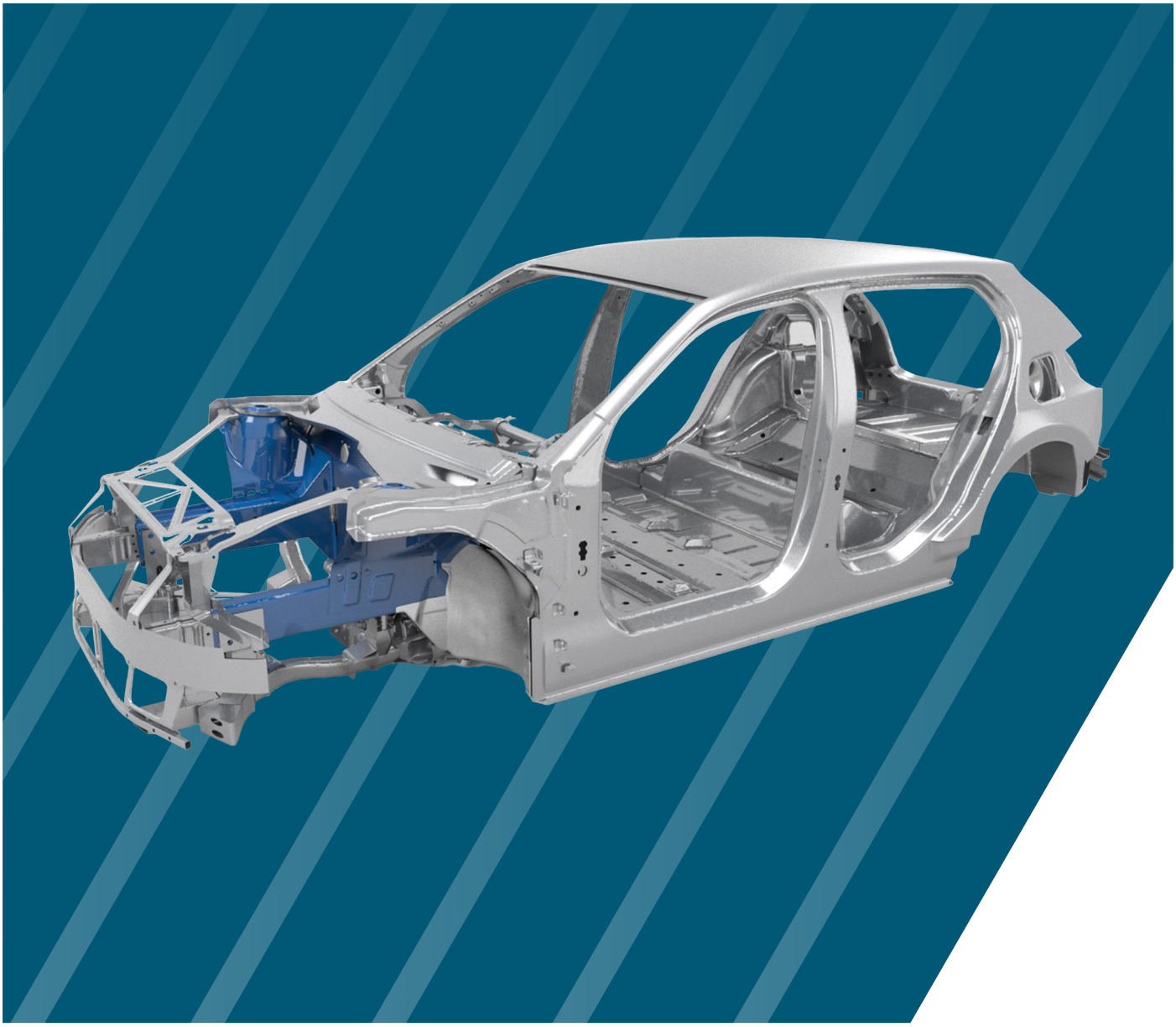
CUSTOMER STORY



EMULATING ENGINEERING EXPERTISE WITH AI

CRASHWORTHINESS OPTIMIZATION AT BMW WITH AI-ENHANCED SURROGATE MODELING

About the Customer

The BMW Group, with its 31 production and assembly facilities in 15 countries as well as a global sales network, is the world's leading manufacturer of premium automobiles and motorcycles, and provider of premium financial and mobility services. The BMW Group sets trends in production technology and sustainability as an innovation leader with an intelligent material mix, a technological shift towards digitalization and resource-efficient production. At the same time, flexibility and continuous optimization of value chains ensure competitiveness.

> Machine learning-based predictive surrogate modeling holds exciting promise for augmenting our human expertise, uncovering new insights and efficiencies while shortening development time.
>
> Moritz Frenzel, BMW

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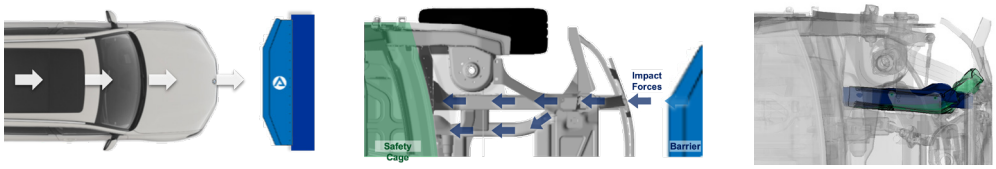


Their Challenge

To ensure passenger safety, crash engineers must orchestrate the chain of events that needs to fall into place during a crash event. This includes judgments on which crash kinematic is favorable combined with the timing of discrete events such as bolts breaking or parts coming into contact at the right time. Handling key performance indicators including energy absorption, peak force level before failure, local displacements, and weight, however, can either be too complex or result in
over-constrained optimization problems, making it difficult to confidently validate crashworthiness within the fast-paced product development process.

Our Solution

BMW uses Altair's integrated Machine Learning solutions within HyperWorks in order to generate optimization constraints that mimic engineering expertise. Clustering, an unsupervised machine learning algorithm, helps engineers to understand how crash kinematics affect key performance indicators (KPI's). Favourable crash kinematics are then enforced during the optimization process through the use of a classifier that, in effect, emulates engineering decision making throughout the process.

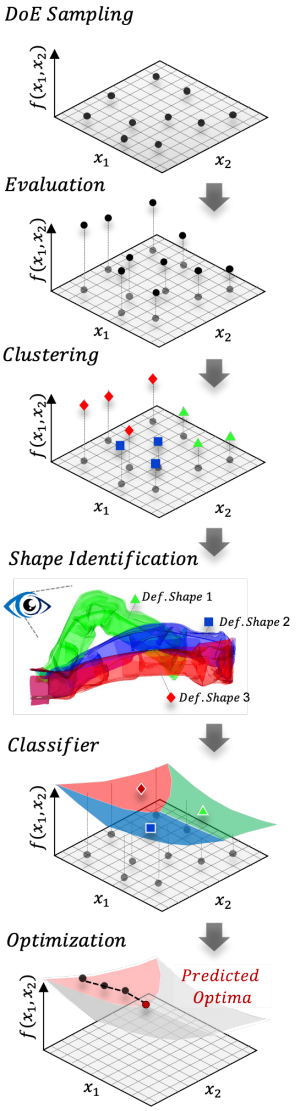
Impact/Value

Altair's Machine Learning solutions help BMW target specific crash kinematics during structural optimization. This is achieved by mimicking engineering expertise through inclusion of ML constraints, that would be infeasible or at the very least impractical to generate manually, during optimization. This simplifies the formulation of the optimization problem and reduces the number of design iterations required to develop complex automotive crash structures.

Conclusion/The Future

This ML-powered workflow augments and extends BMW's existing engineering expertise, allowing them to more efficiently allocate computing and human resources to high-value simulation, analysis, and validation efforts. In the future, BMW plans to explore further applications of Altair ML technologies across their design processes.

To learn more, please visit altair.com/ai-powered-design/



TOP: Front crash scenario, load paths in the car, deformation behavior of the longitudinal beam. **RIGHT:** The Expert Emulation Optimization Process: DoE Sampling, Evaluation, Clustering, Shape identification, Classification & Optimization