APPLYING MACHINE LEARNING AUGMENTED SIMULATION TO HEAVY EQUIPMENT

Simulation-driven design changed heavy equipment product development forever, enabling engineers to reduce design iterations and prototype testing. Increasing scientific computing power expanded the opportunity to apply analysis, making large design studies possible within the timing constraints of a program. Now engineering data science is transforming product development again.

Overview

Augmented simulation features inside Altair® HyperWorks® are accelerating the design decision process with machine learning (ML). The power of ML-based AI-powered design combined with physics-based simulation-driven design leveraging the latest in high-performance computing is just being realized.

High-fidelity Modeling Made Easy with AI

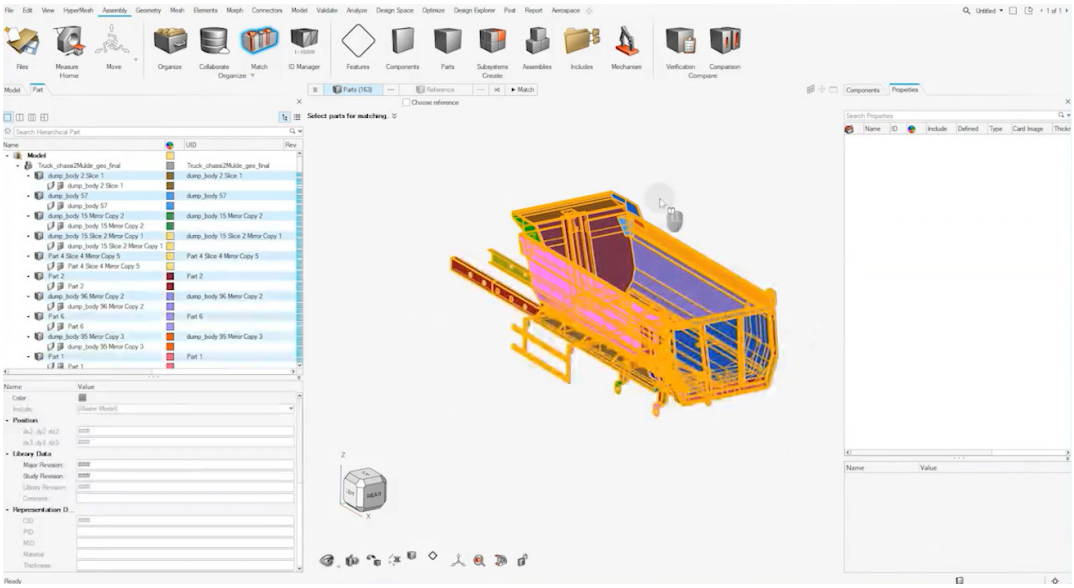
Importing the geometry hierarchy of a complex model as “parts” provides engineers with a wealth of metadata useful for simulation tasks, but it can also be much more challenging to handle than geometry grouped as assemblies. Augmented simulation tools in HyperWorks make it possible to benefit from this part and component data without overburdening the engineer tasked with building the model.

HyperWorks shapeAI makes it possible to automate pattern and shape recognition within a model, enabling the user to select all similar shapes and edit them at the same time. It uses clustering to group the parts, allowing the user to model a small number of groups rather than a large number of individual parts.

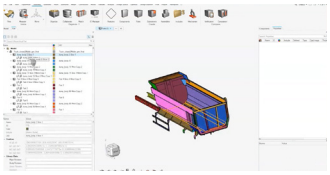
shapeAI contains automatic feature extraction for the specified geometry itself without any additional input or intervention. Combining these features with ML algorithms in HyperWorks’s matching tools puts the power of geometric ML at the fingertips of every user. shapeAI can be used to organize components of complex models by geometric similarity so that modifications to one part can be synchronized to all.

In this truck trailer, similar parts within the geometry are identified by shapeAI and sorted into sets within the Part Browser. Entire groups of similar parts can be sorted, edited, or removed in this simple view, and importantly, similar parts can be linked to enable synching across part instances.

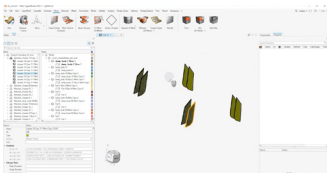
Through this synching function, users can perform meshing and geometry changes on just one part and have those changes reflected on all linked instances. With no master part, the user can make a modification on any part and have it replicated across the entire set, saving massive amounts of time by automating these repetitive tasks.



shapeAI performs part matching by searching for similar parts within the overall geometry



Importing geometry hierarchy as 'parts' provides more data than if parts are grouped by assembly



Meshing performed on one part is synchronized with all matched instances

Facilitate Design Exploration

After modeling a geometry and running structural analysis on the final design, users can explore design alternatives with design of experiments (DoE) and optimize performance all within the same HyperWorks environment.

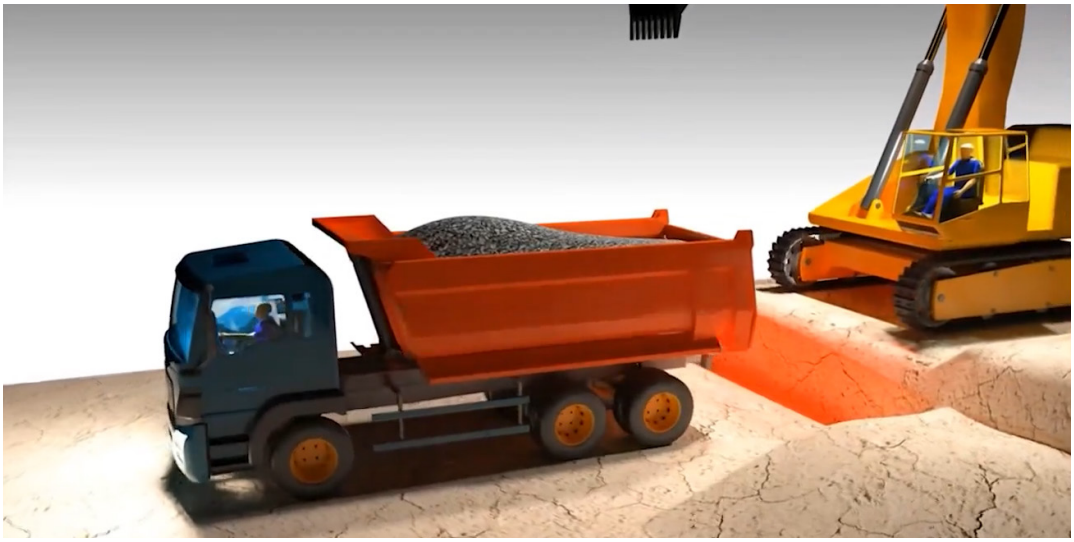
For high-fidelity modeling of complex geometries typical to the heavy equipment industry, analysts can use Altair HyperWorks Design Explorer, an end-to-end workflow for real time performance prediction and evaluation. Automating repetitive tasks using ML, Design Explorer intuitively performs direct modeling for geometry creation and editing, mid-surface extraction, surface and mid-meshing, mesh quality correction, combined with efficient assembly management and process guidance.

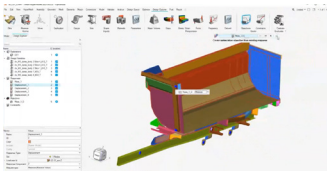
Key Benefits of Altair HyperWorks Design Explorer

- **Set-up:** Using model graphics-based tools, users can easily and interactively create design variables, responses, and goals used in their explorations, dramatically flattening the learning curve, making setup a snap.
- **Execution:** Design Explorer provides integrated job submission and job monitoring tools. You can submit your explorations within the integrated workflow and track exploration runs while they're in progress.
- **Post-processing:** The Results Explorer provides a robust set of reports and tools to visualize and interpret exploration results. In addition, Results Explorer works seamlessly within the HyperWorks post-processing environment allowing you to build dashboards for contouring, animating, and plotting exploration run results.

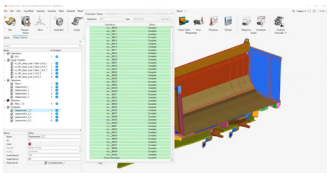
In the same truck trailer example, an engineer might wish to explore a design variable like the thickness of the trailer's welded plates and study the impact of any changes to the design. The user simply needs to define the upper and lower limits of the geometry, the outputs and responses from the solver results, the constraints from existing responses, and their optimization targets. These details can be previewed and edited interactively for each design variable. An optimization run can then be initiated directly within HyperWorks, allowing the user to study interactions, the impacts of the design parameters on structural performance, and plot and interpret the results of the exploration run.

Want to learn more?
Watch the webinar

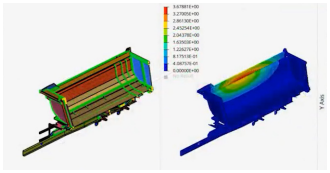




The user sets optimization goal and constraints for DoE study



Optimization run summary in HyperWorks Result Explorer



Studying impacts of design parameters after an optimization run

Working with Altair

Large-scale projects require great precision and heavier loads in extreme environments. Altair's technology for simulation-driven design, data analytics, and HPC and Cloud computing support the development of reliable, innovative, and cost-effective products across all stages of the product lifecycle, from concept development to in-use operation.

Altair's simulation tools are widely used in the heavy equipment industry for rapid investigation and analysis of product performance, factoring in fatigue and impact loads, and offering countermeasures for improvement, but manufacturers are now looking for ways to further augment their product development practices and multiply the productivity of their engineering teams. AI technology is one way Altair is enabling its customers to explore a broader population of high performing and manufacturable new product design alternatives.

Altair® DesignAI™ combines physics-based simulation-driven design and machine learning-based AI-driven design to create high-potential designs earlier in development cycles. It optimizes product development workflows by leveraging Altair's data-driven decision-making expertise and provides a cost-effective acceleration of engineering processes that integrates with existing engineering workflows and toolchains. By applying the same physics-based tools used for verification from concept to design, and through to sign-off and guided by machine learning using organizational specific constraints, Altair DesignAI enables faster design convergence by confidently rejecting low-potential designs earlier in development cycles.

Embracing the convergence of simulation and data science, Altair offers data stream visualization and processing and asset-based digital twin solutions to provide heavy equipment manufacturers added visibility into the in-service life of a product, optimize its performance, perform predictive maintenance, and extend remaining useful life. Whether you're working on farmland, highways, or a construction site, we'll help you carry the load.

To learn more, visit altair.com/agriculture-construction