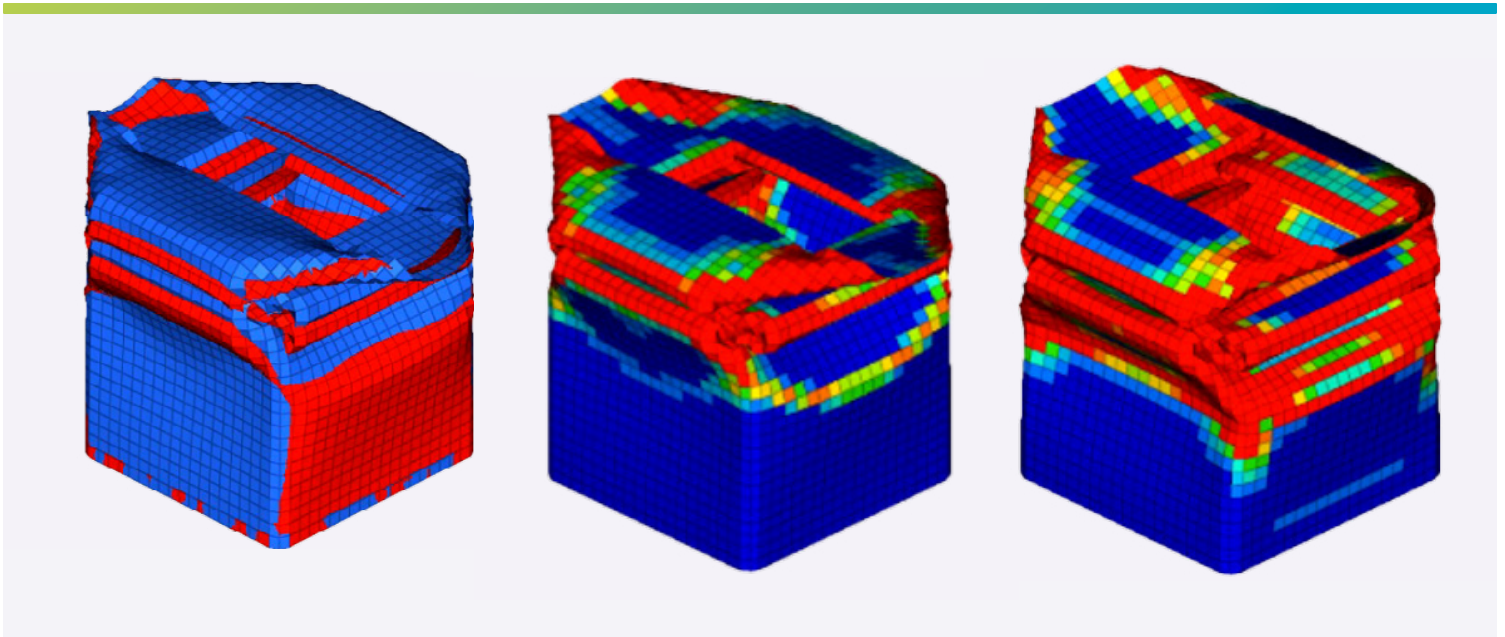# AI/ML-based prediction of crash parameters using ODYSSEE CAE

ODYSSEE CAE helps Satven reduce the time required for predicting effects of different materials and thicknesses on crash parameters in a crush can from multiple hours to a few seconds

Satven was established in the year 2000 with a singular focus & objective – to cater to the varied & complex design & engineering needs of the automotive industry. The company has today grown multifold to become one of India's leading automotive engineering bureaus.

Pictured above (L to R): CAE and LUNAR deformations – CAE is blue, LUNAR in red. Strains comparison: ODYSSEE CAE (Lunar) predicted model (Right) and CAE model (Left)

Skilled human resources, consistent quality, broad knowledge base, strategic partner alliances, domain & subject matter expertise, and strong customer relationships have been continuously propelling Satven's growth into higher orbits.

Satven provides comprehensive solutions to the automotive industry that cover a wide range of engineering activities, including but not limited to Concept Design, Product Design, Value Engineering/ Value Analysis (VA/VE), Dimensional Management, Sourcing, Knowledge Based Engineering (KBE), myriad non-linear and linear FEA, full vehicle crash, NVH, durability, Computational Fluid Dynamics (CFD), and Multi-Body Dynamics (MBD).

Satven is a global organization with engineering centers in Germany (Munich) and India (Hyderabad & Chennai) in addition to offices in Detroit, Munich, Shanghai, and Hiroshima and its corporate offices in Hyderabad.

Fig 1: Energy absorption and force prediction for crush can using ODYSSEE CAE

Challenge

The emergence of Artificial Intelligence and Machine Learning (AI/ML) in vehicle development promises to transform the automotive industry and spur innovation. As a leading engineering solutions provider to the automotive industry, Satven was keen to leverage the advantages of AI/ML to ensure superior services and deliver a definite competitive advantage to its customers.

To this end, Satven embarked on competency development projects to strengthen its capabilities in delivering AI/ML-based solutions to its customers. The team decided to model a solution covering two aspects of vehicle safety using AI/ML approach. These included predicting energy absorption (forces) and deformations for a crush can for combinations of material and thickness.

Solution

The Satven team was keen to use machine learning techniques in the ODYSSEE CAE software from Hexagon (see https://www.mscsoftware.com/product/odyssee). The ODYSSEE optimization package is an innovative tool built by exploiting machine learning and reduced order modelling (ROM) techniques to replace traditional response surface solutions by ROMs, thus allowing for predicting of arbitrary time dependent and non-linear physical phenomena. Using this, Satven was keen to achieve reductions in simulation time / product cycle time and make initial predictions without using simulation software.

Using existing trained data from 20 CAE runs as input, the team was able to predict force and deformation values for specific combination of materials and thicknesses for a crush can using ODYSSEE CAE. Notice the exceptionally low number of runs for obtaining a meta model for this highly non-linear case. This is essentially due to the ROM properties exploiting eigenmodes of the system to establish the model in contrast to external fitted functions.

Results

Automotive development cycles are shrinking by the day. While CAE simulations play a key role in automotive R&D, the processes can be fairly time consuming. For instance, computations for crash test simulations generally takes one whole day to be completed despite using super computers. If the crush can does not fulfil requirements, designers suggest changes such as changing a bead or altering thicknesses, and so on.

The entire process then needs to be repeated, adding considerable time to the development cycle at each stage not to mention the additional resources that are called for in terms of hardware and software. With ML/ROM models, it is possible to drastically cut down the development cycle and speed up innovation. Besides, there is the added benefit of more optimized designs since the short cycles lend themselves well to running multiple Design of

Deformation, strain and animation prediction for crush can using ODYSSEE CAE (Machine Learning)

Objective:
To predict deformation, strain and animation for crush can for specific combination of material & thickness using ODYSSEE CAE (LUNAR) machine learning approach

Advantages with ODYSSEE CAE (AI/ML approach) :
Reduction in simulation time / product cycle time
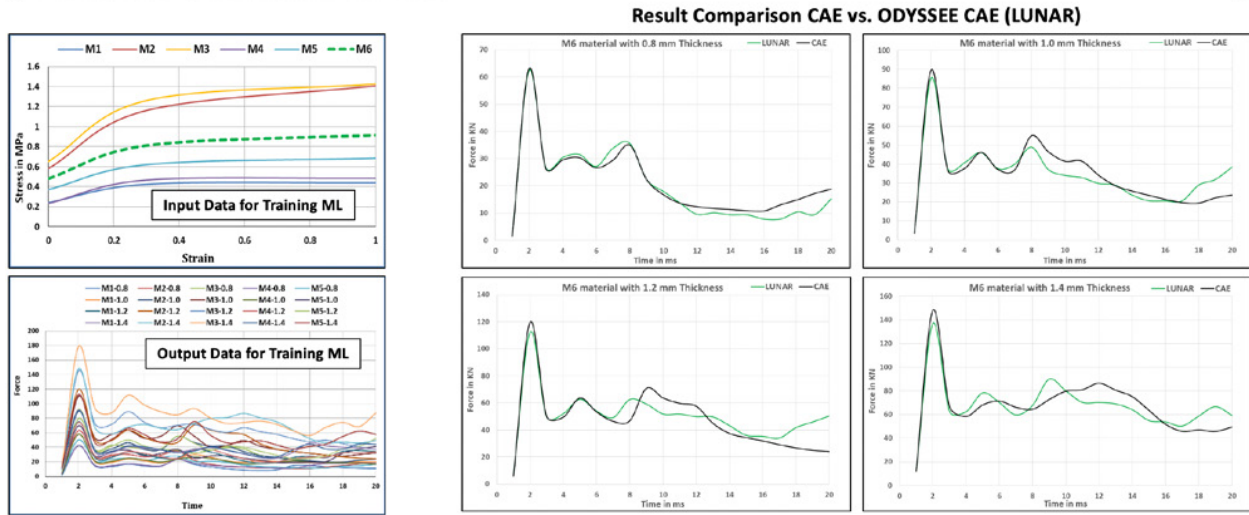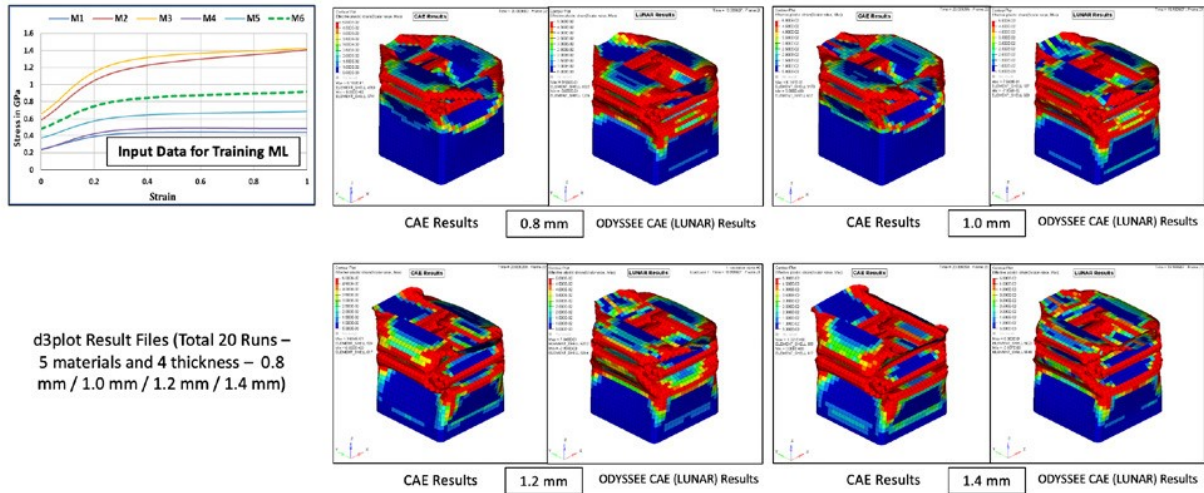For initial predictions, no need of simulation software

Fig 2: Deformation, strain, and animation prediction for crush can using ODYSSEE CAE

Experiments (DoEs) to find the most optimal solutions. A key benefit of using ODYSSEE CAE software from Hexagon is the ability to predict animations accurately, not just for individual parameters, but for all node deformations and element filed output such as strains.

Another significant advantage of the software is that it allows designers to predict results without requiring an in-depth understanding of CAE.

While automation is widely used for pre-processing applications during automotive design, ODYSSEE CAE can enable Satven to significantly speed up the simulation process through automation and machine learning.

Key highlights:
Product: ODYSSEE CAE
Industry: Automotive
Benefits:
ODYSSEE AI/ML approach reduces time from hours to seconds in predicting the effect of different materials & thickness on crash parameters for crush can.

Hexagon is a global leader in sensor, software and autonomous solutions. We are putting data to work to boost efficiency, productivity, and quality across industrial, manufacturing, infrastructure, safety, and mobility applications.

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

MSC Software, part of Hexagon's Manufacturing Intelligence division, is one of the ten original software companies and a global leader in helping product manufacturers to advance their engineering methods with simulation software and services. Learn more at mscsoftware.com. Hexagon's Manufacturing Intelligence division provides solutions that utilise data from design and engineering, production and metrology to make manufacturing smarter.

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