UNIVERSITÄT DES SAARLANDES

Arbeitsgruppe
Zelluläre Werkstoffe und
mikromechanische Testung

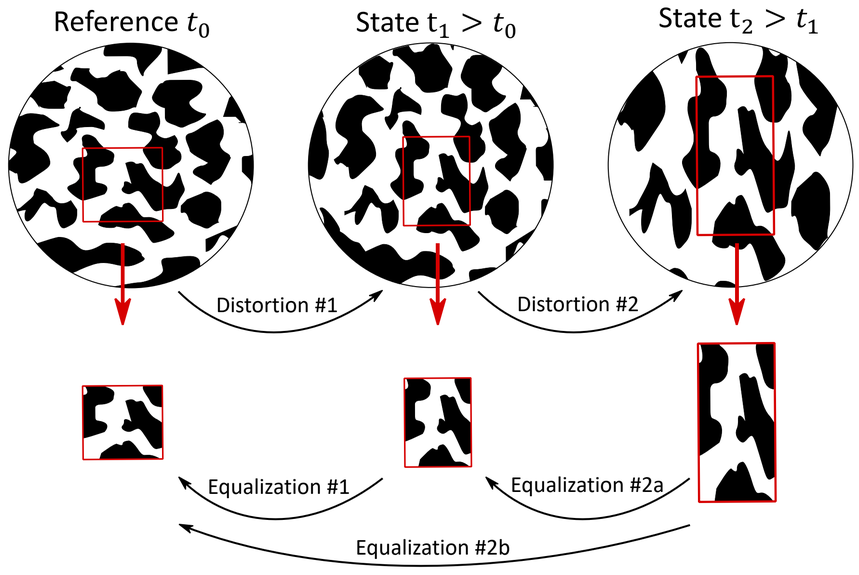
Lehrstuhl für
Technische Mechanik

Investigation of stochastic noise in DIC measurements

Digital Image Correlation in mechanics

The use of digital image correlation (DIC) as optical measurement method was developed in 1985 and is widely spread in the community of mechanical testing. The DIC provides a simple tool for determining local and global strains on the specimen surface. Nevertheless the error and noise in DIC often stays uninvestigated. Therefore this study on stochastic noise and minimization of errors in DIC was processed.

Principle of DIC



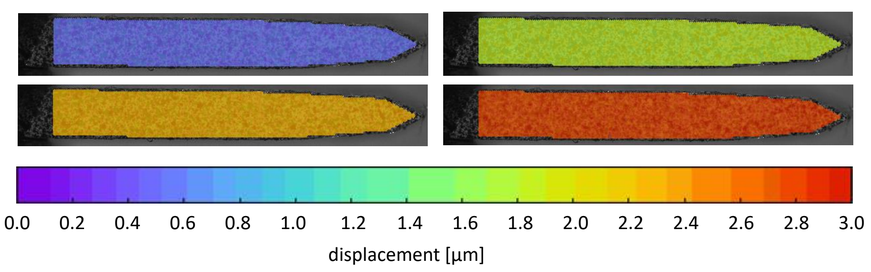
- Optical measurement method
  - No contact needed
  - Based on digital images in different deformation states
- Strain determination from images
  - Irregular, high contrast pattern on specimen
  - Image at t_0 = reference image
  - Calculation of equalization direct to reference or incremental

Noise measurement

- Idea of static attempts
  - No movement of the specimen
  - No movement of the camera

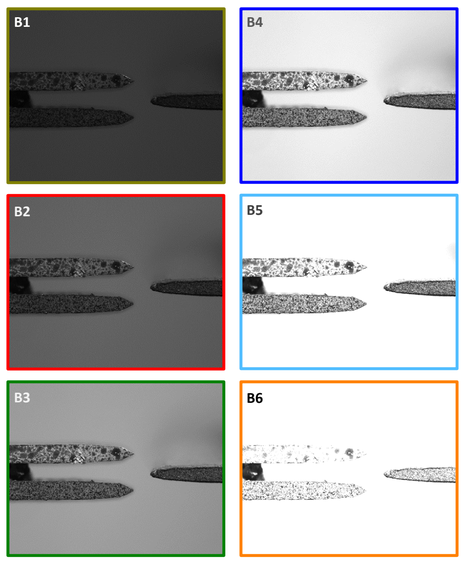
    ⇒ DIC measured displacement must be equal to zero

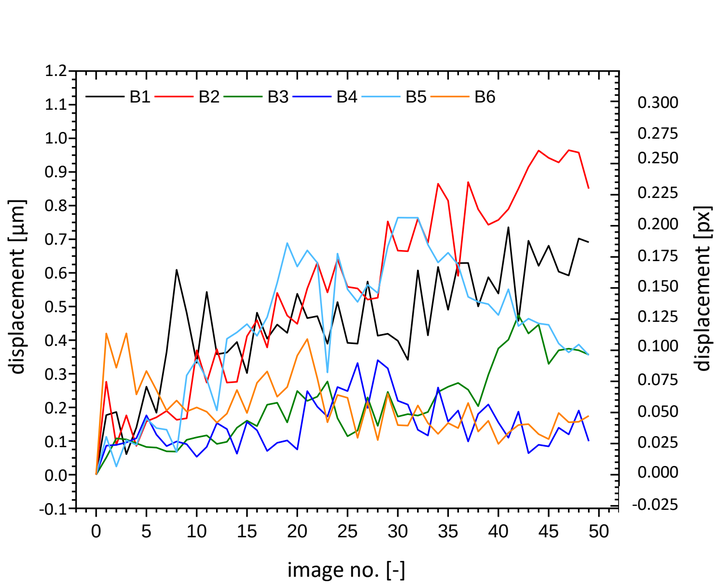
    ⇒ All measured displacements unequal to zero are noises



- Experimental procedure
  - Static camera position
  - Set of 100 images
  - DIC with commercial tool *ISTRA4D®, Dantec Dynamics*
  - Investigation of effects of internal and external parameters

Example: Influence of lighting – brightness level



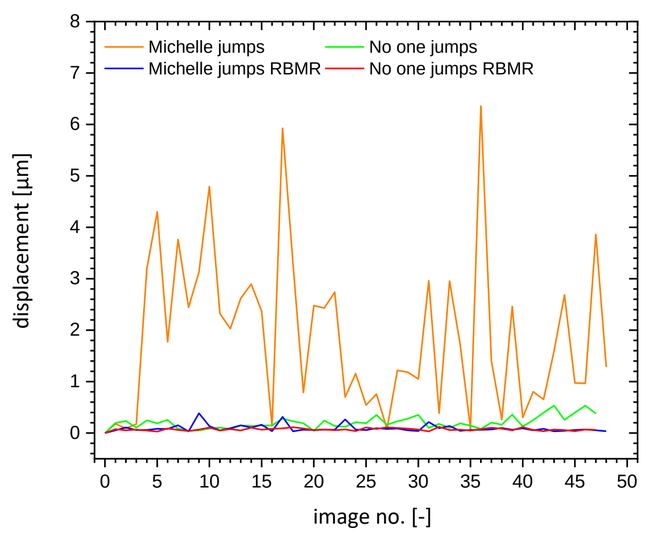


Rigid body movement (RBM) in DIC

- Errors in DIC caused by floor vibrations
  - User related

    ⇒ walking, jumping
  - Environment related

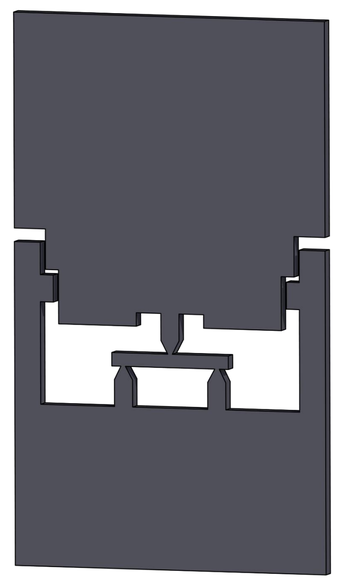
    ⇒ bus passing by, earth quake
- RBM remove with *ISTRA4D®* as an integrated tool (RBMR)
- Experimental procedure
  - High level of floor vibration by someone jumping next to test rig
  - DIC with and without usage of RBMR

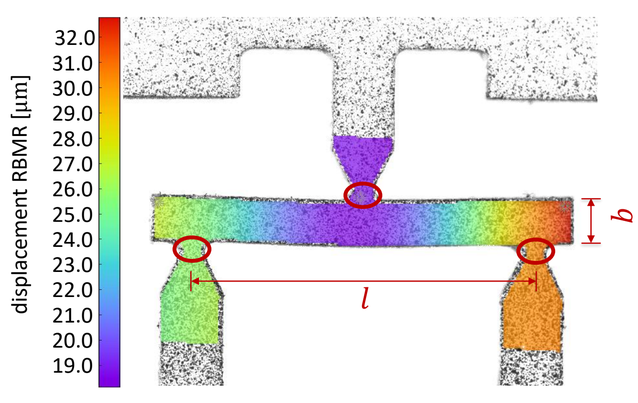


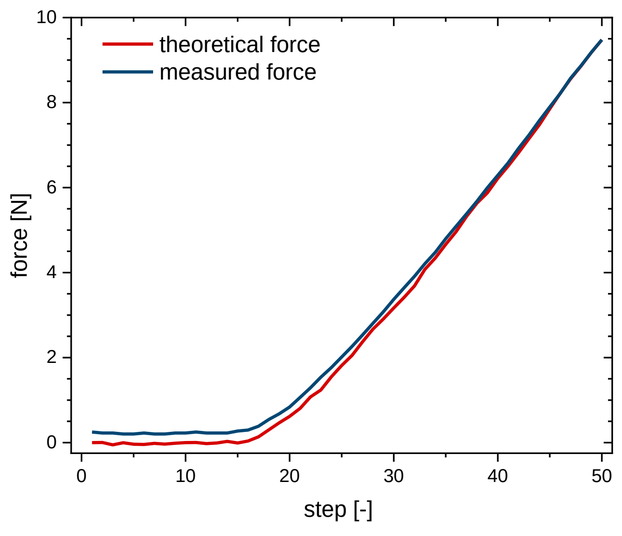
Linking measuring methods

- Use of a calibration target
  - Known material parameters
  - Known maximum displacement
  - Force calculated from beam theory $F = \frac{4w\mathrm{E}bh^3}{l^3}$
- Measuring force by S-bracket force sensor
- Measuring displacement by DIC
  - Exporting displacement at 3 points
  - Calculating bending of the beam
- Comparison measured force and theoretical force

  ⇒ Strong agreement of the forces

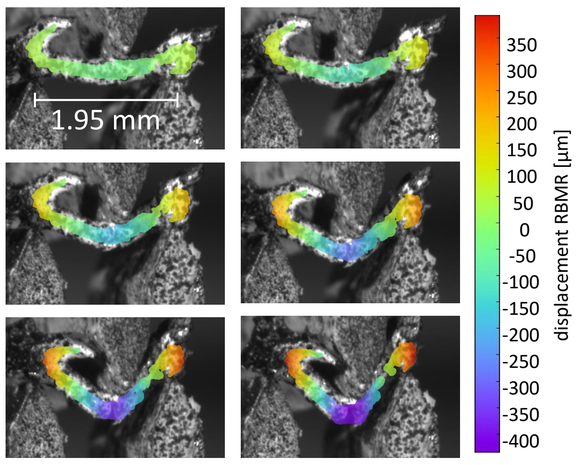






Conclusion and future work

- Static attempts improves DIC results
  - Error to 4% of a pixel
  - Lighting with biggest influence
- Improvements transferable to RBM
- Linking of the measuring methods shows high quality of all measurements
- Future experiments
  - Investigation of open cell metal foam
  - 3 point bending on a single strut
  - Full field strain measurement possible



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