MatchID
Metrology beyond colors

Application Note

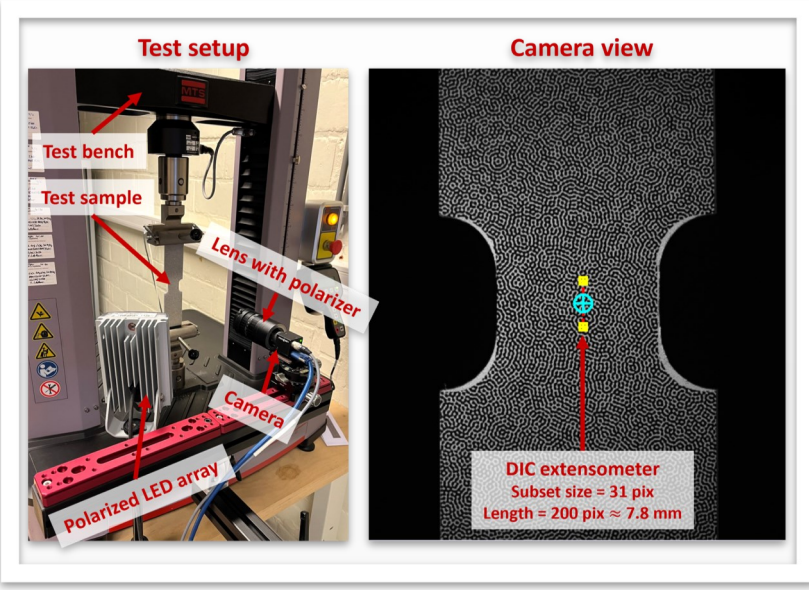
Strain controlled tensile test using real-time DIC feedback

Case Description

Aim: Demonstrate the capabilities of MatchID Grabber's real-time (RT) feedback capability and MatchID feedback-unit.

Approach:

- **Experiment:** Use a 2D-DIC setup with 1D DIC-extensometer to measure true tensile strain induced in a high density polyethylene (HDPE) test sample under uniaxial load (see adjacent figure).
- **RT feedback:** Live-track the true-strain in the test sample using DIC-extensometer. Use the MatchID feedback unit to convert it to an analog signal and feed it to the tensile test bench.
- **Strain-controlled test:** Use the analog signal to control the tensile test bench during the test.



Experimental Setup

- ✓ **2D-DIC camera:** 5 MPx Flir BFS-U3-51S5M-C
- ✓ **Light Source:** Polarized LED array
- ✓ **Field of View:** 80 mm × 48 mm
- ✓ **Lens:** 25 mm Fujinon
- ✓ **Feedback device:** MatchID feedback unit
- ✓ **Controller:** Proportional controller with gain = 500
- ✓ **Control signal:** Voltage ±10 V

Analysis

- ✓ **Type:** 2D-DIC
- ✓ **Quantity live-tracked and used as RT feedback signal:**
  - True tensile strain with 1-D DIC extensometer
- ✓ **Quantities measured with test bench:**
  - Load
  - Crosshead displacement

Results

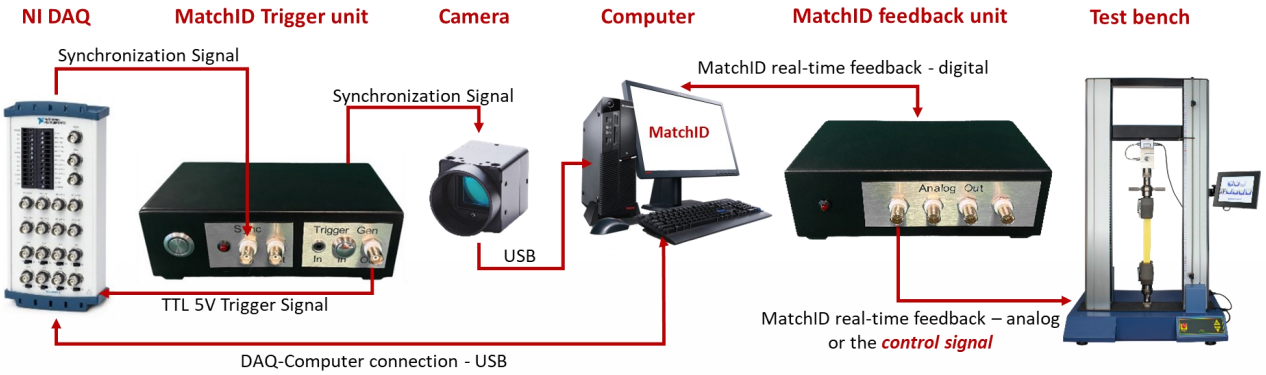
- ✓ **Pixel to mm conversion factor =** 0.04 mm.
- ✓ **Following curves from test bench:**
  - Load vs. crosshead displacement
  - Live-tracked true strain vs. time
  - Load vs. time

Why MatchID

- ✓ Live-DIC tracking and RT feedback capabilities available in MatchID Grabber
- ✓ MatchID feedback unit to output analog signals corresponding to the live-tracked quantities
- ✓ Uni/bi-axial DIC-extensometer capabilities to measure elongation and strain in RT
- ✓ More flexibility to design and control your test!

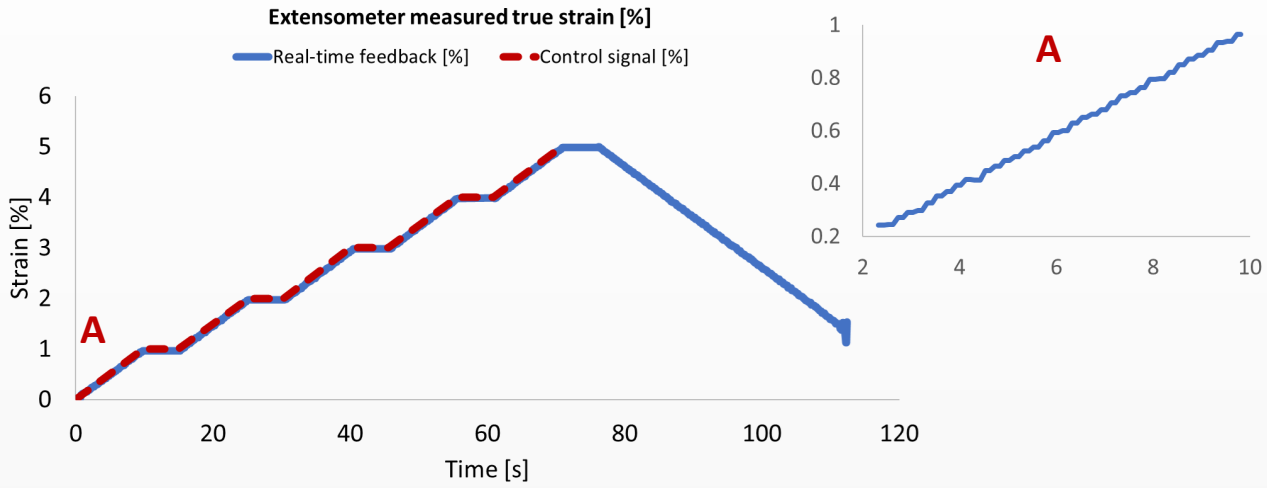
+32 (0) 9 223 64 41 ■ info@matchid.eu ■ www.matchid.eu

Test configuration



Test setup: The NI-card and trigger-unit combination allows to operate the camera. MatchID Grabber's live-tracking capability was used to track the true tensile strain induced in the test sample. MatchID Grabber's real-time feedback feature made outputting the live-tracked quantity possible using the computer's digital communication port. MatchID feedback unit converted this digital signal to an analog voltage signal used to control the test bench.

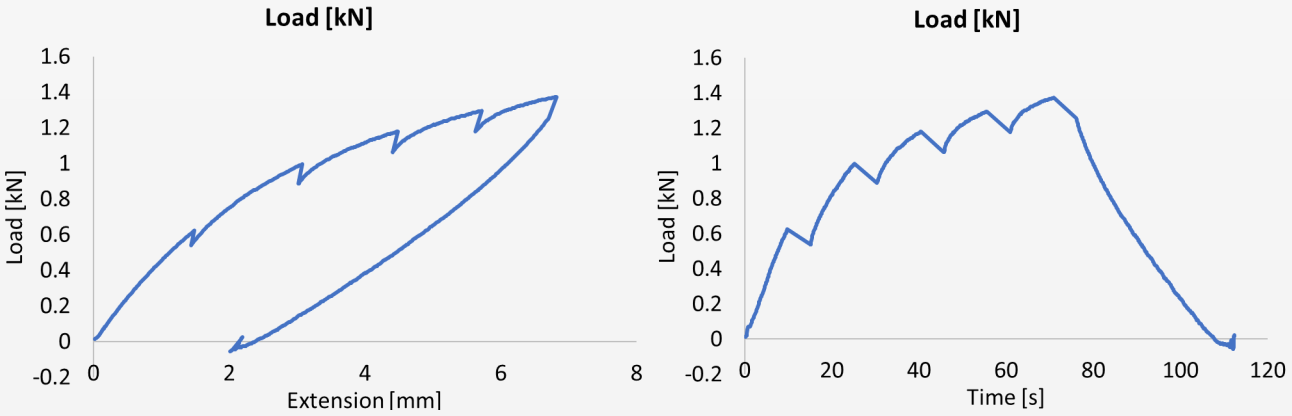
RT DIC feedback to perform strain-controlled tensile test



Test planning and execution: The test sample was loaded in increments of 1% strain at a constant rate of 0.1% per second. After each increment, a dwell time of 5 seconds was prescribed. At the end, the test bench was programmed to zero the force.

Outcome: The ***real-time feedback signal***, i.e. DIC-extensometer measured true strain, follows the ***control signal*** well. The controller is sufficiently robust to the noise on the RT feedback signal, visualized in the detailed view-A.

Conclusions



Existence of *residual strain* after unloading confirms that *plastic deformation* takes place. DIC extensometer being insensitive to slipping effects in the test bench clamps makes concluding this possible. Relaxation due to factors such as *viscoelasticity* is quite evident, especially during the dwell duration. The nonlinearity of the load-displacement behavior within one strain increment is clearly seen. ***Live-tracking*** and ***real-time feedback*** features in MatchID grabber coupled with the ***MatchID feedback unit*** provide ample opportunities and flexibility to control your tests. The procedure laid out here can be readily applied to a stereo-DIC scenario. In the future, the virtual strain gauge (VSG) from MatchID stereo/2D will be made available for live-tracking, expanding the horizon of possibilities.