APPLICATION NOTE
AN-1801

TRILION - APPLICATION NOTE
Bicycle Frame Mechanics

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Problem overview

Final design validation of complex structures can be challenging when considering the intricacies of the mechanics involved in their use. Accordingly, traditional measurements fail to provide meaningful information of the structures actual performances, thereby facilitating the need for alternative methodologies. Optical Metrology allows for full-field data acquisition to show complex strain gradients and displacements encountered in such scenarios.

Test setup

Figure 1 Speckle pattern and applied load

Notes

The optical metrology tool, ARAMIS 3D DIC, was used to measure full-field strain and displacement gradients at the head tube of a bicycle frame during an applied load, simulating a jump landing (Figure 1). Whereas typical measurement tools require an intimate knowledge of the mechanics involved to know where to apply a gauge, ARAMIS employs a stochastic pattern to illuminate all points of interest on the test article. A compressive load was applied to the top and down tube geometry, simulating a jump landing. The resultant force strained the head tube joints showing the complex strain gradient across the entire region (Figure 3). The applied load displaced the two arms of the frame approx. 100 microns which can be seen in Figure 2. A rigid body motion correction was applied to see the resultant motion of the top and down tube during the loading relative to the head tube (Figure 2). The principle strain gradient map shows the weld in compression (point 1), while the outer radius of both the top and down tubes are under tension (points 2,3)

Conclusion

Utilizing the unique ability of ARAMIS to negate translational motion when measuring displacement, the result of the simulated load due to landing was able to be directly measured. In this case, the ARAMIS was able to track very small frame displacements, on the order of a micron, as well as principal strain concentrations in the region of interest. Traditional tools are not able to solve this, so ARAMIS provides the better, or in most cases, the only solution.

For more information on this application, please contact Trilion Quality Systems, world leader in custom optical metrology.

Keywords: DIC, Digital Image Correlation, Full-field strain, Bicycle frame load test

Figure 2 - Displacement and frame distortion along the loading direction

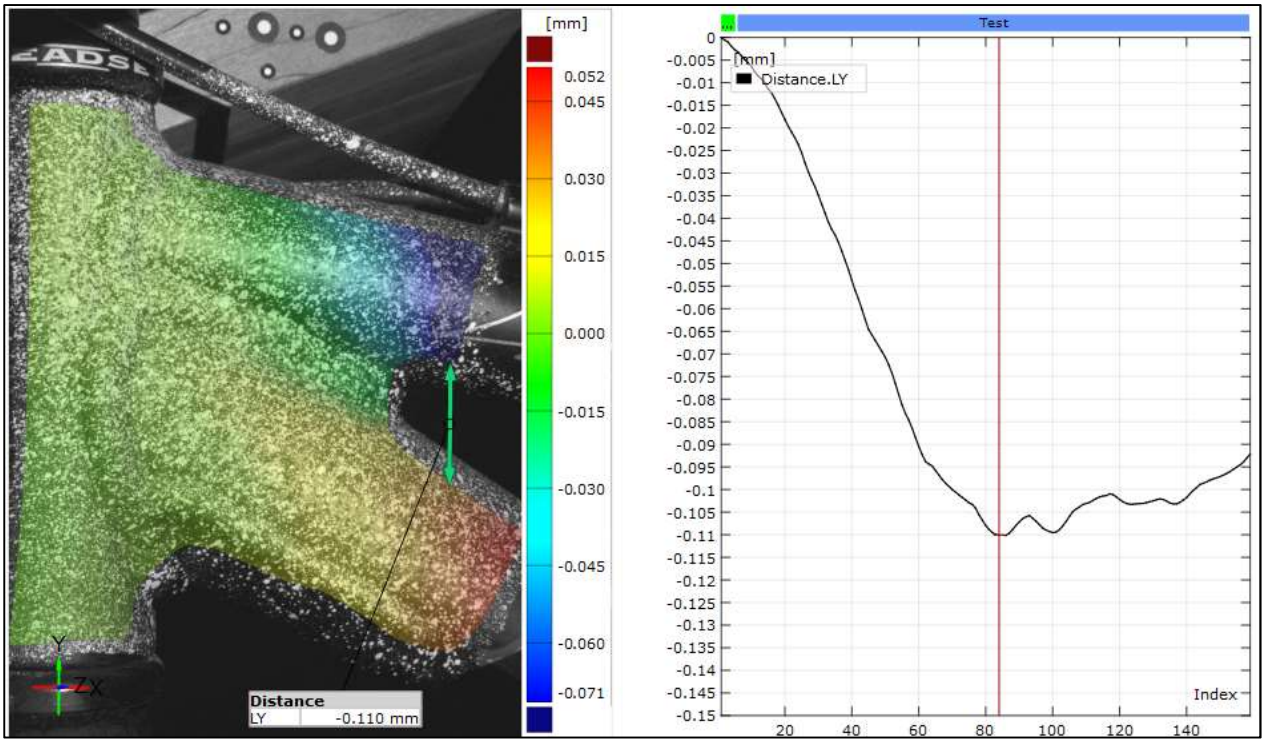

Figure 3 - Principal strain and extreme values points at top load