

TRILION QUALITY SYSTEMS

FATIGUE TESTING
ON T-JOINT IN CYCLIC LOADING

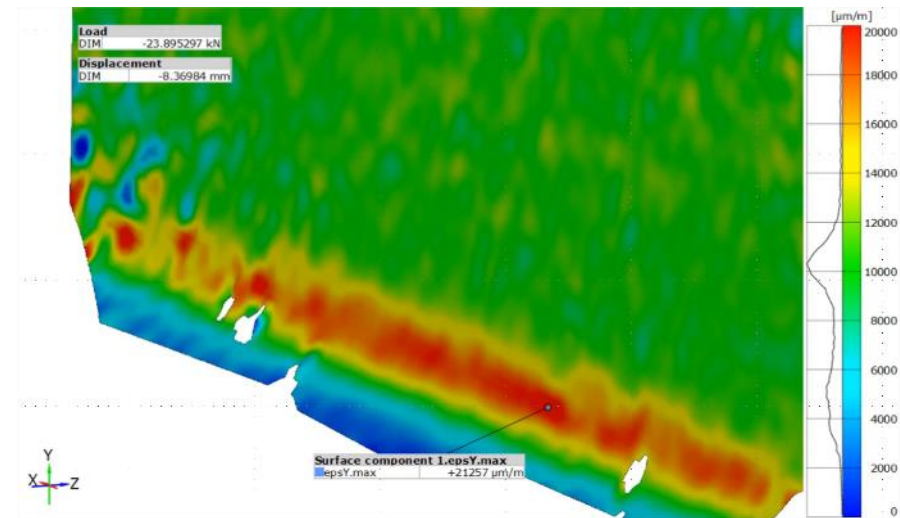
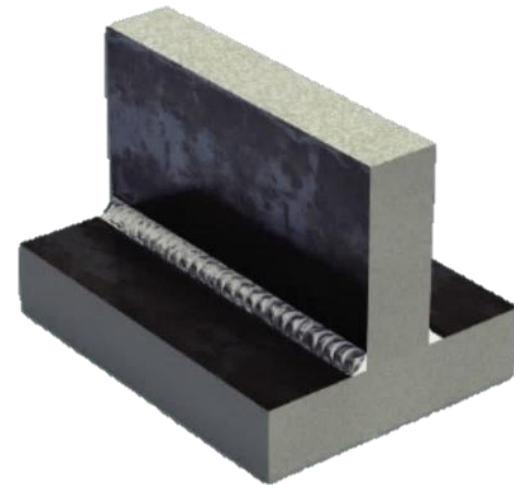
SAE Fatigue Committee
&
JOHN DEERE
JOHN DEERE ADV LAB

STUDY PERFORMED ON
01/31/2017

Eric Norton
John Deere

&

Jonathan Pickworth
Trilion Quality Systems



Jonathan Pickworth

- Senior Sales Engineer at Trilion
- French
- MSc Aerospace engineering and Business
- Proud to support companies and universities with state of the art optical measuring solution!
- Experience across industries, including aerospace, automotive, biomedical, sports...



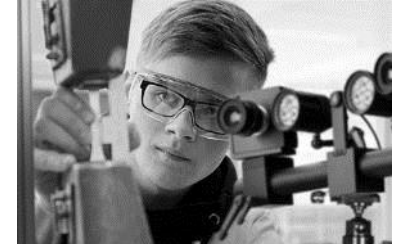
- Exclusive GOM distributor for ARAMIS in North America since early 2000's
- Over 550 hundreds system delivered
- Specialized in custom application development
- Offers consulting services and system sales



Automotive industry



Aerospace industry

Consumer goods
industryResearch and
universities

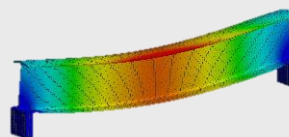
ARAMIS IS A UNIQUE NON-CONTACT MEASUREMENT SYSTEM BECAUSE LABS NEED TO MEASURE ACCURATELY

Displacements

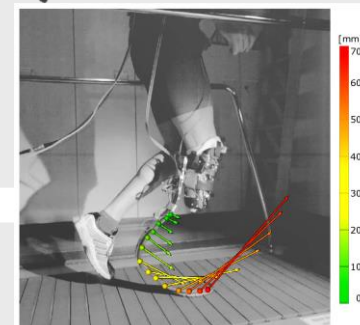
STANDARD TESTING SOLUTIONS

- LVDT
- Laser trackers
- Extensometers
- Draw Wire Sensors
- Clip gages

FEA

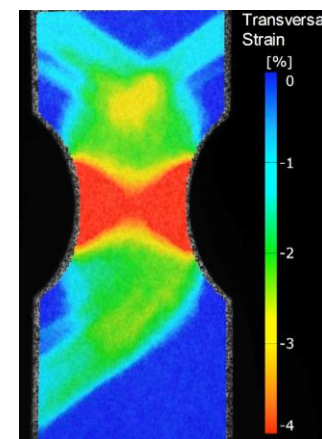
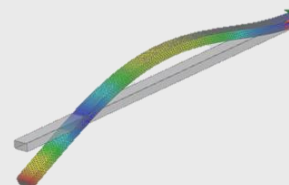


ARAMIS



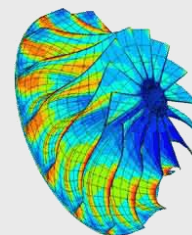
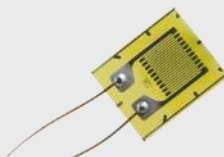
Vibrations

- Accelerometers

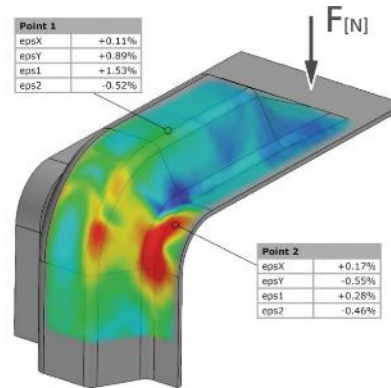
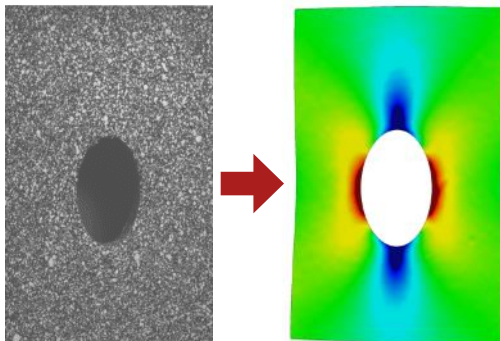
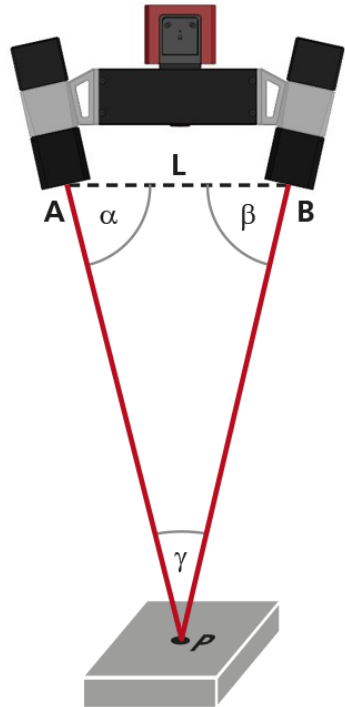


Strains

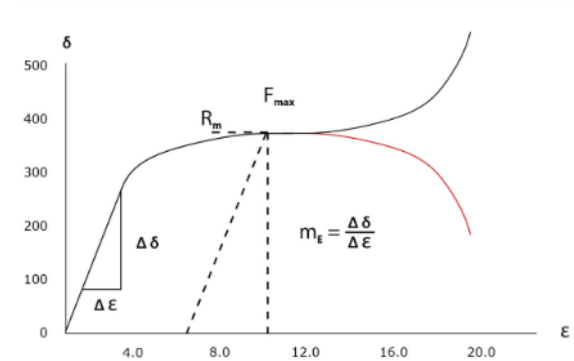
- Strain gages



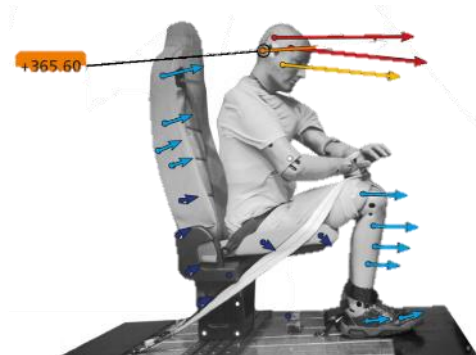
DIGITAL IMAGE CORRELATION TRACKS UNIQUE PIXEL



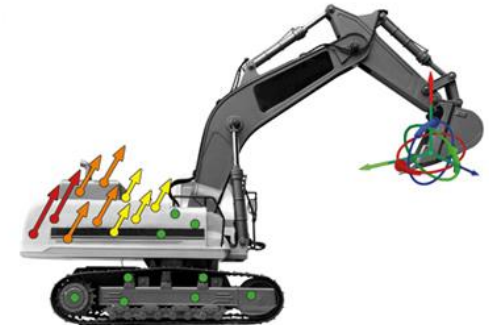
Finite Element Measurement



Material characterization

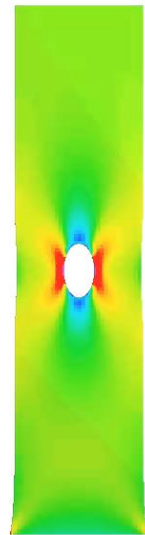


Dynamic testing

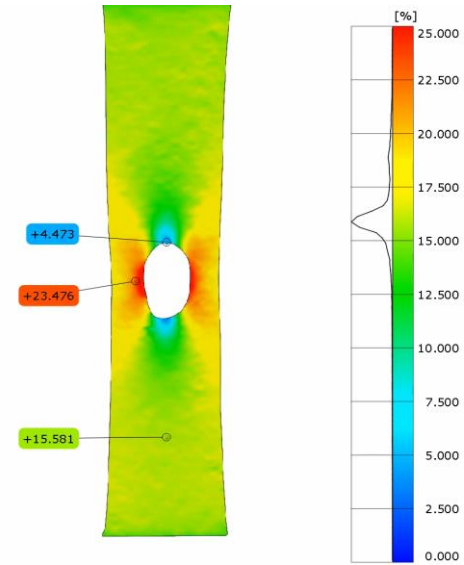


Live component tracking

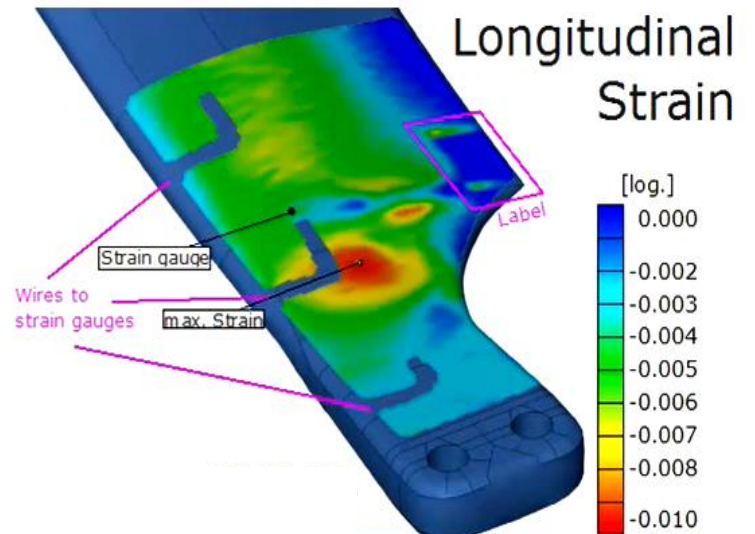
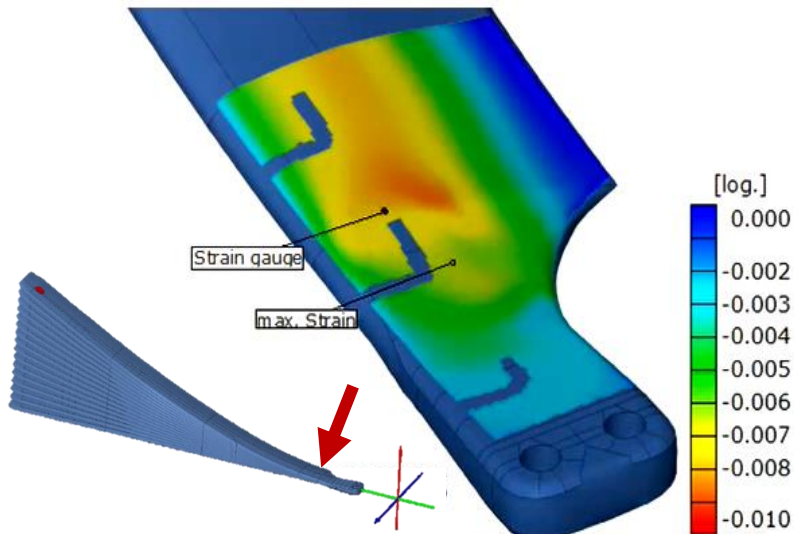
FEA VALIDATION ETS MONTREAL & BOEING



FEA



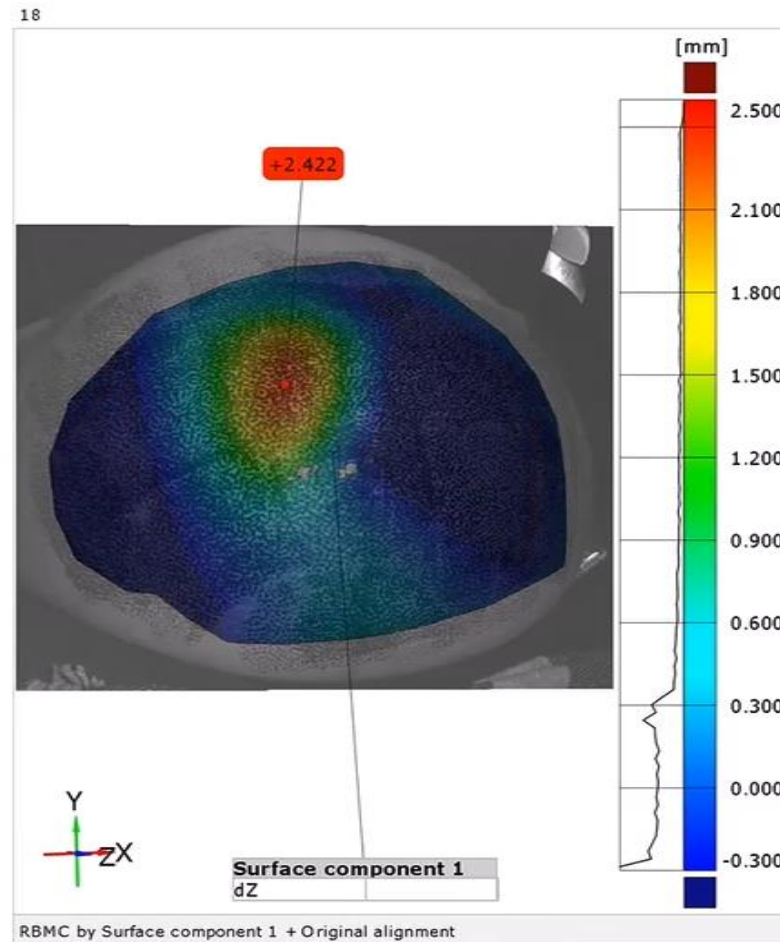
ARAMIS



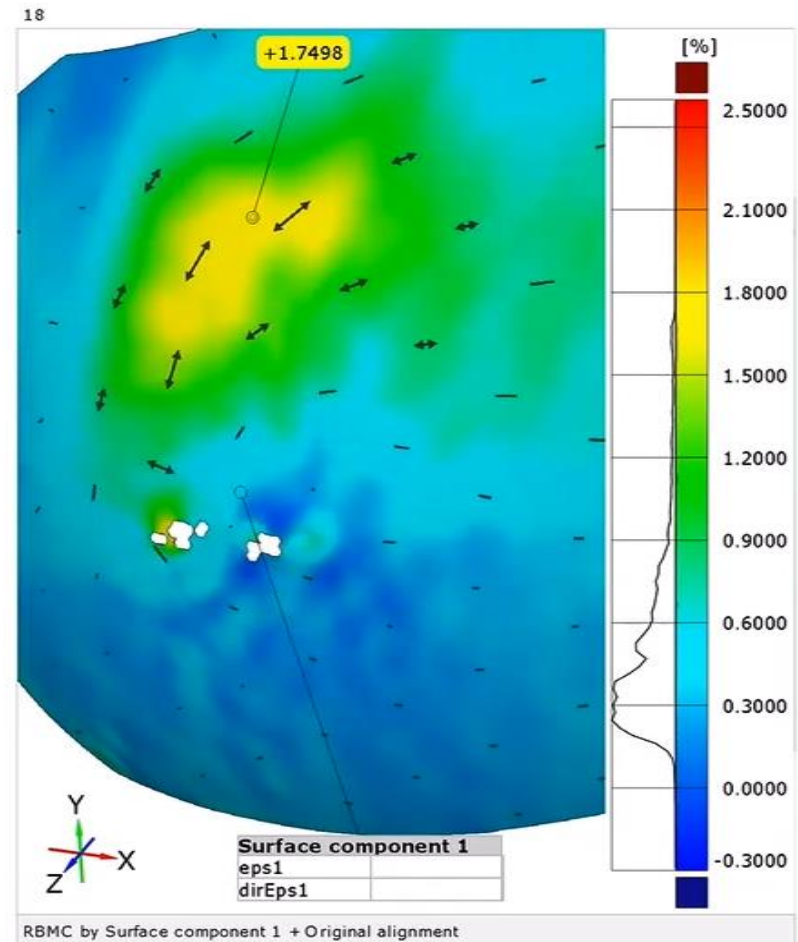
SHOE TESTING ADIDAS



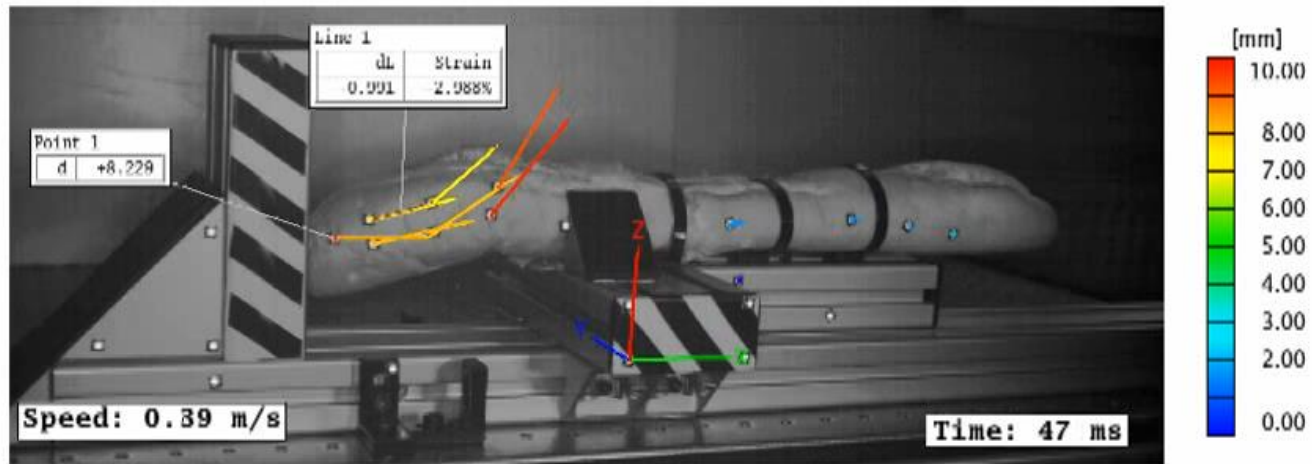
SKIN MEASUREMENTS SOFIA PREGNANT BELLY



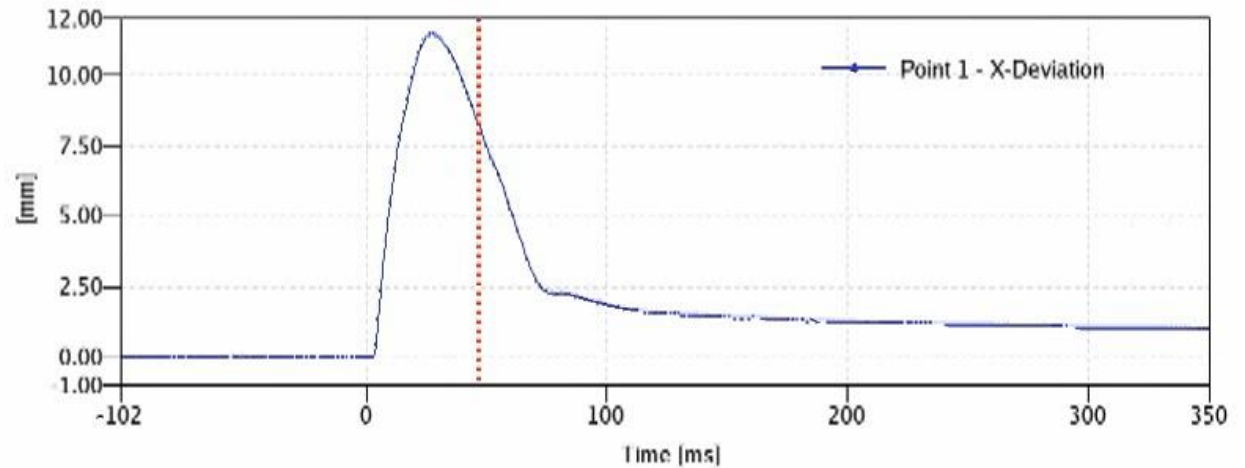
Trilion Quality Systems - Pregnant belly



FRENCH BAGUETTE CRASH TEST



Deformation (Vector)

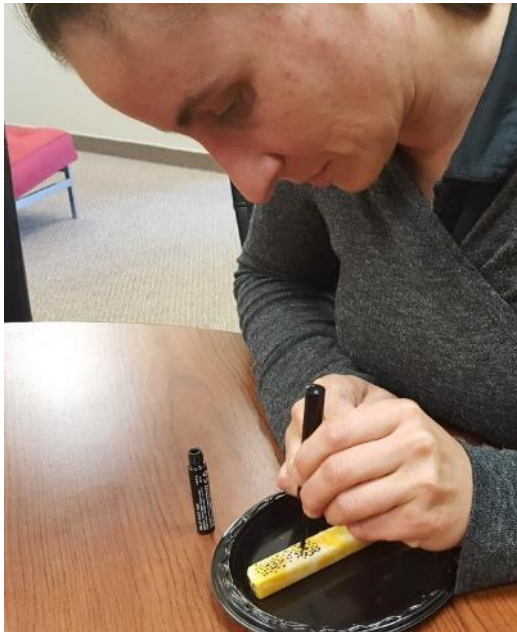


AMERICAN CHEESE STICK DROP TEST

Make-up patterning from facial studies at UPenn Hospital (Botox study)



PHOTRON AX200
512 x 512 pix @ 5,000 FPS



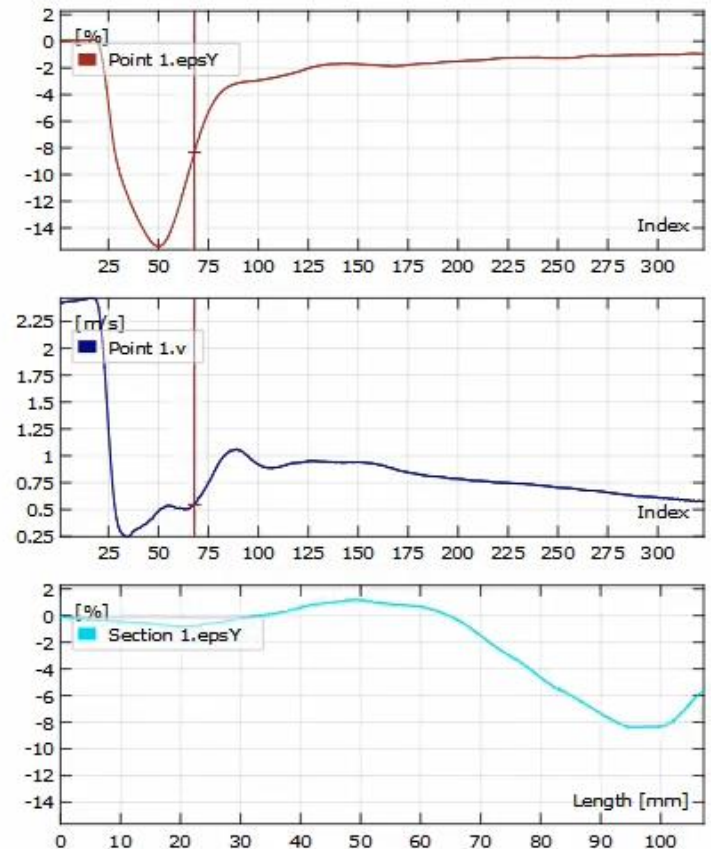
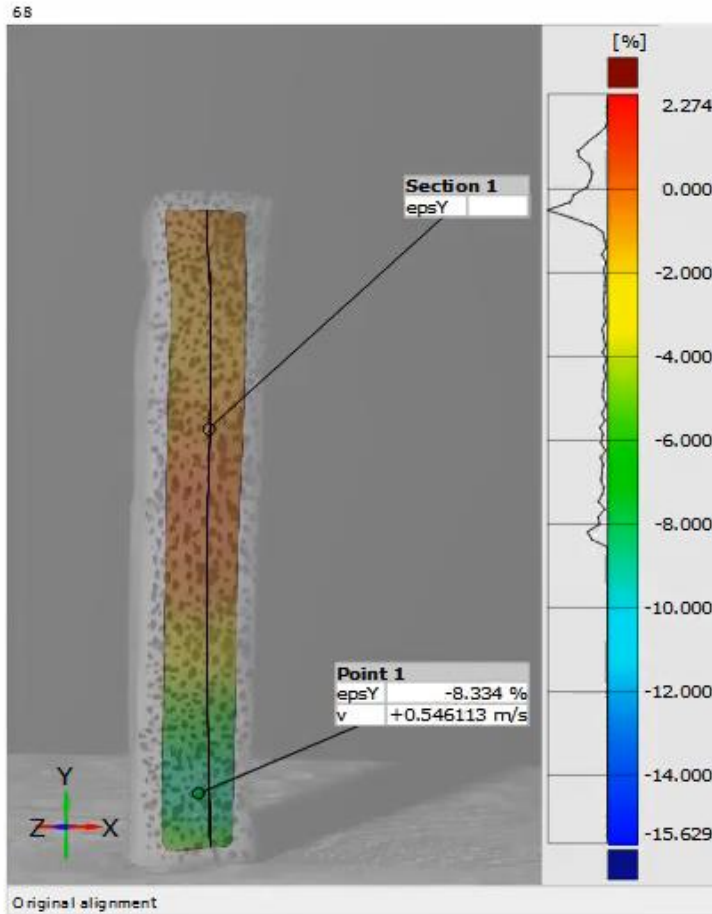
Colby Jack

Mozzarella-
Cheddar

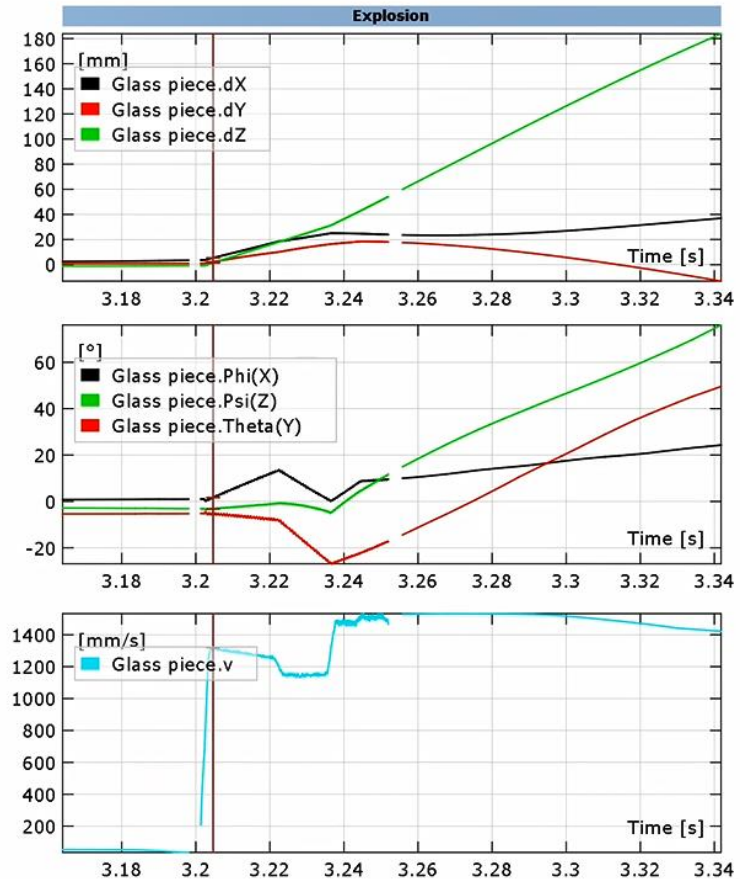
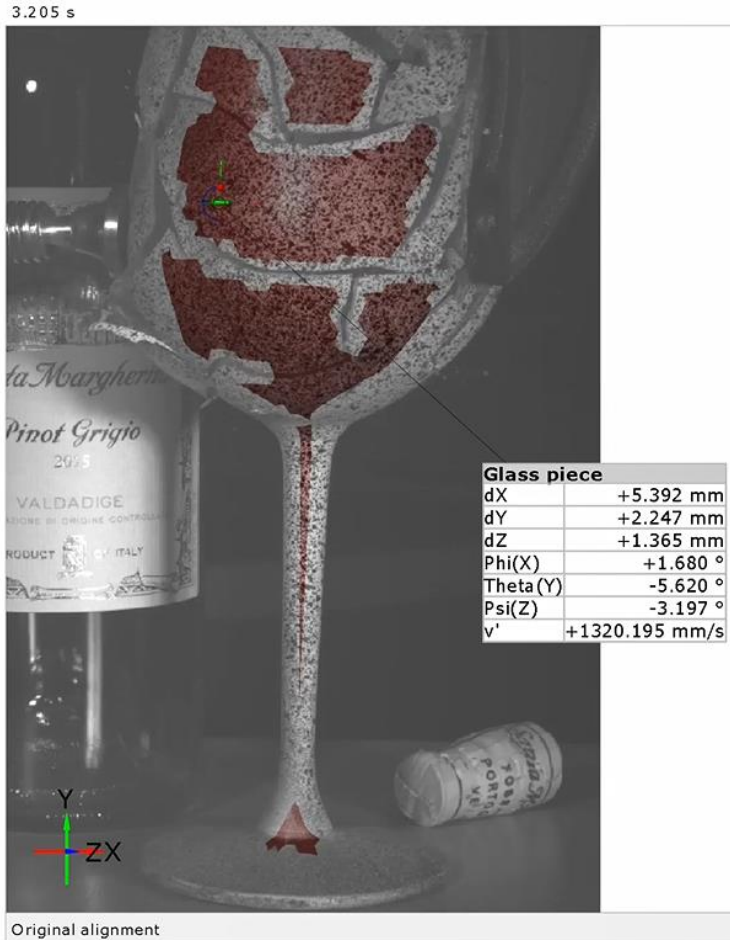
Sharp
Cheddar

AMERICAN CHEESE DROP TEST

Sharp Cheddar



WINE GLASS COMPRESSION TEST



PARAMETERS OF THE TESTS

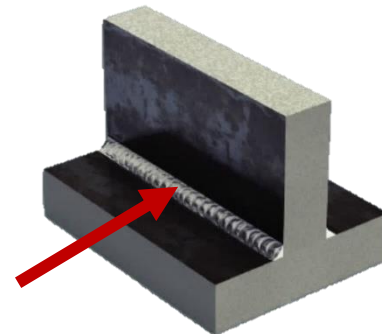
01/31/2017

Test conditions

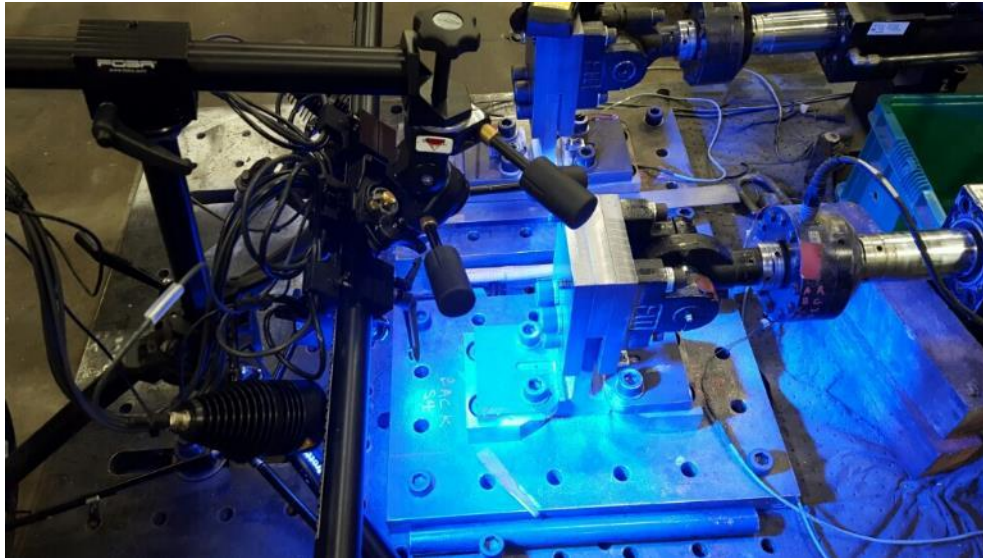
- Tests done machined and welded T-shaped
- Cyclic Loading -24 kN to -2.5 kN at 5.1Hz
- The ARAMIS 6M DIC system was calibrated once on-site prior to testing
- A single view, focusing on the joint, was taken
- A visual pattern was applied with spray paint, blue lights were used to optimize the lighting conditions and to prevent chromatic aberrations

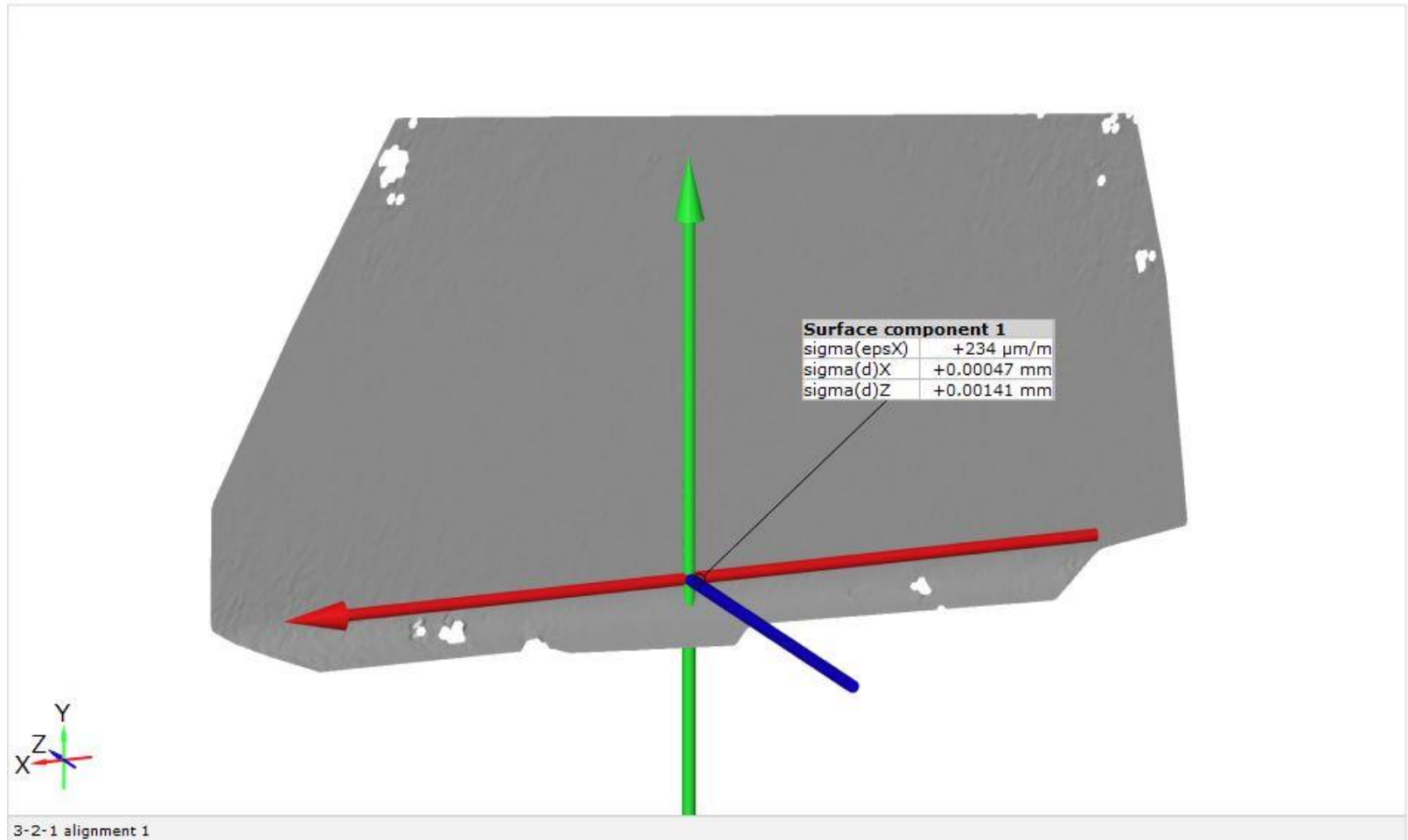
Acquisition parameters

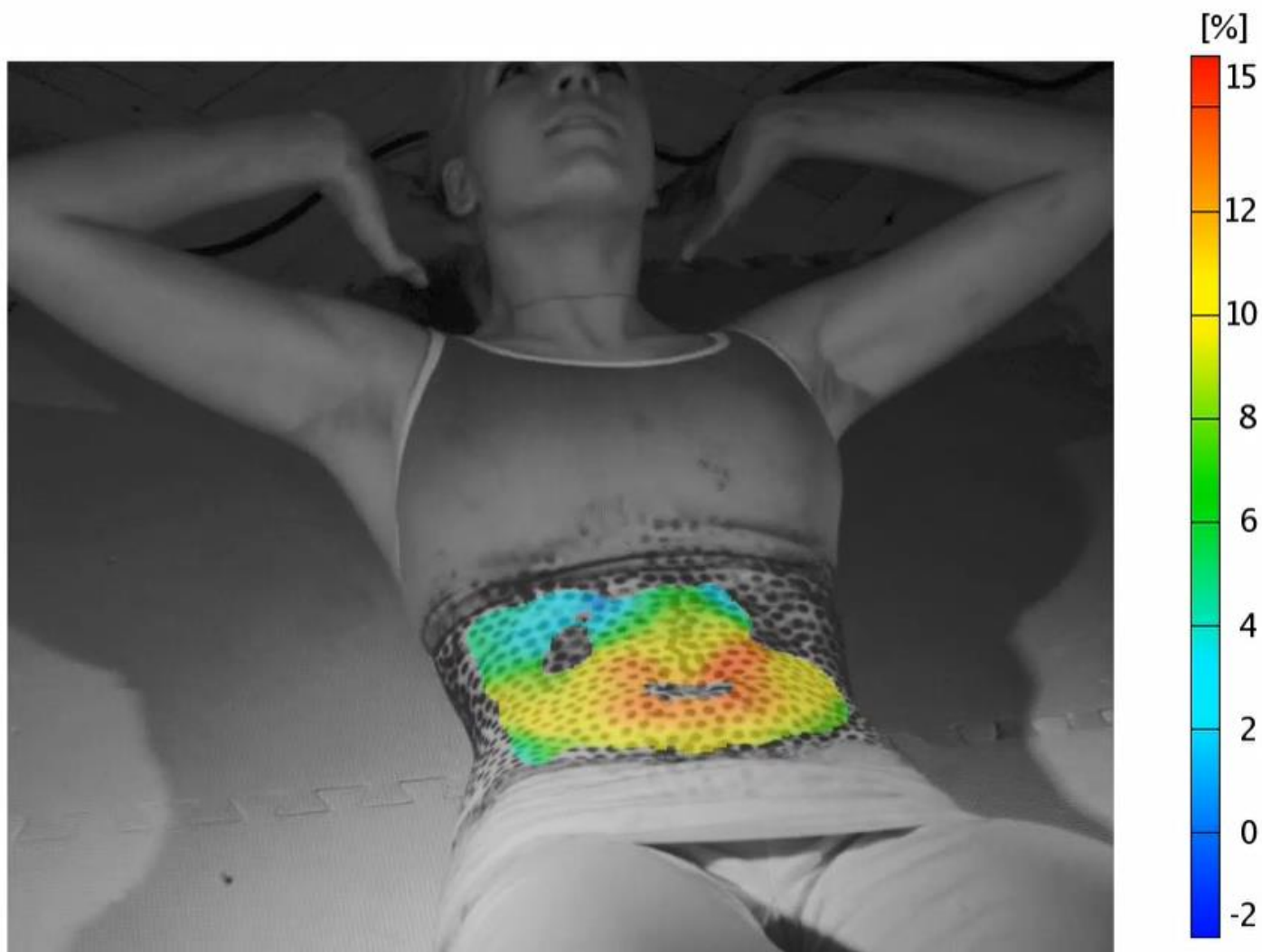
- Frame rate: 44fps
- Resolution: 1,376 x 1,100 pixels
- Measuring volume: 50 x 60 x 30 mm
- Camera angle: 24°
- Equivalent strain gauge length: 1.5mm



ACTUAL VIEWS SETUP AND SENSOR IMAGE



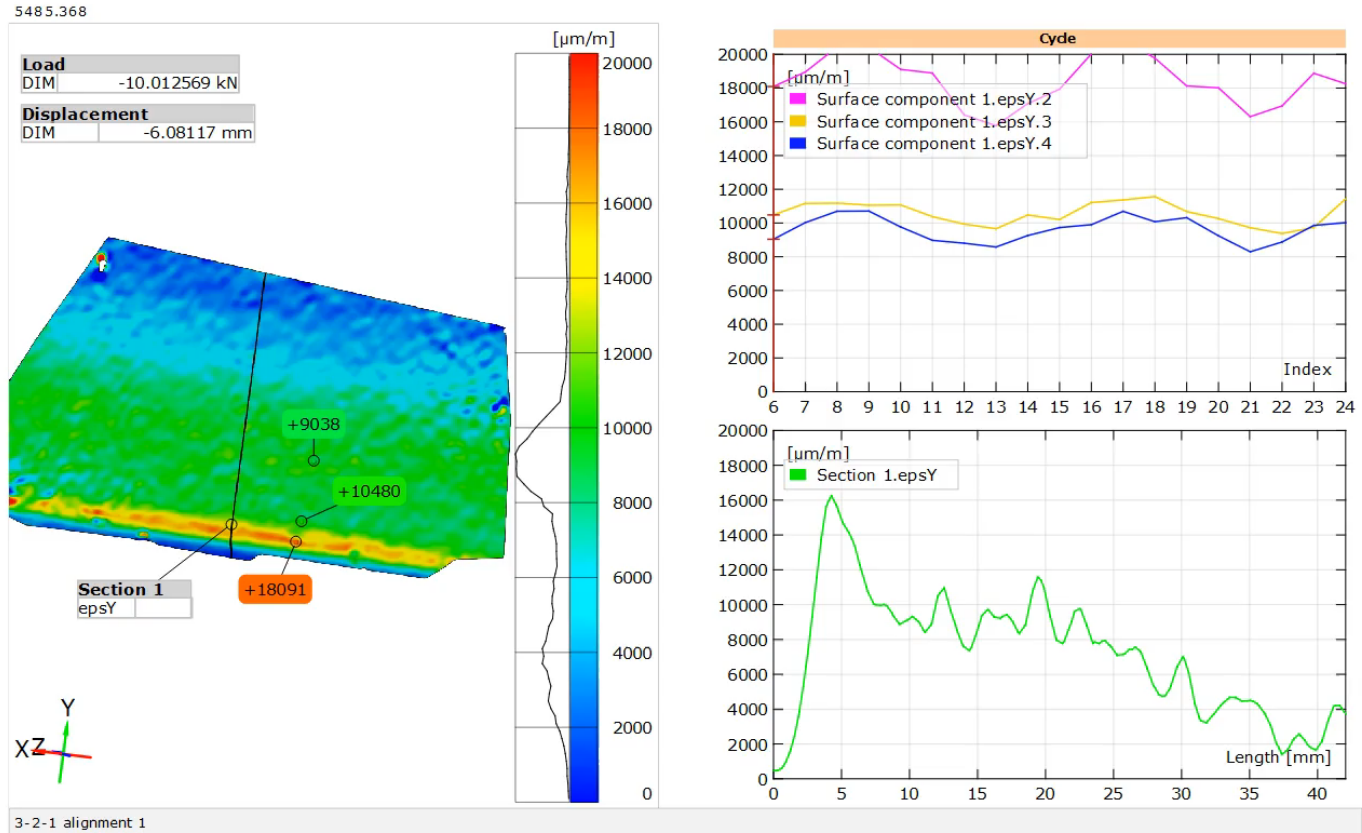
NOISE FLOOR**3D MODEL, COORDINATE SYSTEM AND NOISE FLOOR**

FATIGUE STUDY

SAE Fatigue – ARAMIS Testings
Trilion Quality Systems

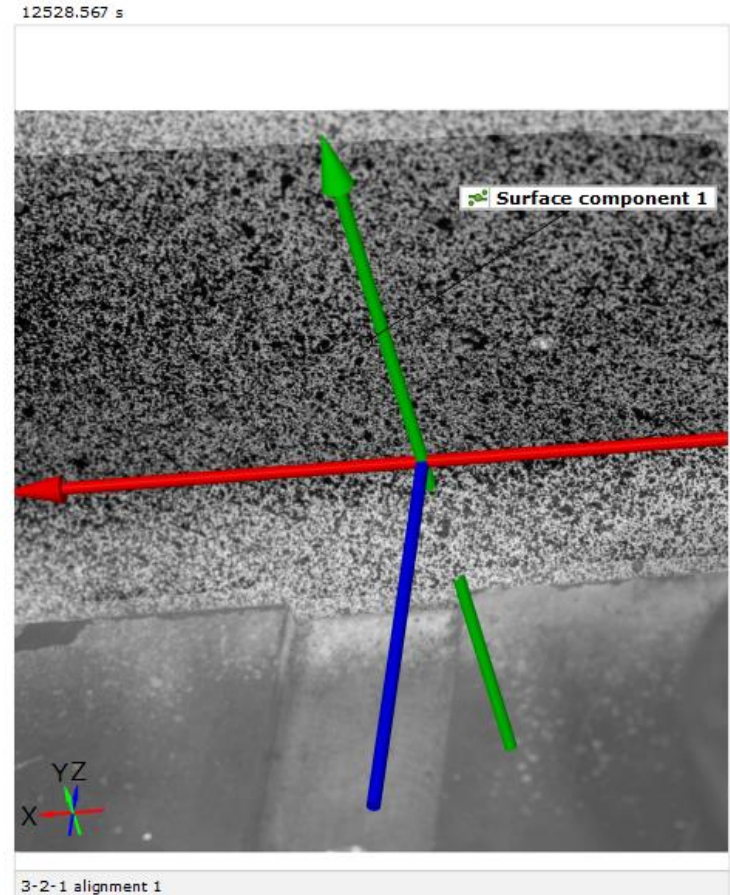
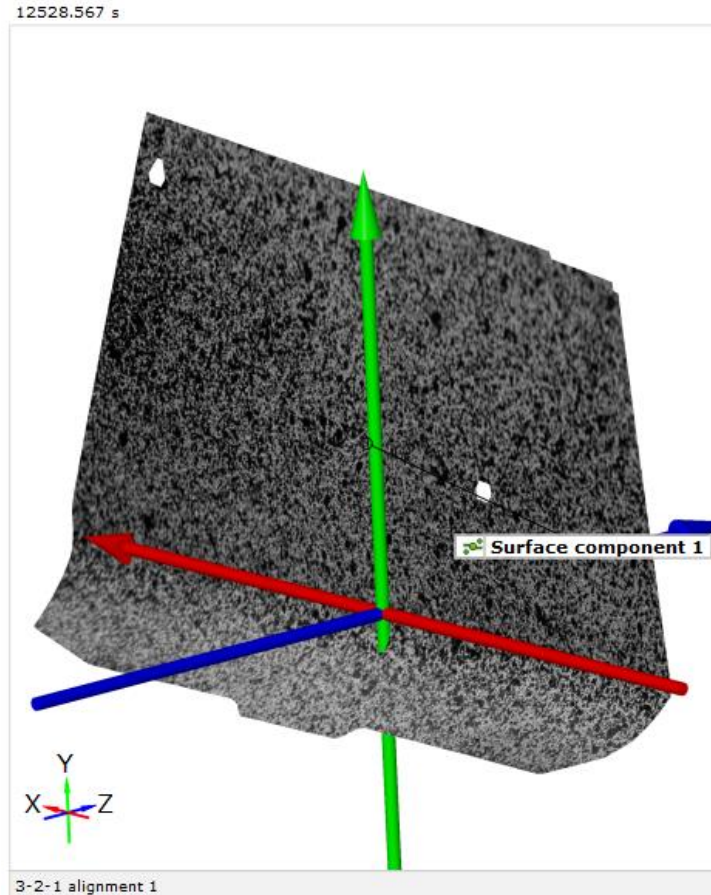


EPSILON Y AT VARIOUS POINTS AND SECTION LINE DURING CYCLES MACHINED SPECIMEN

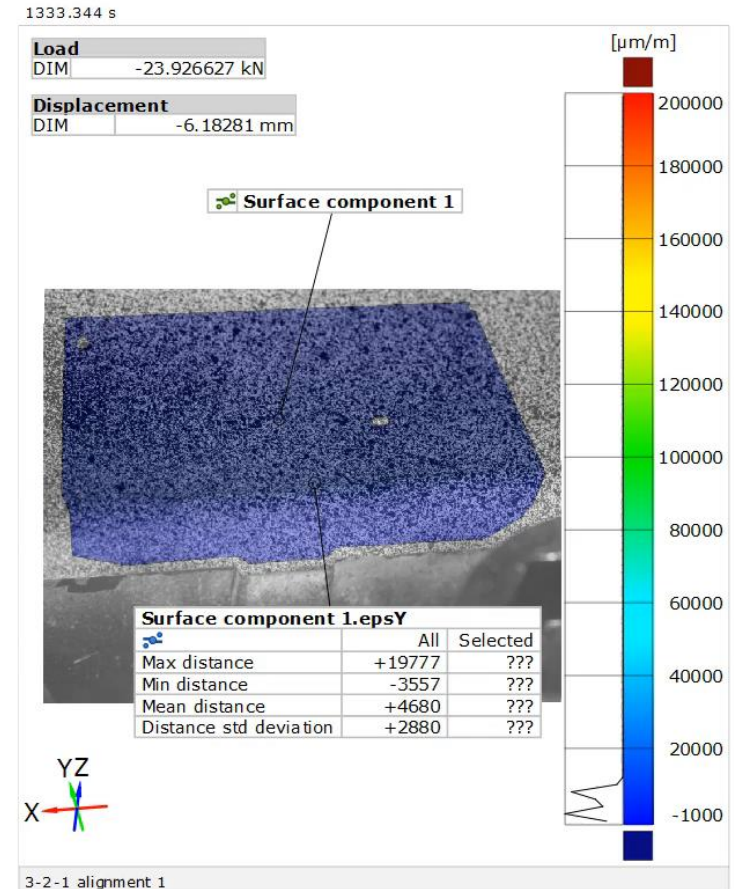
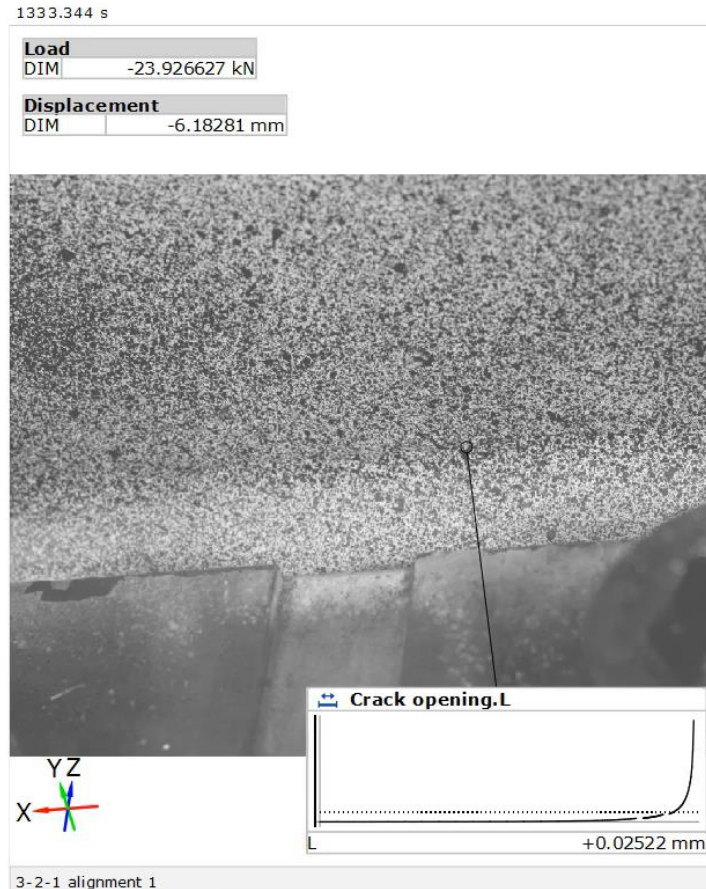


WELDED SPECIMEN – OVERVIEW

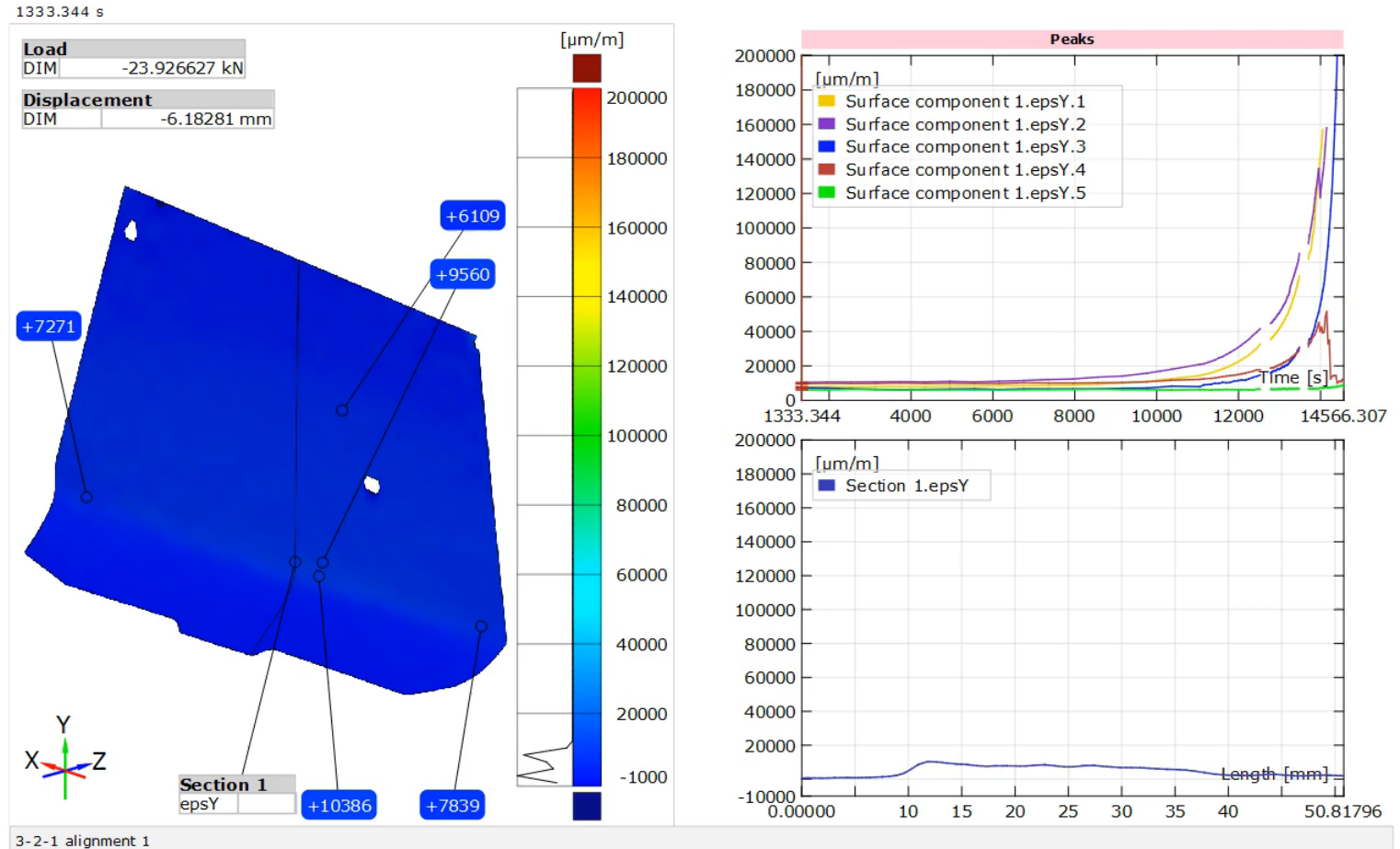
3D MODEL WITH PATTERN AND ACTUAL CAMERA VIEW



CRACK VISUALIZATION AND EPSILON Y DURING PEAKS WELDED SPECIMEN



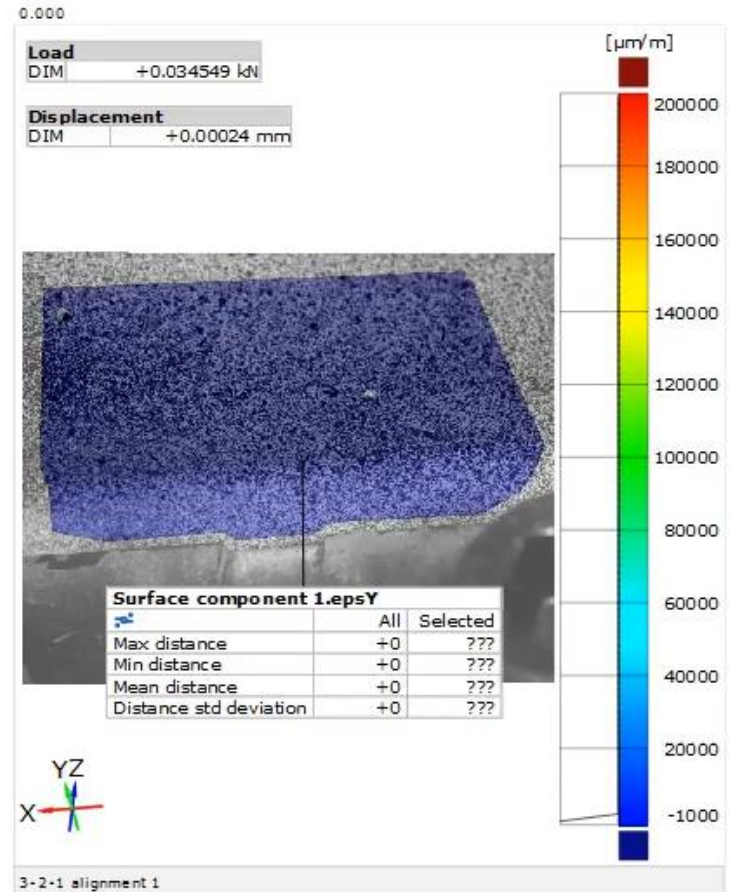
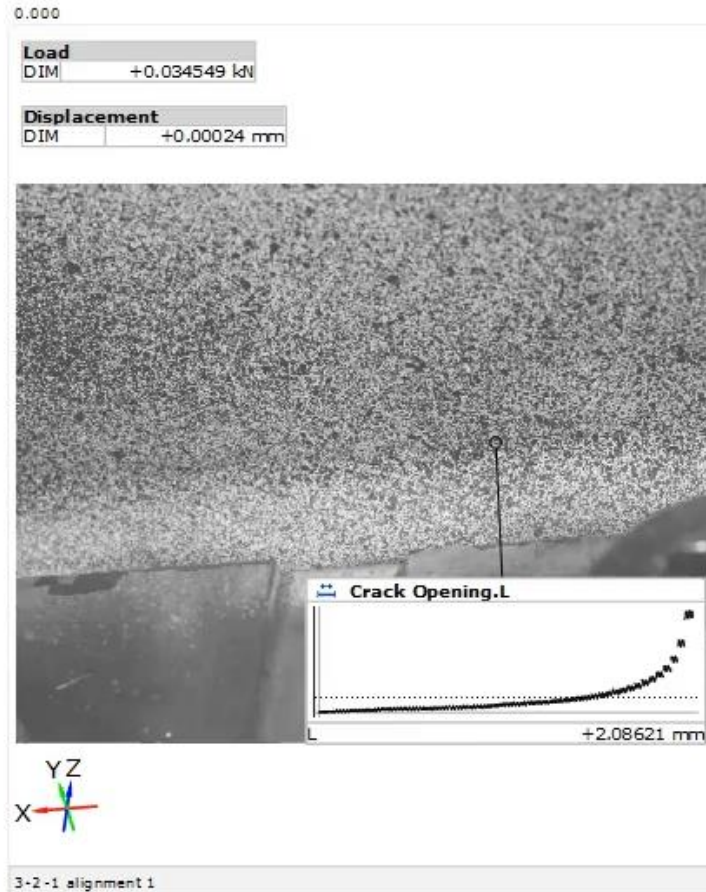
EPSILON Y AT VARIOUS POINTS AND SECTION LINE DURING PEAKS WELDED SPECIMEN



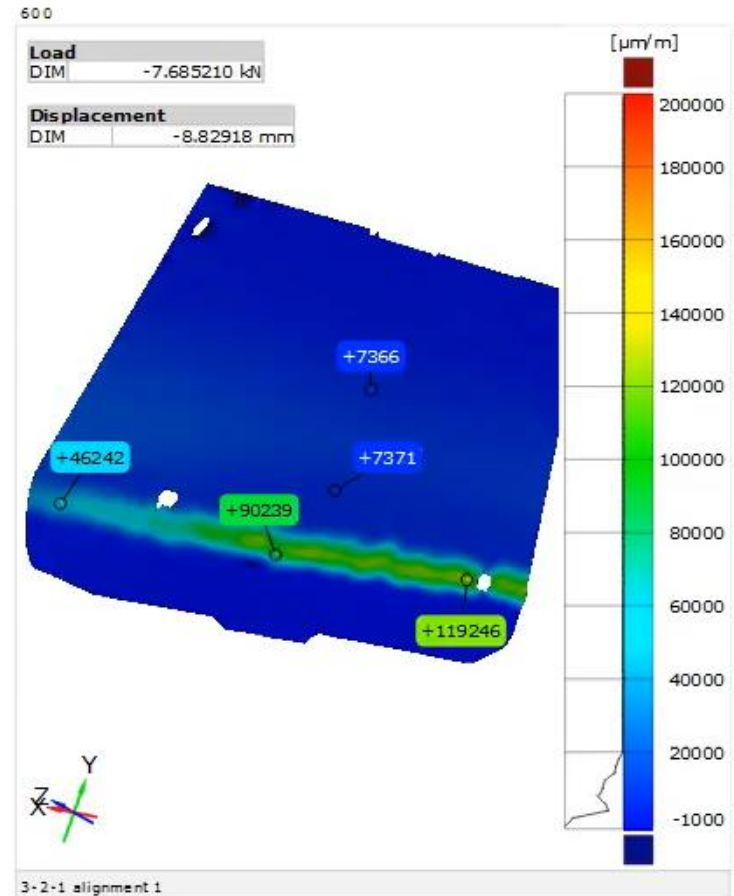
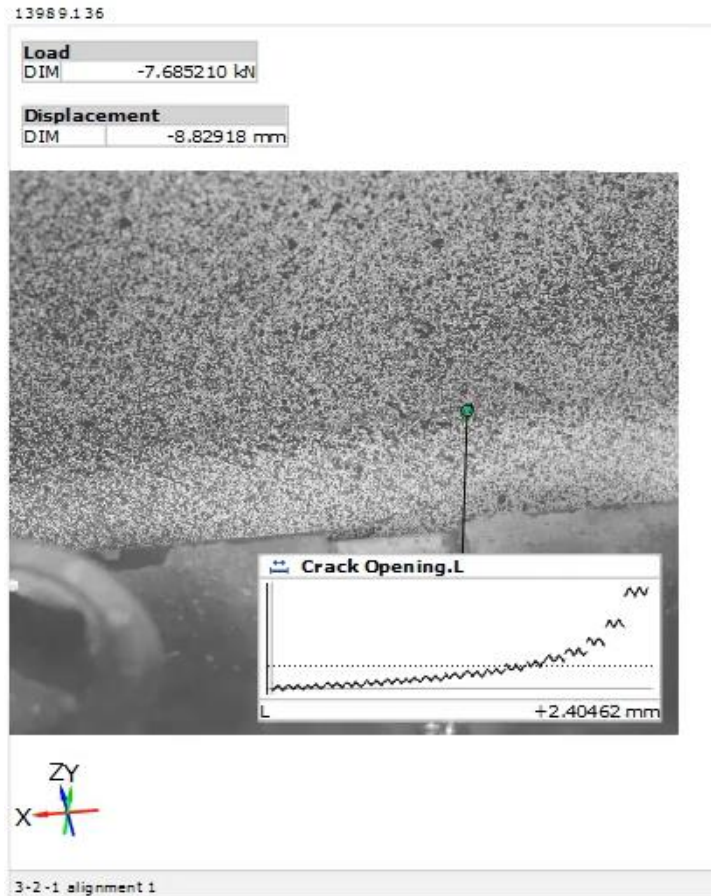
OVERVIEW OF MAXIMUM EPSILON Y AT PEAKS AND CRACK OPENING WELDED SPECIMEN



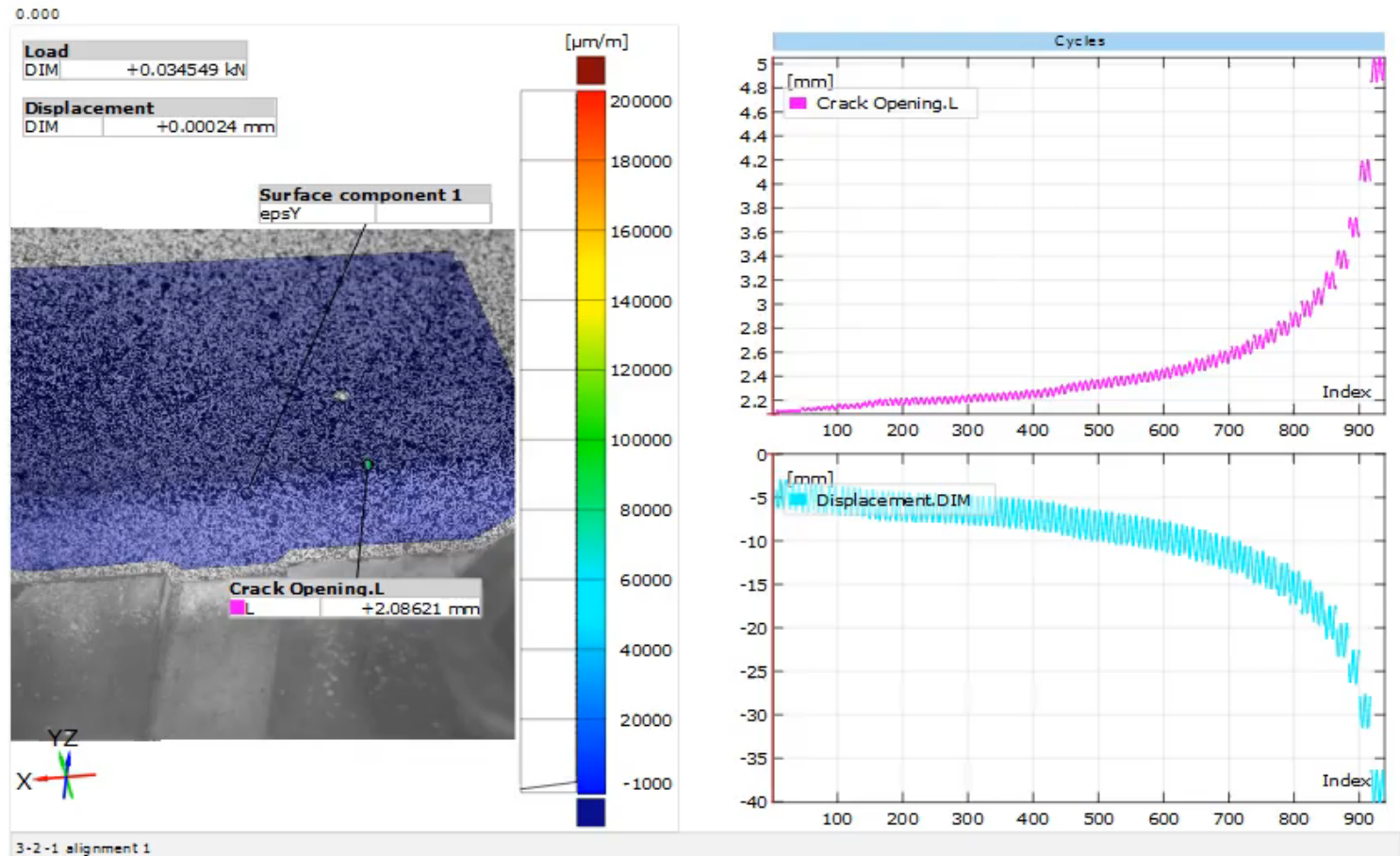
CRACK VISUALIZATION AND EPSILON Y DURING CYCLES WELDED SPECIMEN



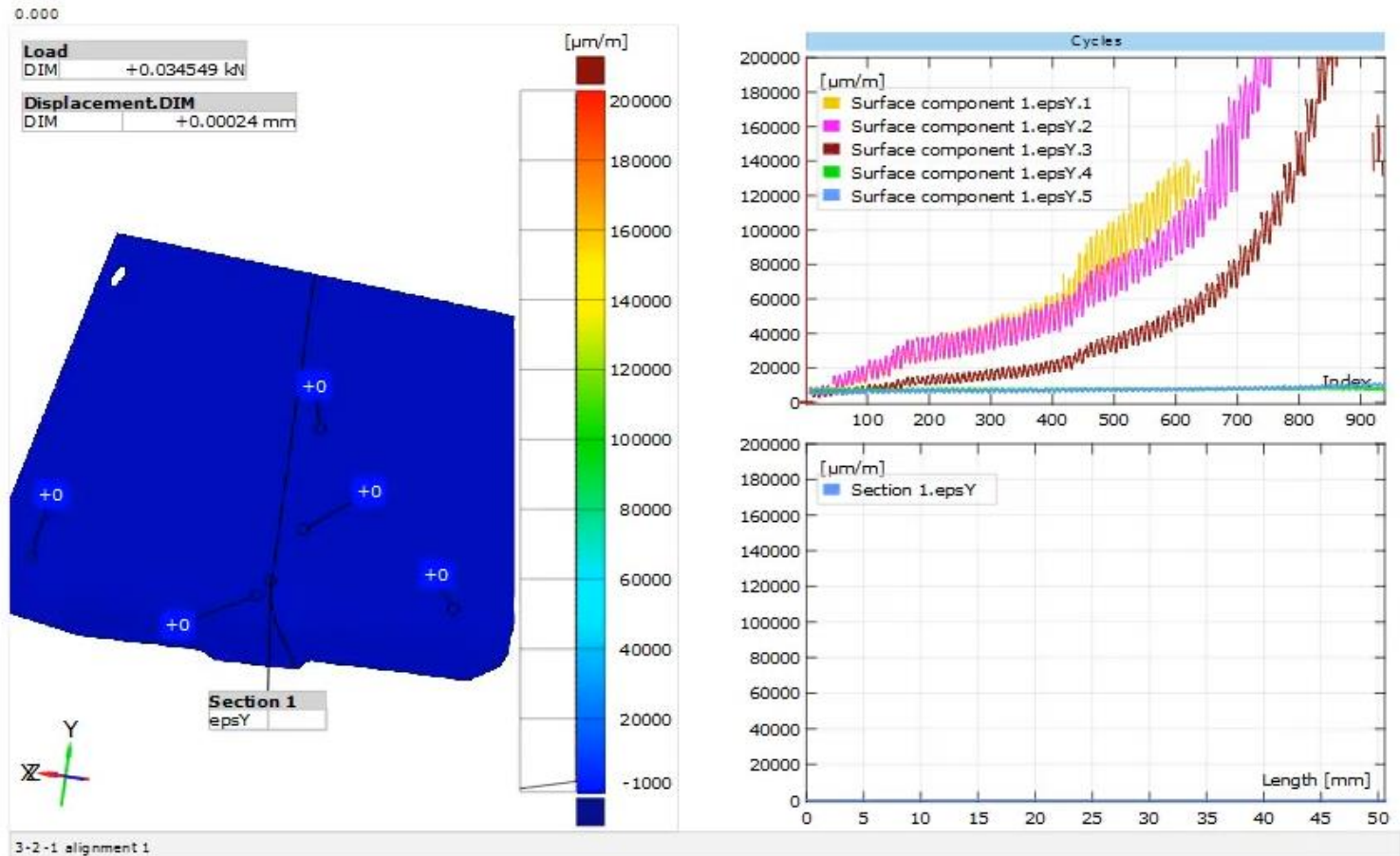
SLOWER CRACK VISUALIZATION AND EPSILON Y DURING CYCLES WELDED SPECIMEN



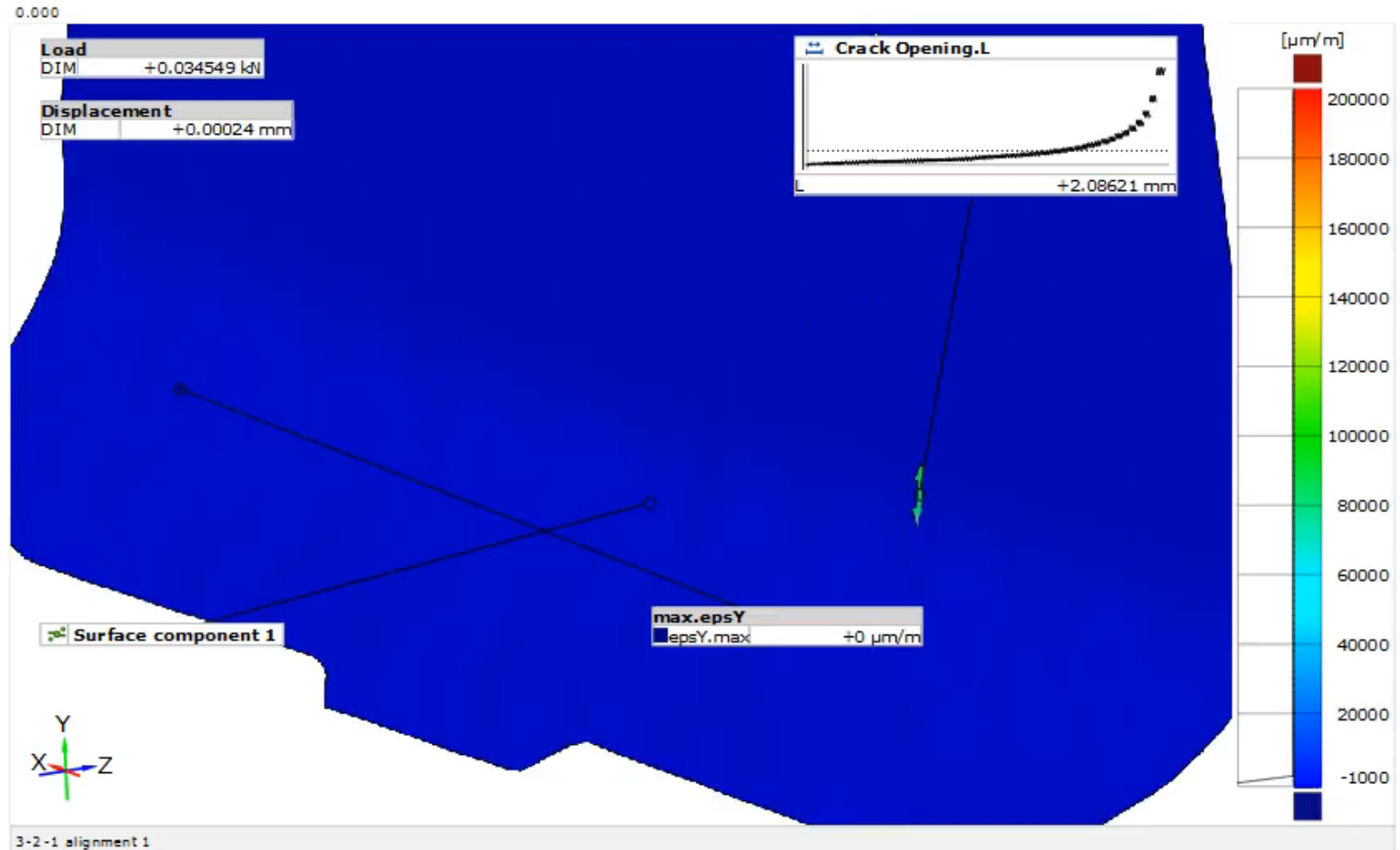
CRACK VISUALIZATION AND EPSILON Y DURING CYCLES WELDED SPECIMEN



EPSILON Y AT VARIOUS POINTS AND SECTION LINE DURING CYCLES WELDED SPECIMEN



OVERVIEW OF MAX EPSILON Y DURING CYCLES AND CRACK OPENING WELDED SPECIMEN



Next steps

Data available

- ARAMIS project files with free viewer to perform additional analysis
- Video files presented in this report
- If you need additional analysis, please contact us

How to access it?

- Eric Norton, John Deere, NortonEricM@johndeere.com
- Jonathan Pickworth, Trillion Quality Systems, jopick@trillion.com

For more information,
feel free to contact us:

Jonathan Pickworth
jopick@trilion.com
215.710.3000

Trilion Quality Systems
www.trilion.com



THE ARAMIS 6M SYSTEM

SPECIFICATIONS OVERVIEW

ARAMIS Adjustable Base 6 Megapixels	
Camera Resolution	2,752 x 2,200 Pixel
Frame Rate (Hz)	25 Hz (up to 44 Hz)
Camera Frame (mm)	500 / 800
Measuring Area (mm)	up to 5000x4000mm ²
Typical displacement uncertainty (100mm field of view)	0.4 – 1.2 micrometer
Typical displacement uncertainty (1m field of view)	4 – 12 micrometer
Strain Measuring Range	0.005% up to > 2000%
Strain Measuring Accuracy	up to 0.005%
Operating Temperature	5 – 40°C
Specimen Temperature	typ. -100°C up to +1500°C

