Case Study

Predicting failure in carbon composite suspension elements

Strain measurement in carbon fibre composite suspension components using the Axiom measurement system together with Video Gauge™

Published October 2023

Challenge

The design of carbon fibre composite suspension components in the automotive and motorsport sectors constantly seeks to improve performance whilst reducing weight and manufacturing costs.

This balancing act leads to a trade-off between performance gains and the risk of component failure over its lifespan.

Spending restrictions in modern Formula One exacerbate this problem and require components to last longer in demanding race conditions.

Traditional strain measurement methods, such as custom mechanical rigs with Linear Variable Displacement Transducers (LVDTs), are often problematic due to compliance in the test rig and in any non-composite elements of the component such as bearings.

Solution

Using Imetrum's Axiom as part of a programme of repeatable periodic data gathering, to feed in-house predictive wear and failure models, helps to improve useful life without risking reliability.

Pre-calibrated measurement volumes simplify the set up and testing process; allowing for rapid turn-around and batch testing that is efficient for technicians to complete. Axiom is available in a range of pre-calibrated volumes for components up to approximately 750 to 850mm in length and/or width.

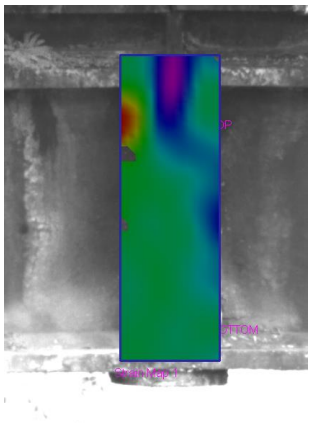
Axiom's accurate strain measurement across multiple points of the component allows baseline strain data to be gathered and compared to strain measurements after each race weekend. This enables the use of predictive analytical methods to model the expected failure point of the component and its current wear cycle and trend.

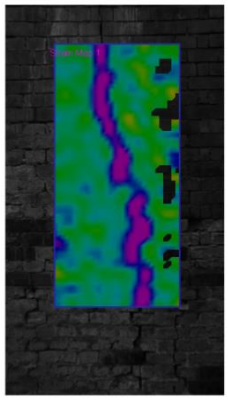
In some cases, the test rig has greater inherent compliance than the component itself, leading to potentially significant errors that could make the test useless for predictive failure analysis purposes. Axiom's video retention and post-processing capability allow historical test results to be revisited and re-analysed enabling side-by-side performance comparisons as well as facilitating the improvement of predictive wear models.

Results

Axiom eliminates these problems by directly measuring the carbon composite element of the component using Imetrum's video-based Digital Image Correlation (DIC) algorithms and 3D optical head. Being able to track multiple target points in the area of interest with a capture frequency of up to 120Hz during a live test and resolutions of between 0.03 and 0.4 µm (microns) provides assurance that the measured values are related to the component health and not compliance in the test rig.

In this instance we're able to track multiple target points, for example between the mounting centres which hold the component to the test frame, as well as across multiple axial and transverse measurement points across the component surface.





More advanced visualisations of strain are possible by applying a speckle pattern to the component surface.

On board post processing of the captured test video, allows features such as sub-surface cracks to be identified.

Visit the website page: https://www.imetrum.com/case-studies/predicting-failure-in-carbon-composite-suspension-elements/