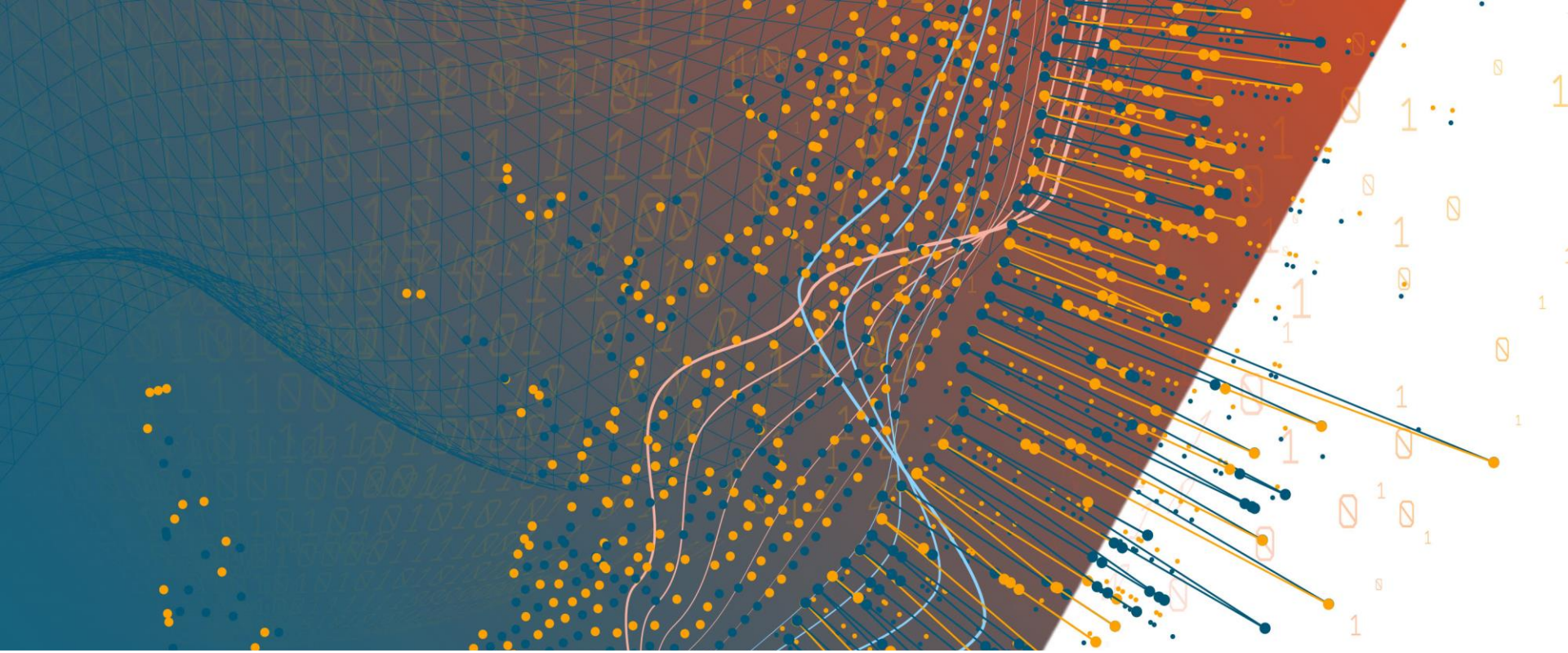


ALTAIR | EikoSim

EIKOTWIN DIC TOP USE CASES

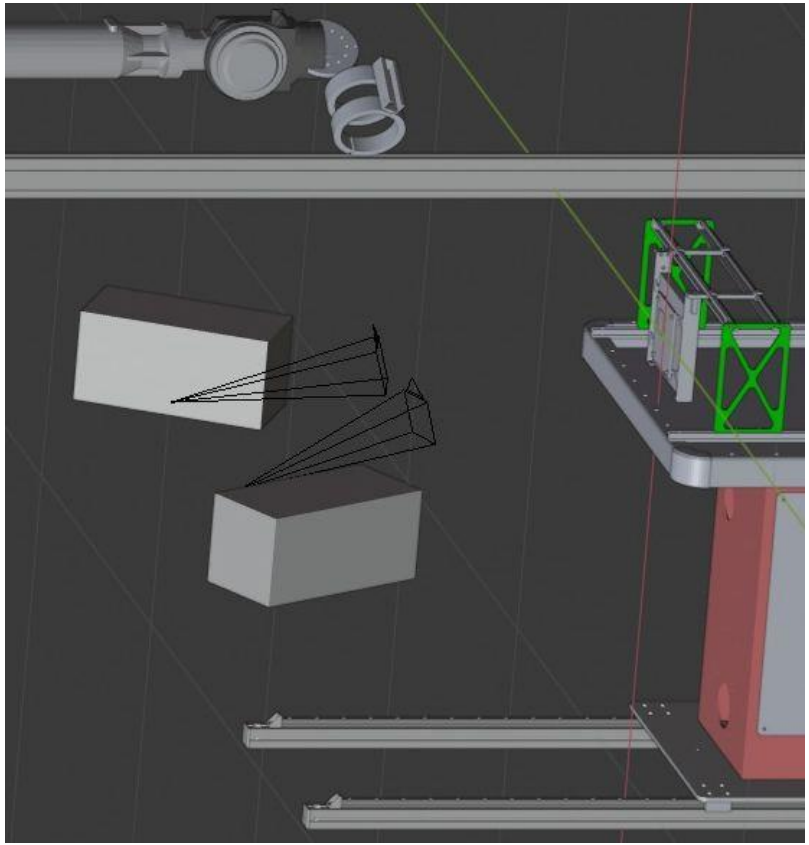
Altair Partner Alliance

Validation of Laser Impact Tests

Challenge

- This study carried out by EikoSim in collaboration with MBDA, ALPhANOV and the Laboratory of Mechanics and Technology (ENS Paris-Saclay), concerns steel sheets subjected to laser shots in their centre in the laser cabin.

  The aim is to quantify the thermomechanical effects undergone by the sheets thanks to the measurement of displacement fields by digital image correlation, in order to validate the thermo-mechanical FE analysis that was done.



Validation of Laser Impact Tests

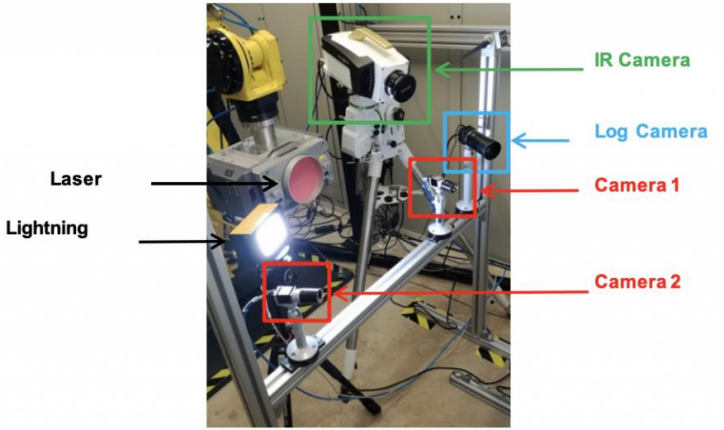
Solution

- The tests are instrumented with a stereovision device with two digital cameras, complemented by an IR camera and a logarithmic response camera. Digital image stereo-correlation allows for non-contact measurement of the 3D surface displacement fields of the part from the images taken during tests by the two digital cameras. This technique assumes of grey level conservation in images. The measured fields are expressed directly on the 3D surface model used for the finite element simulation.

  The measurement analysis shows a 3-step distortion of the sheet:

  1. After laser activation, the sheet in the impact area swells in the laser direction;
  2. Then the sheet in the impact area swells in the opposite direction to the laser;
  3. After laser deactivation, the sheet partially returns to its original position as it cools down.

  Digital image correlation provides access to displacements, as a function of time, at any point on the measurement mesh. By positioning a numerical displacement sensor at a point of the sheet mesh, the observed behavior on the displacement fields is confirmed.



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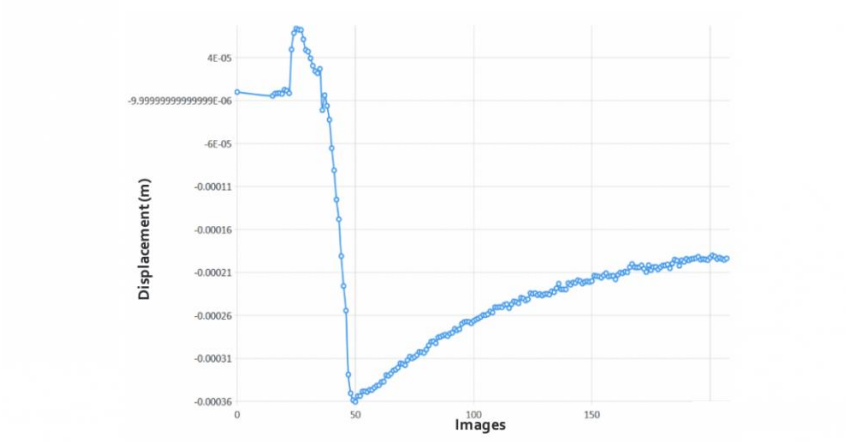
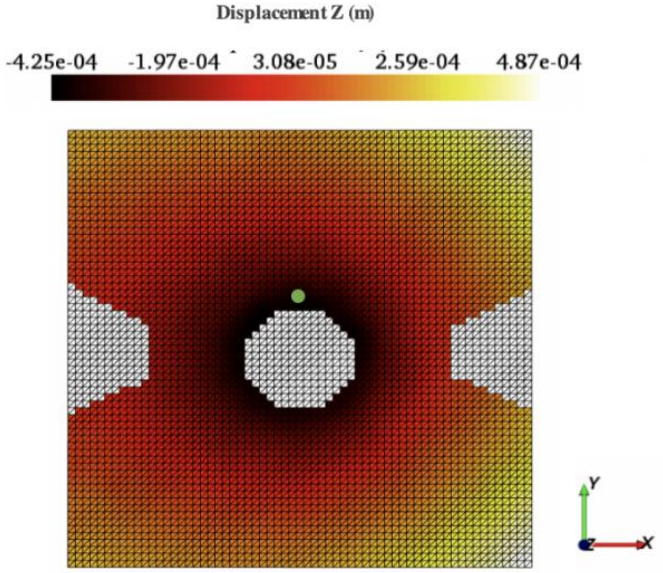
Validation of Laser Impact Tests

Results

- This work has demonstrated the feasibility of an experimental approach by digital image correlation with very encouraging results. They are only a first step in the exploration of the interpretation of power laser-matter interaction phenomena by digital image correlation. Results have been exported directly to HWASCII format in order to post-process displacement fields in Hyperworks and calibrate the simulation.





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Multi-part Simulation Validation at MCE-5

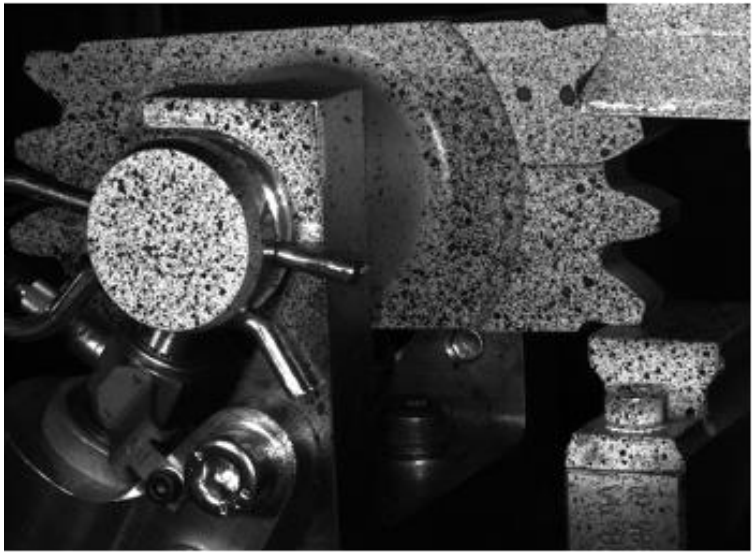
Challenge

- MCE-5 is developing high-performance mechanical parts, in particular for the propulsion, helping to make vehicles more fuel-efficient, more economical and environmentally friendly.

  In order to guarantee the conformity of its products, MCE-5 must estimate the uncertainty in the fidelity of its test devices with the relevance of the measurement obtained with their certification loads, and thus of the relevance of the measurement obtained with their conventional sensors.

  In this test, a high-performance gear is subjected to cycles of step loading. The wheel is free to rotate on its axis, and a movement is applied to the upper insert in contact with the third tooth of the wheel is in contact with the lower plate and the force is measured at the lower key.

  The objective of DIC monitoring is to quantify the test kinematics in order to ensure that the application complies with the certification specifications. On the other hand, MCE-5 wishes to capitalize on the comparison between the simulation and the measurements obtained by DIC.



ALTAIR

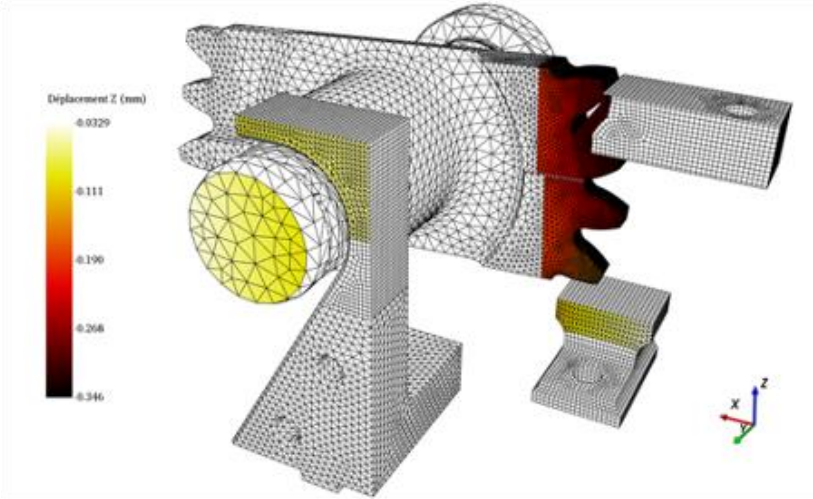
Multi-part Simulation Validation at MCE-5

Solution

- In order to obtain this test monitoring by DIC, a pair of cameras is set in place to observe the areas of interest of the study: the teeth of the wheel, the pad stop and bottom, and the wheel axle.

  The digital image correlation software EikoTwin DIC compares the images for each loading stage and calculates and displays the displacements and deformations on the measurement mesh for each step of solicitation.

  EikoTwin DIC allowed MCE-5 to measure the displacement at any point in the zone of measurement for each loading step, and thus evaluate the test performance in relation to the desired behavior.



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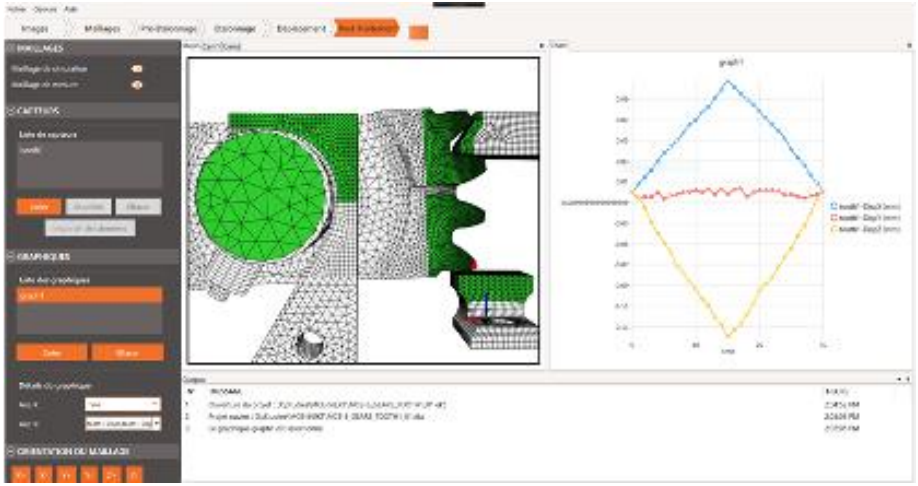
Multi-part Simulation Validation at MCE-5

Results

- The results provided by EikoSim allowed MCE-5 to verify the conformity of the test set-up with the certification specifications, proving that the load and unload travel paths are the same, and that the position at minimum and maximum load during cyclic loading are constant.

  In addition, MCE-5 was able to validate the numerical model and thus be able to use it in the future in its validation and certification processes for its parts.



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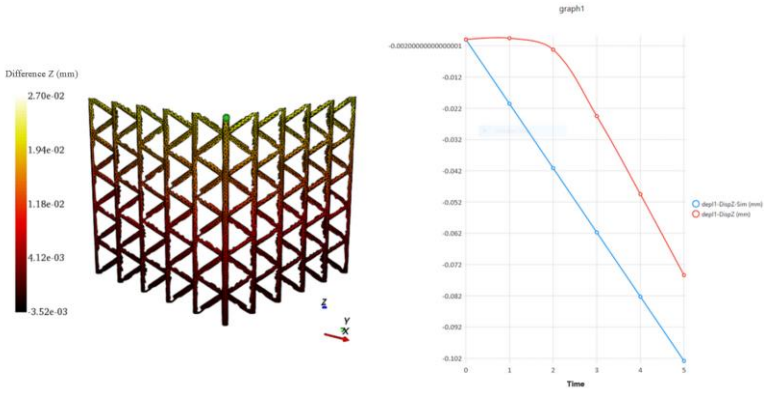
Lattice Structure Modelling and Investigation at IRT Saint-Exupéry

Challenge

- The Institut de Recherche Technologique (IRT) Saint - Exupéry is leading the LASER (Lattice Structures for Engines and LauncheRs) research and development project in partnership with major aeronautics and space manufacturers on the use of lattice structures (or "lattices"). These structures obtained by additive manufacturing have a high potential for mass reduction and optimization of mechanical behavior.

  In order to provide partners with tools for understanding and designing these structures, the Saint - Exupéry TRI must use more comprehensive means of measurement than traditional means. During this test, a 5x5x5 mesh BCCZ specimen (centered cubic meshes and vertical beams) is subjected to compressive loading between two plates. Partial discharges are carried out and the test is conducted until the specimen ruptures.

  The objective of stereo-DIC monitoring is to capture the full complexity of the kinematics, including in particular the characteristic shear-band deformation mode. Simulations can be compared to these measures to improve their predictions.



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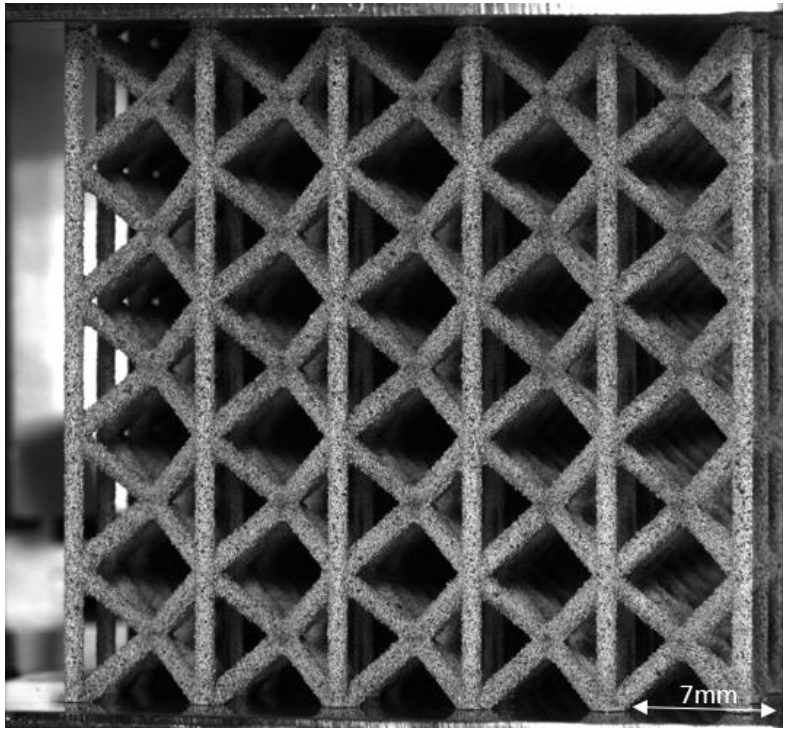
Lattice Structure Modelling and Investigation at IRT Saint-Exupéry

Solution

- In order to obtain this test monitoring by stereo-correlation, two pairs of cameras are set up to observe two perpendicular faces of the specimen. This arrangement is chosen to capture with certainty the appearance of shear bands on one of the two observed sides.

  Using our digital image correlation software EikoTwin DIC, we measure during the test the three-dimensional kinematic behavior of the beams visible on both sides under observation.

  This measurement is carried out using the same mesh size as that used for the simulations, which greatly facilitates the test-calculation comparison.



Lattice Structure Modelling and Investigation at IRT Saint-Exupéry

Results

- The results provided by EikoSim allowed IRT Saint - Exupéry to capture the kinematics of the test, in particular the appearance of shear bands and cracks before rupture.

  Additionally, the IRT Saint - Exupéry team was able to compare its digital model with stereo-DIC measurements, and thus improve the predictability of its models.

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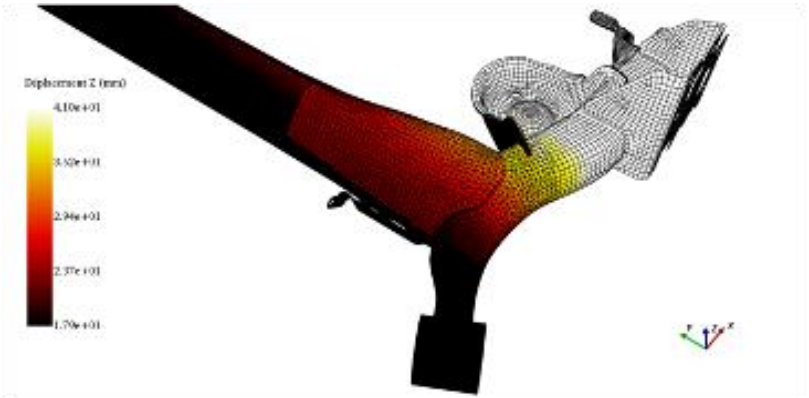
Loading Path Validation at Renault

Challenge

- Renault is a major car manufacturer in France. In order to size and guarantee the fatigue resistance of its most critical components, Renault must ensure that the predictive digital simulation reproduces as closely as possible the experimental behavior observed on the fatigue bench.

  A stress sequence, resulting from tests carried out upstream on the track, is extracted and reproduced on a test bench. It consists of a cyclic loading representative of a real use of an axle (bends, passages on heterogeneous terrain, presence of cobblestones, etc.).

  The aim of the instrumentation of this bench with stereo-correlation systems is to visualize as much of the axle as possible and to verify that it is capable of withstanding a predefined number of representative load cycles, thus increasing the degree of confidence attached to the simulations.



ALTAIR

Loading Path Validation at Renault

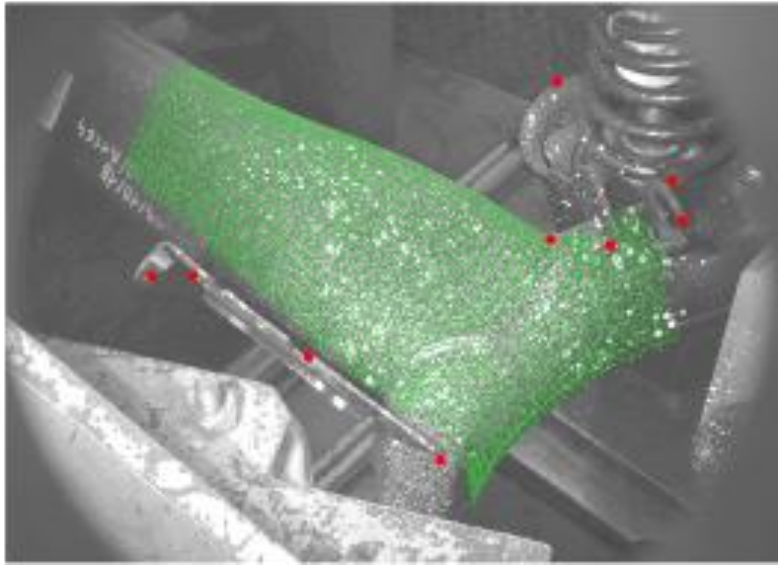
Solution

- In order to give access to this vital information during multi-axle fatigue tests, a pair of cameras is placed around the test to capture the kinematics of the test.

  Despite the large, rigid body movements of the part, EikoTwin DIC captures the entire kinematics of the passage over the wrong cobblestones.

  Since the measurement is expressed directly on the finite element mesh of the part, the comparison is immediate with the displacement fields provided by the dimensioning calculation for the fatigue stress under consideration.

  EikoTwin DIC allows the user to compare their numerical load cycles with the real cycles extracted from the preliminary tests. On the other hand, the software enables CAE engineers to check the validity of the dimensioning of their part for fatigue resistance under near-real stresses and to validate the relevance of their numerical model.



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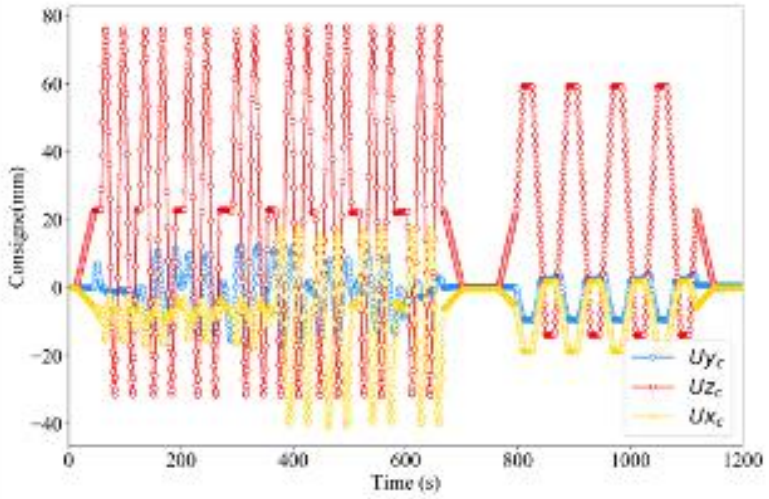
Loading Path Validation at Renault

Results

- On the one hand, the results brought by EikoSim allowed an immediate comparison of the measured and simulated fields on the instrumented area and to highlight the deviation in the measured and calculated values, due to the idealized boundary conditions of the numerical simulation.

  Simultaneously, the stereo correlation of digital images makes it possible to obtain a very great kinematic richness. EikoTwin DIC measured the equivalent of 1300 displacement sensors (corresponding to the nodes of the measuring mesh) recording the movement of the workpiece over 1200 instants in a single uninterrupted test.

  The measured displacements were then fed back as boundary conditions into the finite element model to improve the predictability of the simulation for this fatigue design.



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