HEXAGON

Case study

Pedestrian protection using the ODYSSEE Suite

ETA – Troy, Michigan

ODYSSEE CAE and ODYSSEE A-Eye analyse hood design for pedestrian impact protection in real-time

ETA has 38 years of experience providing engineering services and solutions to OEMs and Tier 1 and Tier 2 suppliers. ETA offers ‘Accelerated Concept to Product’ and ‘Virtual Proving Ground’ processes to aid their customers in bringing concepts to market quicker.

ETA offers consulting services to many different industries, including the automotive industry, during the stages of product development. The expertise of ETA extends to include but is not limited to CAE structural analysis, crash and safety simulations, product development, and durability studies. ETA uses several engineering software packages, including machine learning to create solutions to the engineering challenges they see.

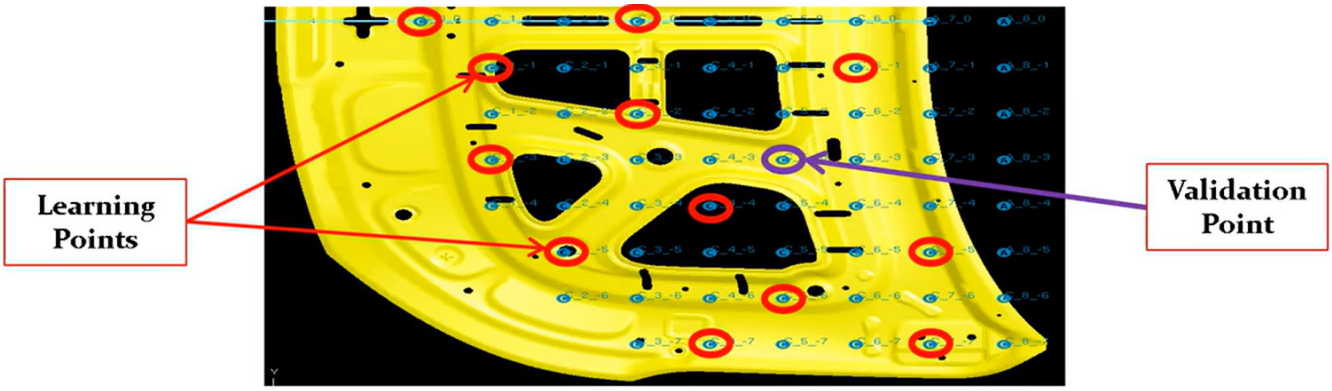

Fig 1: Location points to determine the injury score. Each location point listed has X&Y coordinates to the latch and the hinge, and the surface hardness.

Challenge

Pedestrian safety is a critical consideration for designing a car's hood. A pedestrian is most likely to hit the hood in a collision and sustain injuries. Performing analyses at all possible impact locations allows designers to assess the extent and mitigate the pedestrian's injuries. The differing impact locations have different levels of reinforcements, changing the forces and accelerations felt by the pedestrian. There are hundreds of other places on a car hood that a pedestrian's head may impact and should be analysed. An entirely new simulation to predict the injury score at each impact location is challenging to achieve. Independently simulating each location is inefficient as nearby locations would have similar injury scores. Machine learning techniques can infer injury scores for similar areas based on similar and nearby simulation data. The ODYSSEE suite can increase the efficiency and speed of analysing the hood safety design through numerical data or imagery with machine learning. This increased efficiency and speed enables ETA to provide the best solutions to their customers in the automotive industry.

> **Real-time computing because you literally spend no time on doing any parametric studies, it only takes a few seconds."**
>
> **Divesh Mittal,**
> Engineering & Software Manager

Solution

ODYSSEE suite increased the speed and efficiency of hood design safety analysis. The machine learning techniques used by the ODYSSEE suite, including reduced order models (ROM), decrease the computation requirements and time needed to run accurate simulations. Both ODYSSEE CAE and A-Eye were trained with 12 simulations to predict the HIC15 injury value and the risk score associated with a head impact on the hood. For ODYSSEE CAE, the impact location distances to the latch, hinge, and the structural rigidity of the hood was labeled. For ODYSSEE A-Eye, the learning database uses the hood structural supports as an image with contrasting color combinations for the impact location (shown as a circle). Predictions for the HIC15 value, injury risk score, and acceleration plots follow the training. The reduced models were then able to predict all the car hood locations efficiently.

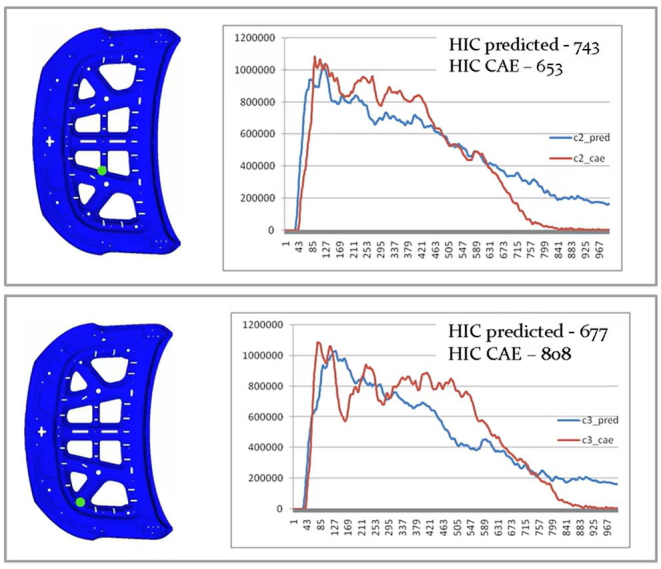

Fig 2: Acceleration curves for head impact on hood at two locations. Blue graph curve shows ODYSSEE A-Eye prediction, the red curve shows the FEM validation curve.

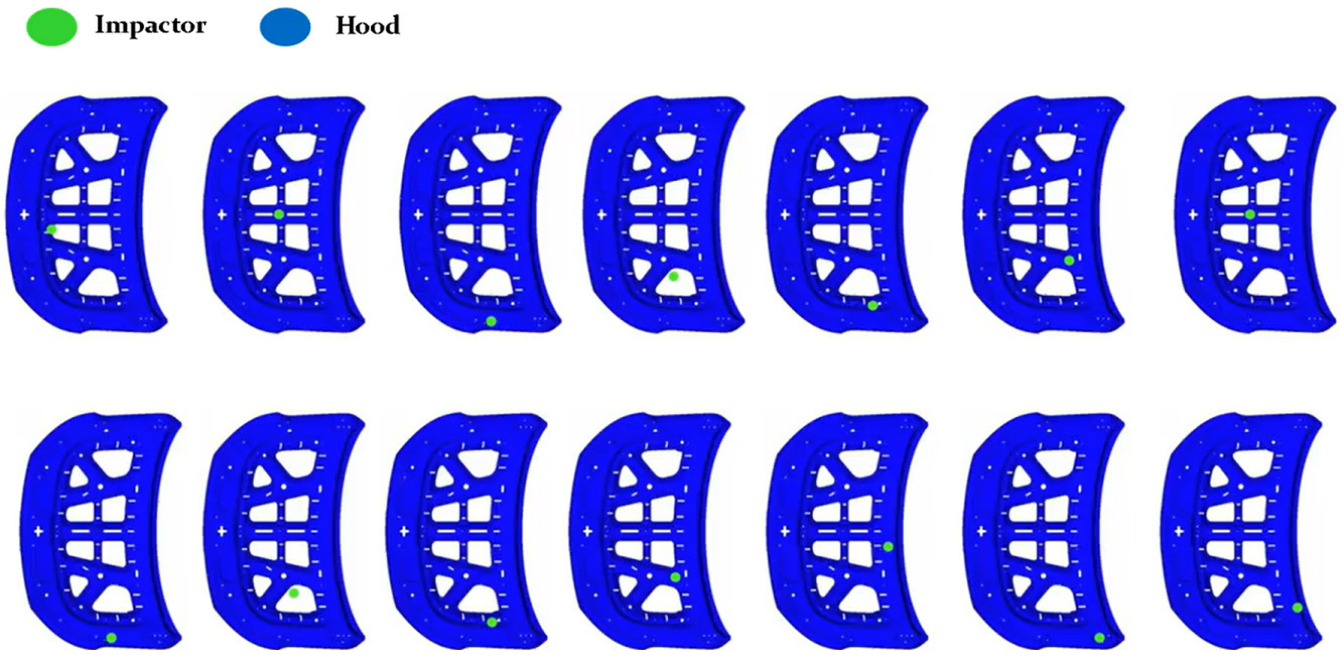

Fig 3: The 12 learning simulations used for ODYSSEE A-Eye. The placement of the green circle indicates the location of the head impact.

Results

ODYSSEE suite can quickly evaluate the hood design for pedestrian protection. Both ODYSSEE CAE and A-Eye assessed the 53 selected locations accurately in seconds. The predictions made by ODYSSEE CAE had a perfect correlation with the injury scores and similar HIC15 values. The predictions by ODYSSEE A-Eye with the image inputs had similar HIC15 values and only a few minor variations on the risk score assessment. The predicted acceleration curves matched the simulation's acceleration peaks and general dynamics. With further training, ODYSSEE A-Eye would become more accurate in predicting the injury value and the risk score. The future of this study includes training on multiple hood designs, allowing for a new hood structure design assessment for pedestrian safety in real-time.

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Key highlights
Product: ODYSSEE CAE, ODYSSEE A-Eye
Industry: Automotive
Benefits: • ODYSSEE CAE and ODYSSEE A-Eye analyse hood design for pedestrian impact protection in real-time

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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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