulic cylinders for inducing forces into the structure as resulting from take-off and landing.

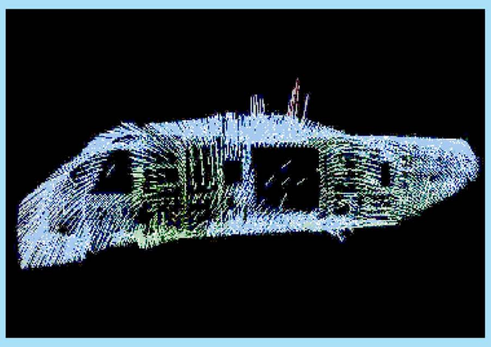
NH90 helicopter

- 5200 targets
- 350 images
- s_{XYZ} = 0.2 mm
- Graphic overlay to display deformation vectors

NH90 mounted in a jig



Resulting point cloud

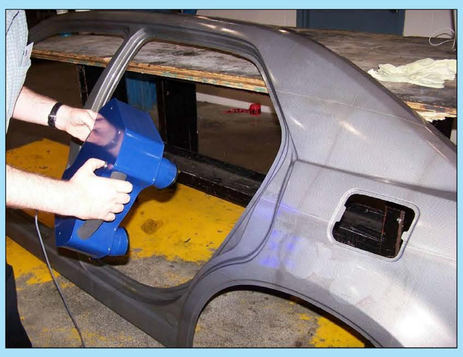


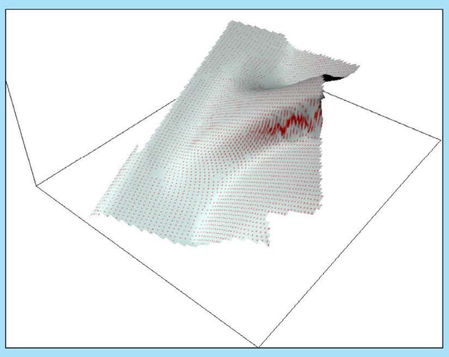
Deformation vectors

Strain Analyses for Sheet Metal Forming

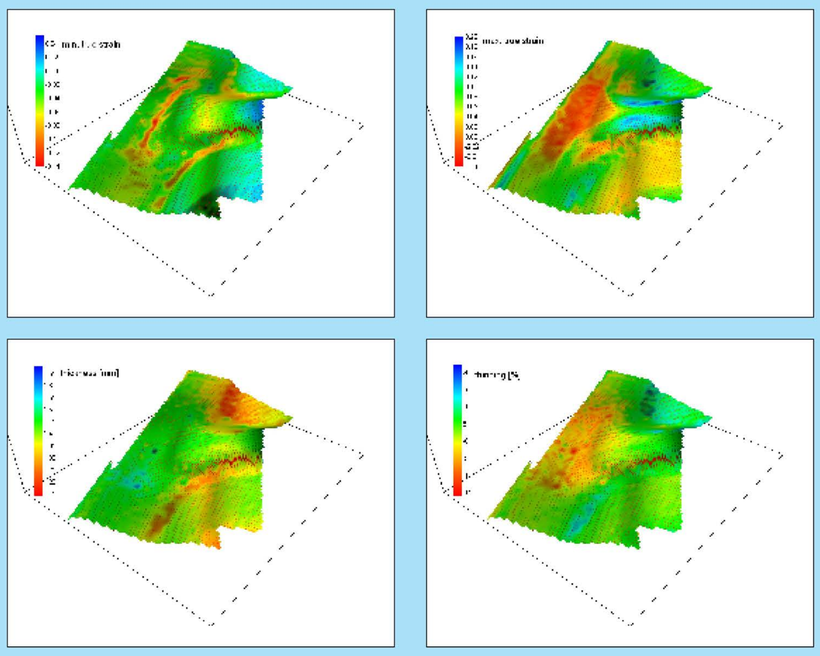
During set-up of stamping tools, strains and thickness of sheet metal have to be analysed. A known reference grid pattern is etched onto the sheet metal before stamping. After stamping the deformed grid is measured photogrammetrically. Deviations from the known reference grid result in the calculation of the strain parameters.

Four camera head of the VIALUX AutoGrid system for image acquisition





Point cloud of observed grid points



Resulting true strains, thickness and thinning

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