

CASE STUDY

NIO develops improved durability simulations with help from AMCT and nCode DesignLife



NIO, a global automobile manufacturer headquartered in Shanghai, is a pioneer and a leading company in the premium smart electric vehicle market. NIO differentiates itself through its continuous technological breakthroughs and innovations, such as its industry-leading battery swapping technologies.

HBK's Advanced Material Characterisation & Testing facility (AMCT), near Sheffield, UK, has helped accelerate NIO's capabilities for fatigue simulation through a unique combination of custom testing solutions to provide high quality material fatigue data and the power of nCode software.



CHALLENGE

Performing accurate virtual failure prediction in innovative BIW (Body-in-White) structures requires new material fatigue properties.

SOLUTION

NIO selected HBK's AMCT facility to carry out material characterisation testing due to its testing expertise and the ability to deliver a materials database that could be used directly and easily in nCode software.

RESULT

A standardised materials database for fatigue and common processes enabling higher quality results from which engineering design decisions can be made. This enables NIO to develop efficient and robust structures for durability performance, reducing weight and energy consumption to maximize range.

NIO ET5T demonstrates innovative body engineering (image copyright NIO)

NIO'S QUEST FOR ACCURATE VIRTUAL FAILURE PREDICTION

NIO's extremely ambitious lead time to market requires accurate virtual failure prediction capabilities. Establishing these is crucial for avoiding issues during the vehicle's physical testing and user operation. NIO was using several different tools for durability simulation (including nCode DesignLife) for their vehicle structures and one of NIO's main challenges was that they lacked the material fatigue properties required to generate accurate property cards for the new materials being introduced on their innovative and pioneering BIW technologies.

According to Artur Tarasek, NIO's Durability CAE Expert (Computer-aided engineering), "The first challenge was how do we build confidence in our material data." Artur is at the NIO Performance Engineering centre where he supports all the durability and simulation efforts. The centre is just outside Oxford, UK and its role includes defining methodologies and engineering processes that can be used across different teams throughout the global business.

The on-going need to reduce the weight of the structures tends to increase the use of aluminium and thinner gauge high strength steels. However, the effect of welding on high strength steel usually results in lower fatigue performance than the base material and therefore increased potential for cracking over time. Joints tend to be weak points and hence were NIO's highest priority. The lack of material fatigue data for all these scenarios reduced the confidence in simulation accuracy. This meant that a conservative approach was adopted to ensure robustness but resulted in mass and cost penalties.



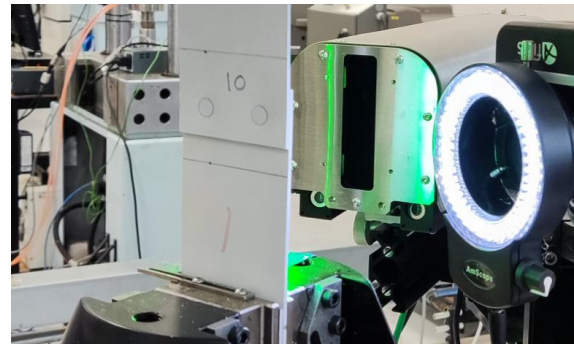
Example NIO body structure

ADVANCED MATERIALS TESTING WITH AMCT LAB

NIO looked at other testing labs for performing the material characterisation tests to provide the types of data required, but Artur states, "there is nothing like HBK's AMCT lab that provides the entire package" both in terms of the available testing expertise but also the ability to deliver a materials database that could be used directly and easily in nCode software.

With the complexity of mixed materials used in modern automotive structures, there was a wide range of material characterisation testing required: from base material testing at different thicknesses, seam welds, laser welds and also hybrid jointing techniques including adhesives with spot welds in steel and adhesives with rivets in aluminium. A major reason why NIO selected the AMCT was the level of technical support given by HBK throughout the process, including the drawing up of the required matrix of tests. Close collaboration on the process delivered high quality materials data that could be used directly in nCode DesignLife.

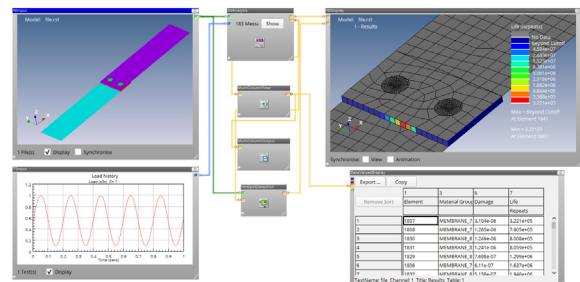
nCode DesignLife also became the choice for durability CAE across the organization due to the value for money using the versatile Prencsia Access token licensing. Measured "road load" time series data is being post-processed by other groups in NIO using nCode GlyphWorks and there were therefore advantages in using common tooling.



Fatigue test of joint specimen

EFFICIENT AND ROBUST SOLUTION FOR IMPROVED DURABILITY PERFORMANCE

NIO have been able to build confidence in the materials database used for durability CAE, providing a single source of materials data which is common and accessible to their engineers. This has meant more confidence in simulation results, the ability to develop new modelling techniques and the ability to correlate issues found in the field. A standardised materials database for fatigue and common processes defined using nCode DesignLife have enabled higher quality results from which engineering design decisions can be made. According to Artur, "We have a single process that is used across the organization." Together, this enables NIO to develop very efficient and robust structures for durability performance, reducing weight and energy consumption to maximize range.



nCode DesignLife simulation of fatigue in joint specimen