Reduced order modeling of advanced versatile seats

Faurecia Brières Tech Center - France

ODYSSEE CAE helps Faurecia reduce the time required for crash seating simulations by over 97% for the Cockpit of the Future.

Faurecia was founded in 1997 and has subsequently become a world leader in automotive parts. One in three cars uses Faurecia components.

Faurecia is a top ten global automotive supplier with the majority of global OEMs using their components. Their seating division employs 42,515 employees in 77 locations and 13 research centers dedicated to maintaining the safety and the comfort of the occupants. Faurecia recently developed a low carbon footprint seat as a step towards their goal of being carbon neutral in 2030. With the goal of inspiring mobility, Faurecia is working towards the "Cockpit of the Future".

Fig 1: Four severe seat load cases at high speeds, top left is a front crash, top right is a rear crash, bottom left is a 18kg luggage crash, and bottom right is seatbelt anchorage test.

Challenge

Faurecia is creating the "Cockpit of the Future" with better seating and intuitive console electronics and displays. The increasingly adjustable seating is crucial in giving passengers the most comfortable driving experience. While comfortable, the seats must ensure that the passengers remain safe in all seated positions during a crash scenario. Faurecia is implementing regulatory bodies' request for extensive virtual crash testing. The crash analysis should be performed for all possible crash configurations and all occupant types including the newer elderly and obese models. Faurecia finds that using FEA analysis to fully model all these crash simulations would take years of computational time and large amounts of power, hindering their goal of being carbon neutral by 2030. Could ODYSSEE CAE offer a better way to simulate every crash scenario while limiting the computation time and power needed?.

Solution

Faurecia was enthusiastic to use ODYSSEE CAE machine learning to reduce the computational time needed to analyse a crash configuration. ODYSSEE CAE was put to the test to showcase its ability in analysing four intensive crash scenarios. The first crash scenario was the luggage test to determine the direction of the final velocity of a 18kg luggage during a crash. The next two scenarios were the high-speed front and rear crashes. The fourth scenario was the seatbelt anchorage test to determine if the seatbelt would restrain the passenger during the crash. ODYSSEE CAE developed reduced order models (ROM) using machine learning techniques to each of the scenarios. The first three ROMs each were trained on 60 FEA simulations to achieve high fidelity results. The seatbelt anchorage ROM was trained with the front crash simulation ROM instead of FEA analysis. ODYSSEE CAE reduces the computational time and power for FEA level results.
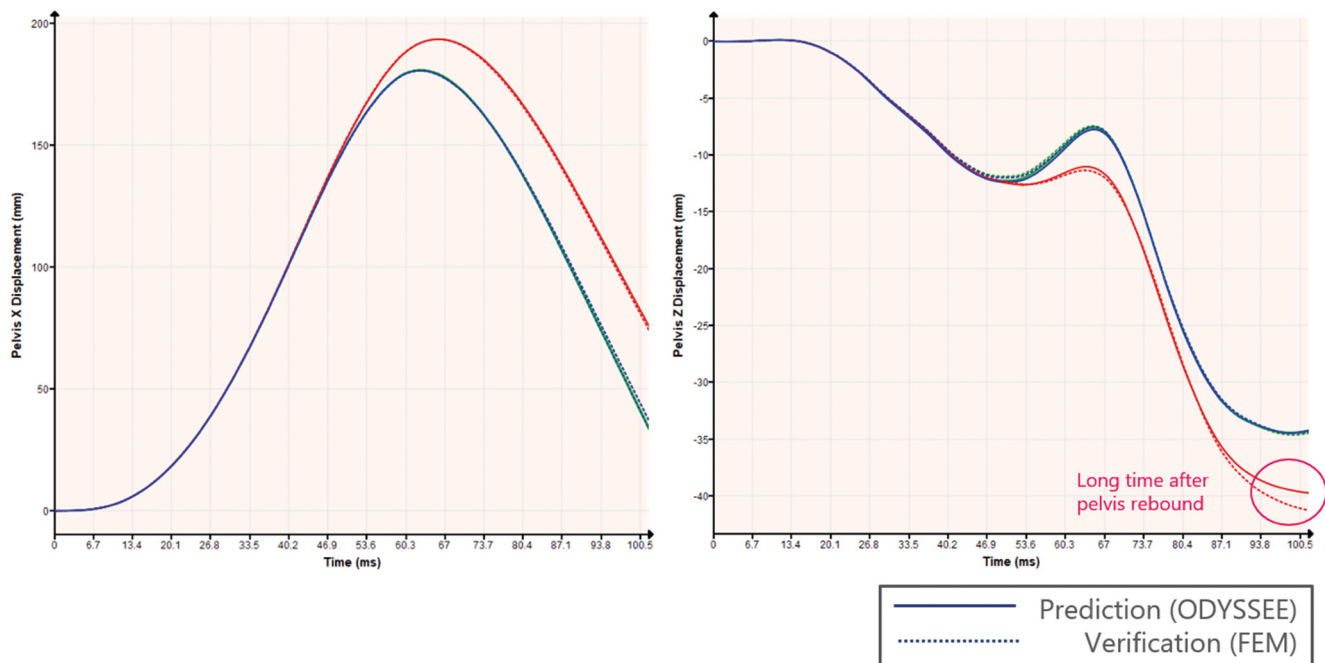
Fig 2: ODYSSEE CAE verification with FEM for pelvis displacement in a front crash scenario.

Results

Time

ODYSSEE CAE's simulations does not need a computational cluster, freeing it for other simulations. A computer with 8-cores using the ROM simulations was much faster than a 28-core cluster performing the FEA analysis. The front crash scenario was modeled in 1min compared to the 11hr FEA analysis. The seatbelt anchorage test was performed in 27min compared to the 10hrs for FEA analysis. The rear crash scenario was completed in 1hr compared to the 14hr FEA analysis. With over 97% reduction of computational time, Faurecia can perform 14 or more similar simulations in the same amount of time needed for a single FEA analysis.

> " Hard test results can be used to predict a different test configuration thanks to R.O.M."

Steeve Lainé,
Calculation / Simulations Engineer
FAS / R&D / Global Validation Services

Accuracy

ODYSSEE CAE attains FEA level accuracy with ROM. The luggage model was achieved to the desired error range with further training possible to reduce the error. The ROM front crash scenario was accurately modeled to less than 1mm difference with the FEA analysis. This is less than the 5mm optical tracking uncertainty in physical testing. The rear crash model accurately captured the global displacement and identified locations of concern. The seatbelt anchorage model predicted the same critical failure in the same location and time as the FEA simulation.

Faurecia uses ODYSSE CAE to predict extensive crash scenarios accurately and quickly. The lower computing power needed for the models aids Faurecia in achieving their carbon neutral ambitions and the limited computation time enables more diverse crash scenarios to be modeled. ODYSSEE CAE empowers Faurecia to make the safest "Cockpit of the Future" through comprehensive virtual simulations.

Key highlights
Product: ODYSSEE CAE
Industry: Automotive
Benefits: • ODYSSEE CAE helps Faurecia saves over 97% on computation time with FEA level accuracy

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