MERCURY RT

Comparison of DIC and FEA

In engineering, **component testing** is essential to verify that products meet **design specifications, safety standards, and performance expectations**. Engineers test either **individual parts** or **entire structures** depending on the required insights and testing methodology. One of the most effective ways to analyze component behavior is by combining **Digital Image Correlation (DIC)** with **Finite Element Analysis (FEA)** for precise strain and displacement evaluation.

Objective

This study aims to evaluate the **strain and displacement fields** on both the **top and side surfaces** of a clamping device component. The results obtained using **DIC** were compared with predictions from **FEA** to assess the accuracy of the two methods.

Description of the Case Study

The test was performed on a **clamping device component**, analyzing **strain distribution** and **displacement** under two conditions:

- **Half-way screwed**
- **Fully screwed**

A pair of **synchronized 2.3 MP Ximea cameras**, capturing images at **20 fps**, was used to track **surface displacement and strain** with high precision. The cameras were positioned at a **20° angle** to accurately capture **out-of-plane motion**.

The data obtained provided insights into the **structural integrity** of the component and allowed for a direct comparison between experimental **DIC results** and simulated **FEA predictions**.

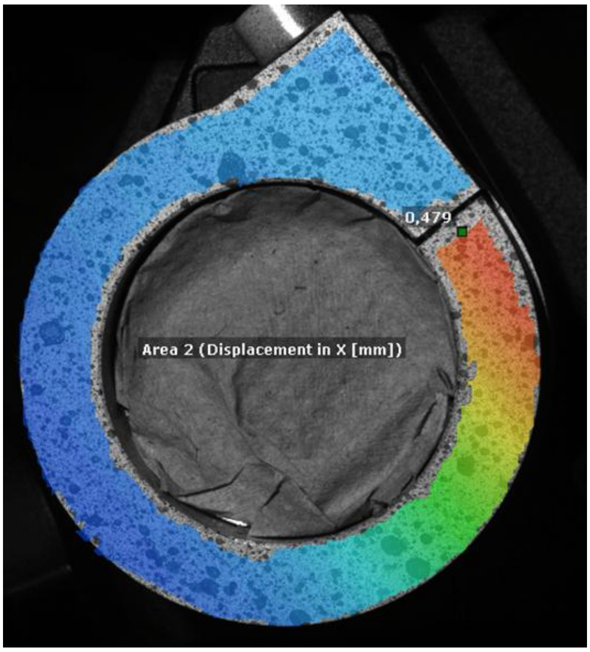
Fig 1: Clamping device.

MERCURY RT

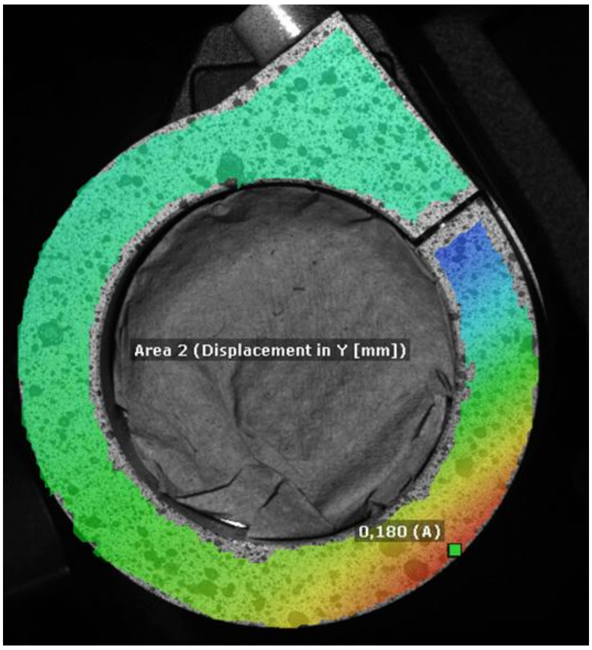
Visual Results

❖ Displacement Measurement

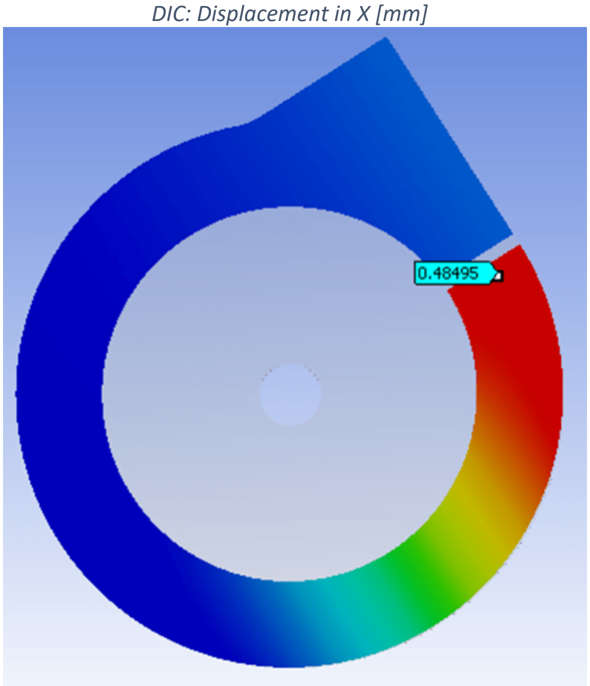
The displacement in the **X and Y axes** was measured on the **top surface** of the component after fully tightening the screw. The results are shown in the two images below:



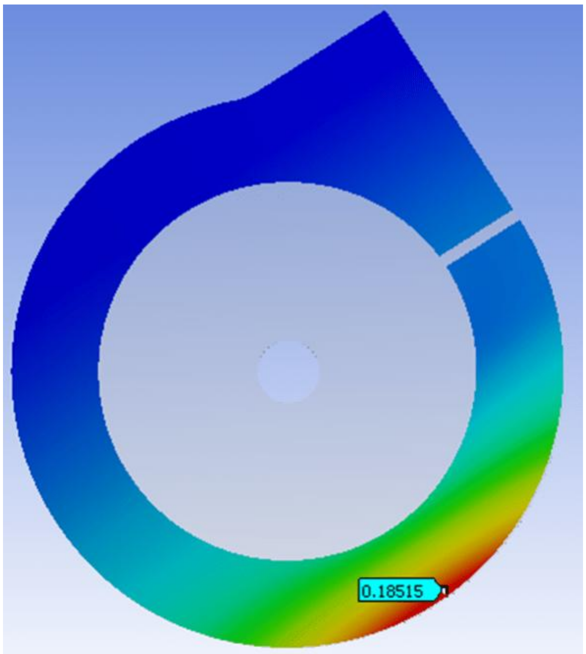
DIC: Displacement in X [mm]



DIC: Displacement in Y [mm]



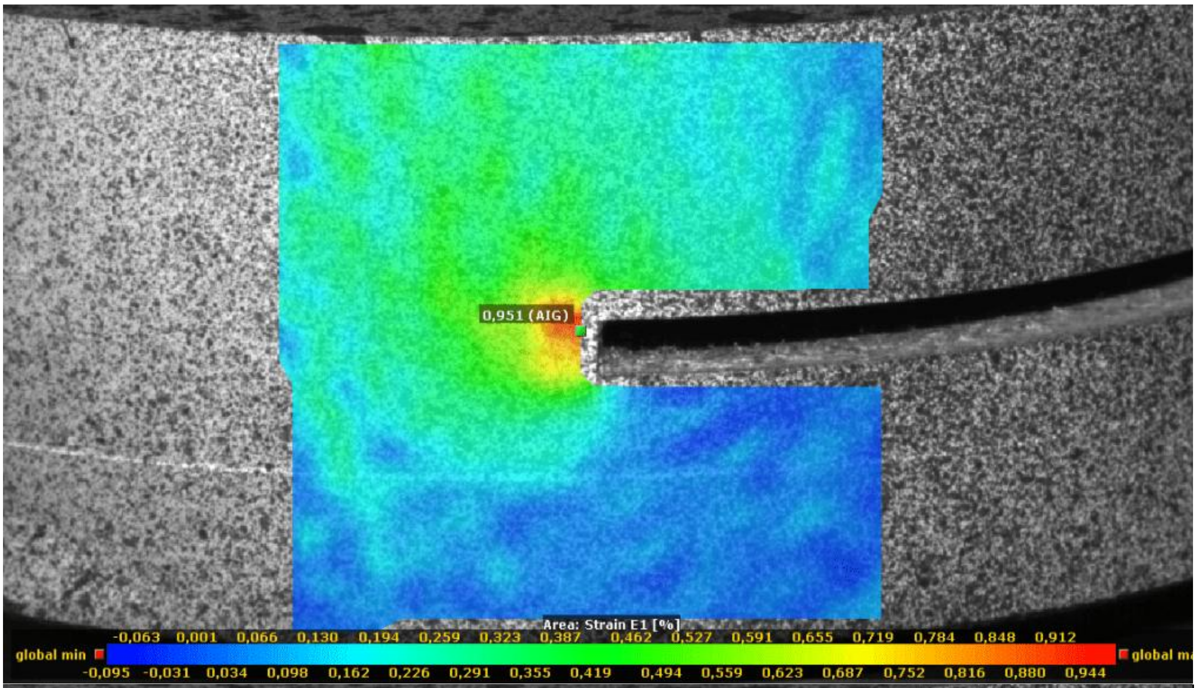
FEA: Displacement in X [mm]

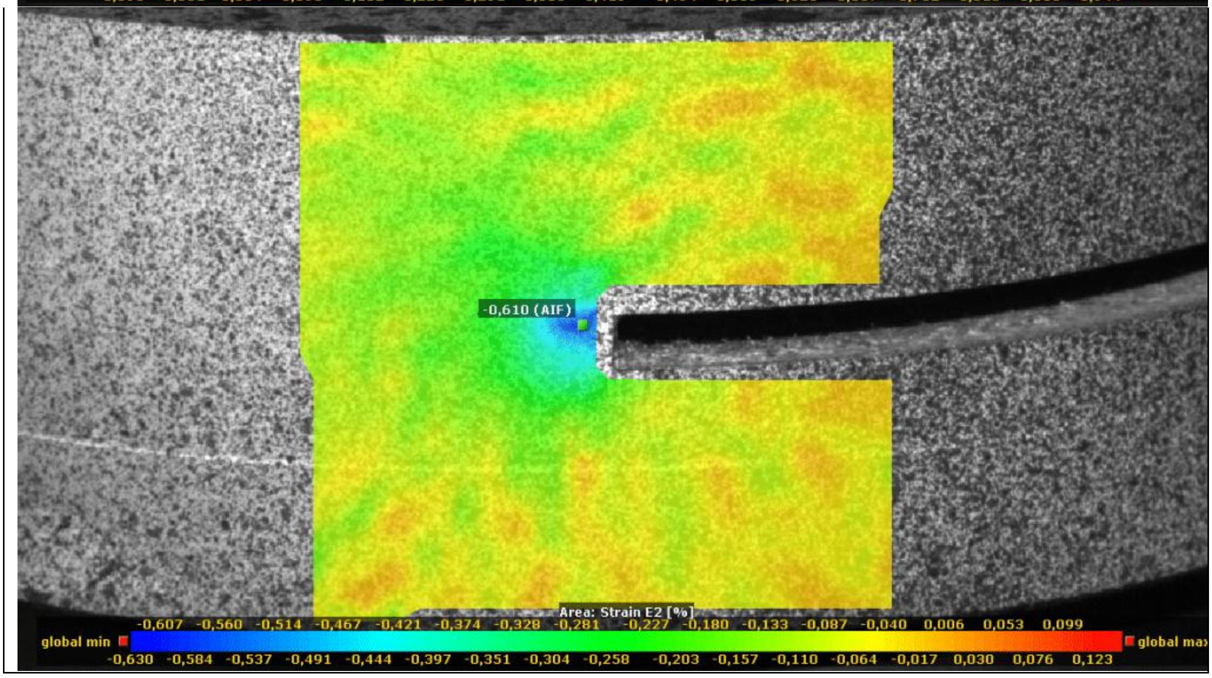


FEA: Displacement in Y [mm]

❖ Displacement Measurement

Next, strain values were measured in **E1** and **E2** directions under identical conditions. The following images show the results for both:



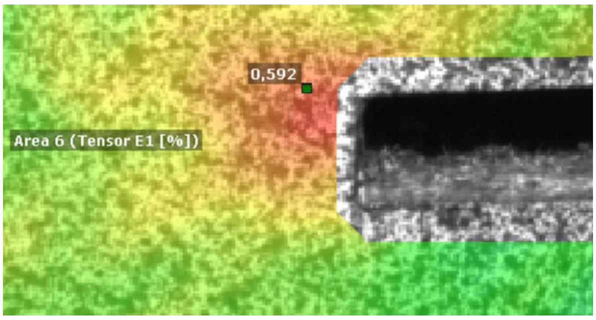


To further compare the experimental and simulated results, the strain values were recorded when the **screw was halfway tightened**. The comparison between **DIC and FEA** is as follows:

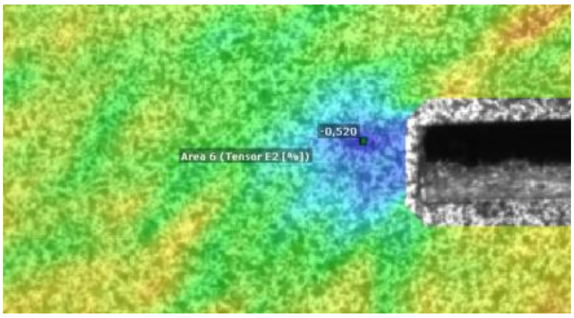
- **DIC: 0.592 % | FEA: 0.603 %**
- **DIC: -0.520 % | FEA: -0.523 %**

With a **highest percentage difference of less than 3%**, the **DIC method closely matched FEA predictions**, validating its accuracy in component testing.

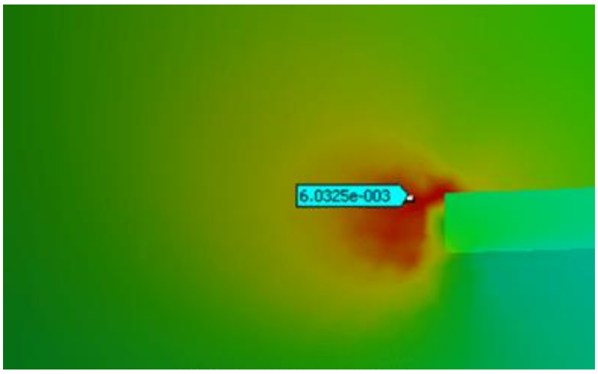
Mercury MS s.r.o,
Maříkova 2043/42, Řečkovice, 621 00 Brno.
www.mercury-dic.com
info@mercury-dic.com



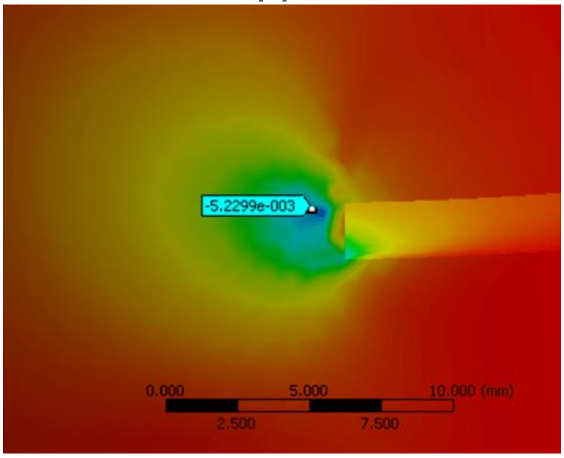
E1 [%]: DIC



E2 [%]: DIC



E1 [%]: FEA



E2 [%]: FEA

Advantages of Using DIC for Component Testing

❖ **Full-field strain and displacement tracking** instead of point-based data from traditional sensors.

❖ **Non-contact measurement,** avoiding errors introduced by mechanical sensors.

❖ **High accuracy and flexibility,** capturing strain and displacement across complex geometries.

❖ **Post-processing capabilities,** allowing in-depth analysis and direct comparison with FEA simulations.