HEXAGON

Case study

Dynamic load prediction of a wheel

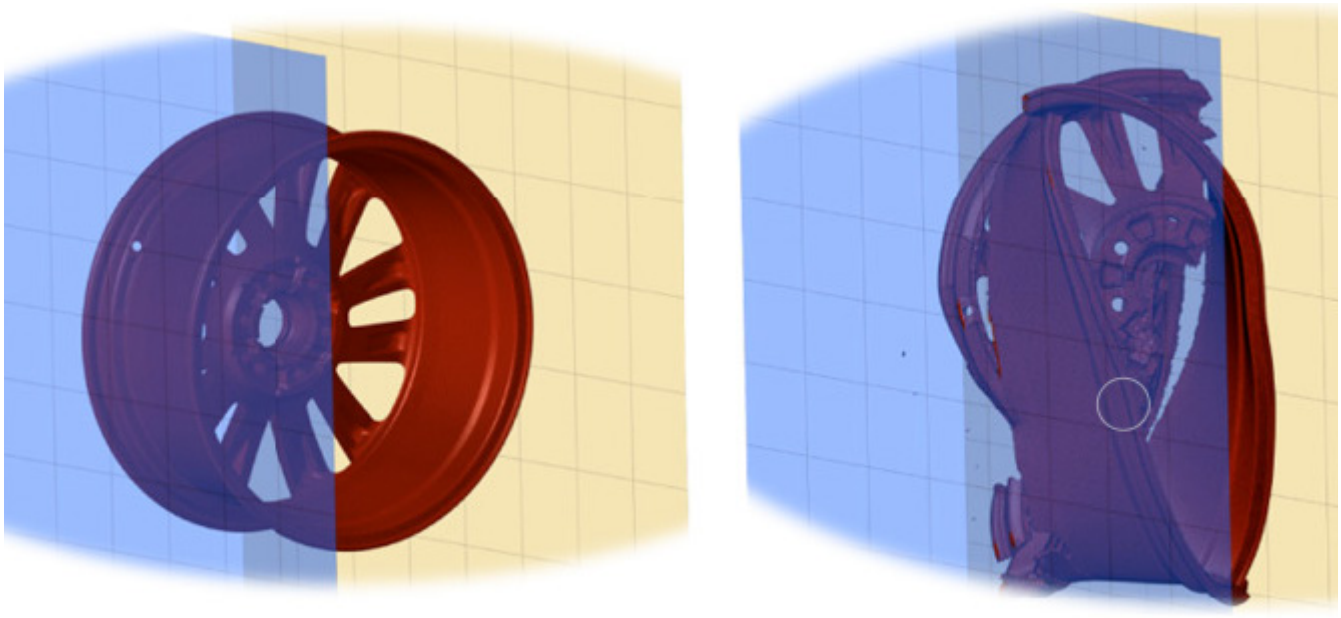
Ford Motor Company, Michigan, USA

ODYSSEE CAE enables Ford to save 59 days of computational time studying a wheel's rotational radial load characteristics.

Ford Motor Company was established in the year 1903 and their aim is to help build a better world where every person is free to move and pursue their dreams. Ford is the oldest American car manufacturer and has 13.8% of the vehicle market share in the US.

Ford produces many cars, SUVs, and trucks in various price ranges under the brands of Ford and Lincoln. In 2020, Ford sold 4,187,000 vehicles worldwide and had a market share of 5.8% of all vehicles sold worldwide. Ford slogans over the years have included "Go Further", "Built Ford Tough", "Ford. Designed for Living. Engineered to Last.", and "Ford has a better idea". Ford designs their vehicles to be enjoyed by their customers for a long time.

Ford is a multinational organization with globally geographical headquarters and the cooperate headquarters located in Dearborn, Michigan.



Pre-Crash

Post-Crash

The FEM setup in the pre-crash and post-crash position of a wheel simulation where the blue side is the dynamic loading, and the yellow is the reactionary side.

Challenge

Ford designs their vehicles with the slogans “Built Ford Tough” and “Go Further” in mind and delivers a quality vehicle to their customers. To ensure that they have a car that is “Designed for Living. Engineered to Last”, Ford digitally tests their car parts including the wheel design. There have been new advancements in aluminium alloys and manufacturing process which opens new avenues for Ford’s wheel designers to explore. With the myriad of new options, the wheel designers can design functional and aesthetic wheel designs with new stylings and shapes to attract new customers and achieve performance requirements. Each of these new wheel design possibilities would need to be tested to guarantee stringent quality and performance requirements of Ford’s vehicle parts. The current method of testing the wheel designs digitally for the variation of loading along the wheel’s circumference when rotated and radially loaded takes approximately 9hrs per degree with finite element analysis (FEA). Can ODYSSEE CAE help Ford reduce the time needed to study the wheel’s dynamic load characteristics?.

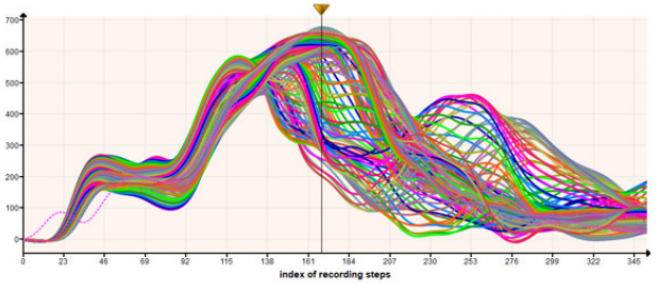


Fig 1: Load time history over the full 180° design space as predicted by ODYSSEE CAE. The dotted red curve represents the final validation curve achieved in a FEM simulation.

Whereas finite element solution would have taken more than 1000 hours to achieve the solution for the full design space, (ODYSSEE CAE) was able to accurately predict the full response within seconds.”

Laike Misikir,
Vehicle Crash Safety and CAE Engineer

Solution

"Ford has a Better Idea" with ODYSSEE CAE to reduce the computational time needed to fully study the new wheel designs while achieving results comparable to FEA. The current finite element method (FEM) analysis uses 1 million elements and advanced material models to preserve the detailed geometry and capture material fractures. While this FEM method yields high fidelity results, it is at the expense of high CPU usage and large time costs. This is where ODYSSEE CAE helps, it used 20 FEM runs to learn the system's characteristics. From learning the behaviours, ODYSSEE CAE was able to create an analytical solution that can predict the entire 180° analysis of the wheel's behaviour. The reduced time and computational costs associated with this method of analyzing the wheel's behaviour will allow Ford to study more wheel designs.

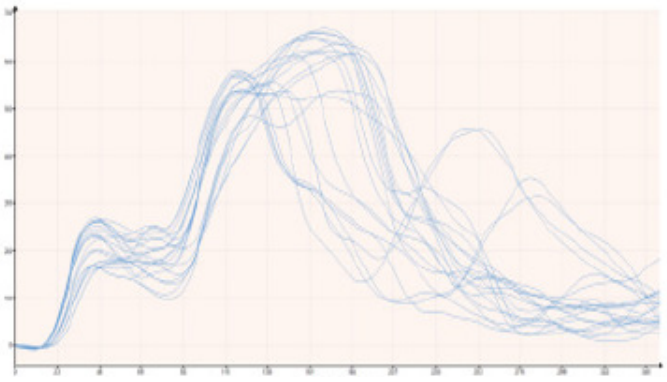


Fig 2: The initial 20 FEM simulations with time history curves.

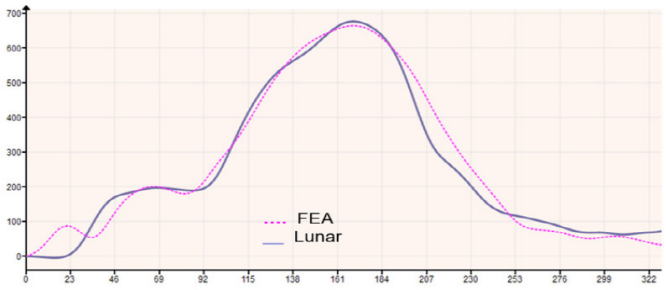


Fig 3: The final validation curve comparing a prediction by ODYSSSEE (Lunar) and the FEM Simulation.

Results

The "Built Ford Tough" slogan is a high-quality standard for vehicles that begins with the wheel design.
The original FEM intensive analysis of the wheels is prohibitively computationally expensive with 9 hours per degree or 67 days for the full 180° analysis.
ODYSSEE CAE reduces this time to less than 8 days for learning and to seconds to provide the full 180° analysis.
Ford can analyse 8 new wheel designs in the same timeframe it used to analyse one. This method provides results with an accuracy above 92% when compared to the FEM analysis for multiple wheel designs.
ODYSSEE CAE helps Ford's time "Go Further".

Key highlights
Product: ODYSSEE CAE
Industry: Automotive
Benefits: • ODYSSEE CAE helps Ford saves 59 days of time on simulating new wheel designs

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Our technologies are shaping production and people-related ecosystems to become increasingly connected and autonomous – ensuring a scalable, sustainable future.

Hexagon's Manufacturing Intelligence division provides solutions that use data from design and engineering, production and metrology to make manufacturing smarter. For more information, visit hexagonmi.com.

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