AI/ML

Powered by DEP MeshWorks

AI/ML Application in DEP MeshWorks

DEP MeshWorks | Application Sheet

DEP MeshWorks AI/ML-driven approach uses advanced modeling and simulated data to deliver reliable predictions, facilitating rapid geometry changes and streamlined design optimization.

Training with Enterprise Data → Performance Prediction → Parametric Modelling → Optimization → Generative AI

Work Flow - Driven by MeshWorks

Challenges in Concept Studies:

Training AI/ML models for CAE and CFD presents several challenges, including limited or noisy data, the need for effective feature selection, and a lack of labeled datasets. Managing uncertainty in predictions is critical, as engineering problems often involve varying factors such as material properties. Additionally, models must generalize well across different scenarios—not just the ones they were trained on. Addressing these challenges requires careful data handling and the development of advanced models to ensure accurate and reliable predictions.

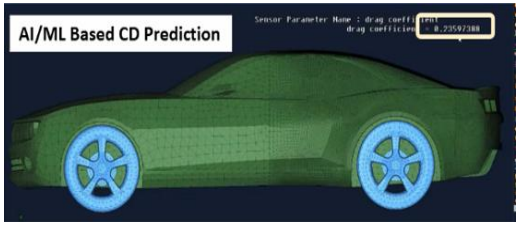
The Solution:

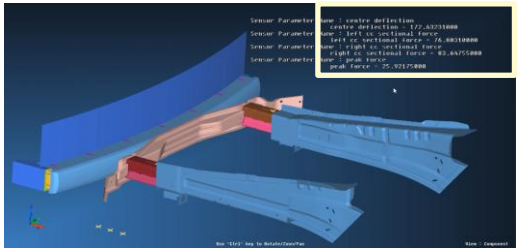
DEP MeshWorks' AI/ML platform addresses these challenges by enabling the training of accurate predictive models through the integration of advanced techniques such as PINNs, CNNs, and geometric processing, combined with deep CAE domain knowledge. This allows the platform to generate precise models capable of detecting design changes effectively. Instead of relying on large datasets, MeshWorks simulates data based on design parameters, accelerating the design process and improving predictive performance. Its Morphing technology enables rapid geometry adjustments without the need for original CAD data, allowing engineers to make real-time modifications and instantly view results. The AI/ML model then re-predicts the outcomes after each change to maintain accuracy.

Value:

- DEP MeshWorks combines AI/ML, parametric tools, and morphing technology to accelerate the design process with quick and efficient modifications.
- It leverages Generative AI (Gen-AI) to create innovative topologies.
- These topologies can be seamlessly transformed into manufacturable designs using ConceptWorks tools.
- This integrated approach enables engineers to develop optimal, production-ready solutions faster and more efficiently.

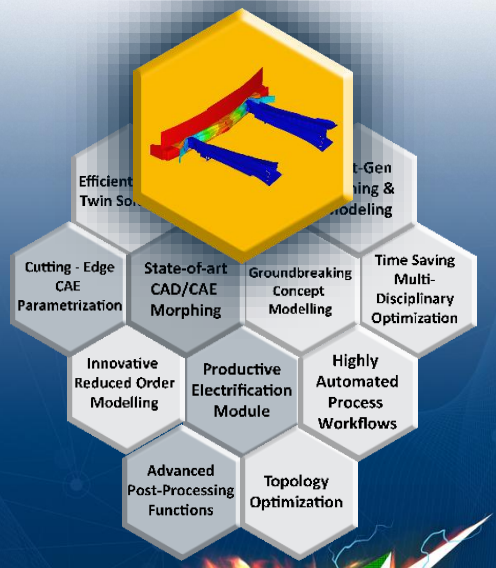
PREDICTED OUTPUTS FOR NEW DESIGN





Intelligent AI/ML CAE Framework

Fast Optimization Made Easy & Applicable At All Stages Of Product Design & Development



DEP MeshWorks

Training Predictor Model & Predictor

DEP MeshWorks | Application Sheet

DEP MeshWorks AI/ML Trainer and Predictor modules leverage advanced machine learning and parametric design to generate highly accurate, early-stage predictions that accelerate development and continuously improve with real-world data.

Training with Enterprise Data → **Performance Prediction** → **Parametric Modelling** → **Optimization** → **Generative AI**

Work Flow - Driven by MeshWorks

Training the Predictive Model:

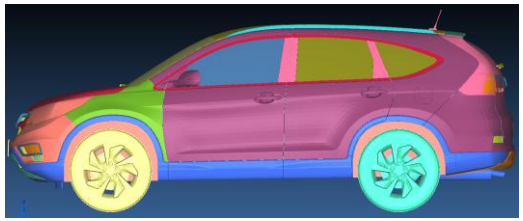
The DEP MeshWorks Trainer Module combines advanced machine learning techniques—such as Physics-Informed Neural Networks (PINNs), Convolutional Neural Networks (CNNs), geometrical processing, and UNet—with parametric CAE knowledge to create highly accurate predictor models. Using DEP MeshWorks' parametric technology, the platform generates design variations from base models to serve as training data. This enhances model accuracy and enables efficient, data-driven design optimization. The approach promotes innovation and improves overall engineering efficiency.

Predictor:

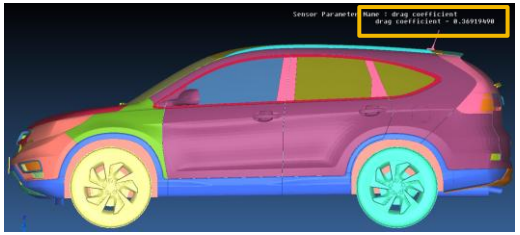
The AI/ML predictor model enables rapid identification of key responses for new designs, including scalar values (e.g., stress, temperature, pressure) and vector values (e.g., velocity, force, displacement). These outputs provide insights into both performance and dynamic behavior.By leveraging this model, predictions can be made early in the design process—prior to building physical prototypes—significantly accelerating development. Additionally, the model continuously improves by incorporating real-world data, resulting in increasingly accurate predictions for future designs.

MODEL TRAINING

NEW DESIGN FOR PREDICTOR



PREDICTED OUTPUTS FOR NEW DESIGN



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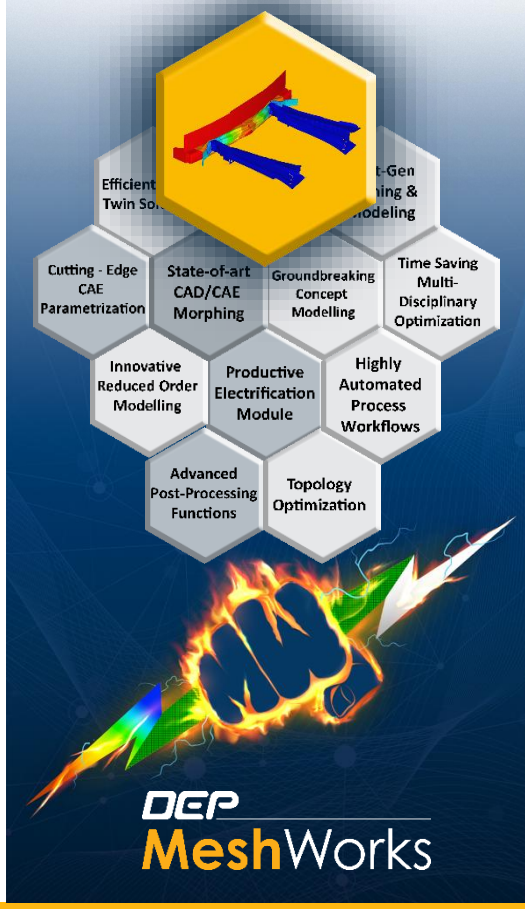


Re-predictor, Auto Parameterizer, & Optimizer

DEP MeshWorks | Application Sheet

An AI/ML integrated approach streamlines design iterations by automating parameterization, morphing geometry, and predicting performance, eliminating reliance on CAD and improving overall efficiency.

Training with Enterprise Data → **Performance Prediction** → **Parametric Modelling** → **Optimization** → **Generative AI**

Work Flow - Driven by MeshWorks

Quick Design Change:

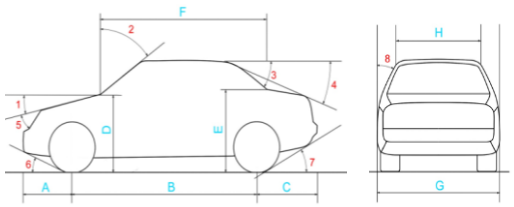
DEP MeshWorks' Morphing technology accelerates design iterations by enabling quick adjustments to the FE model without requiring the original CAD data. Engineers can instantly visualize how changes impact the simulation, while the AI/ML predictor model updates the responses to ensure continued accuracy.

Auto Parameterizer & Optimizer:

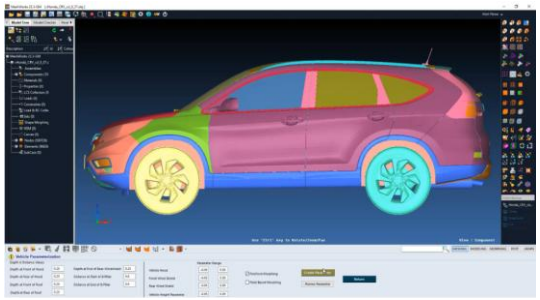
The Auto Parameterizer automates the creation of design parameters based on user input, integrating AI/ML, parametric tools, and morphing technology to streamline the design process. This powerful combination enables fast, iterative design changes, with the AI/ML model predicting performance and outcomes for each adjustment.

Parametric tools refine key parameters, while morphing technology modifies the geometry to meet design requirements. Engineers can implement changes rapidly without manually tweaking every detail. The system continuously evaluates the design in real time—optimizing performance, minimizing material usage, and reducing costs. It also ensures compliance with safety standards throughout the process, accelerating the design cycle and allowing engineers to explore more alternatives quickly. The result is a high-performance, cost-effective, and safe product.

NEW PARAMETRIC MODEL



MESHWORKS AUTO PARAMETERIZER



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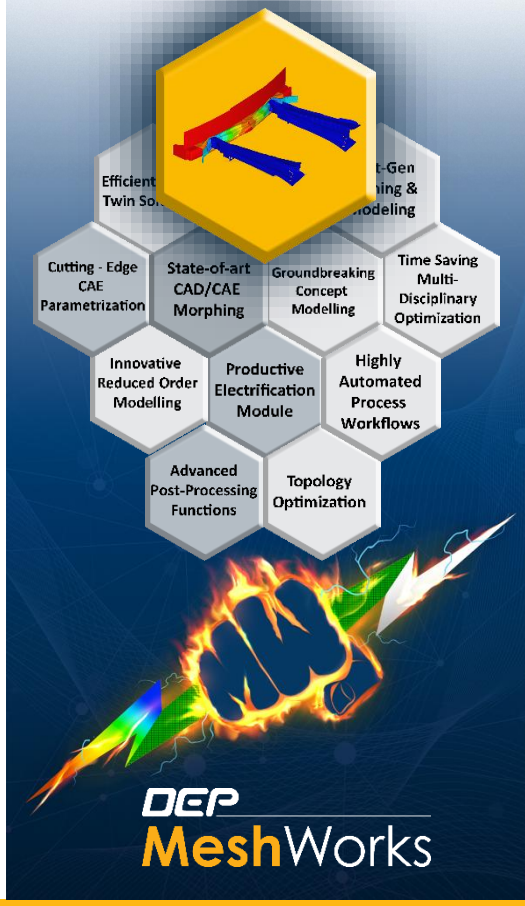


Gen AI

DEP MeshWorks | Application Sheet

DEP MeshWorks leverages Gen-AI to generate innovative, manufacturable topologies and automates the concept-to-production workflow, accelerating design exploration and reducing time-to-market with optimal performance and cost efficiency.

Training with Enterprise Data → **Performance Prediction** → **Parametric Modelling** → **Optimization** → **Generative AI**

Work Flow - Driven by MeshWorks

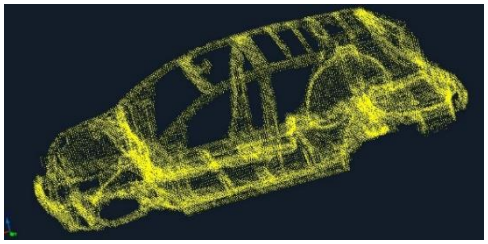
Gen AI:

DEP MeshWorks uses Gen-AI to create innovative, efficient topologies that expand design possibilities. The AI generates optimized designs that may not be easily discovered through traditional methods. These models are then rapidly converted into manufacturable designs using ConceptWorks tools, automating the entire process from concept to production.

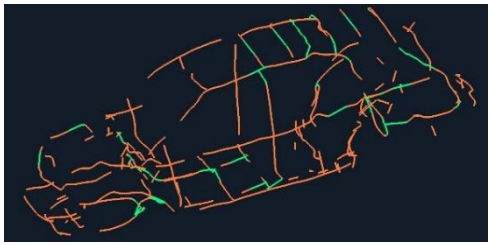
This approach ensures that designs are both cutting-edge and practical for manufacturing, streamlining the transition from ideas to real products. By automating this workflow, MeshWorks accelerates the design-to-production cycle, significantly reducing time and effort.

Engineers can quickly test and refine multiple design variations, reaching optimal solutions that meet performance, cost, and manufacturability targets. The combination of AI-driven design and automation enables faster, more efficient delivery of high-quality products to market.

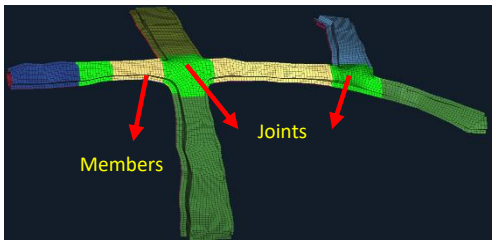
POINT CLOUD DATA



CENTERLINE AND JOINTS



MEMBERS AND JOINTS GENERATED



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