

Detroit Engineered Products (DEP) is an engineering services, product development, software development, consulting and talent acquisition company. Founded in 1998 in Troy, USA, DEP has expanded globally with operations in Europe, China, Korea, Japan and India. DEP employs an accelerated and transformed product development process, facilitated by our proprietary platform, DEP MeshWorks, which significantly reduces product development time across multiple industries.

The field of engineering simulation is undergoing significant changes due to advances in AI and ML technologies. These advances are refining numerical methods such as Finite Element Analysis (FEA), Finite Volume Methods (FVM) and Finite Difference Time Domain (FDTD), which in turn are streamlining the solution of complex 3D physics problems with increased speed and accuracy. These enhancements not only increase solver efficiency, but also introduce dynamic visualization capabilities, improving the overall user experience in engineering simulation.

DEP MeshWorks AI/ML technology is a robust framework that integrates a wide range of algorithms and models, including Convolutional Neural Networks (CNNs), Deep Neural Networks (DNNs), Physics-Informed Neural Networks (PINNs), Graph Neural Networks (GNNs), and U-Net architectures. Its adaptability is a key feature, with models continuously trained on customer data to ensure ongoing relevance and high accuracy. Our recent update to the MeshWorks platform, built on top of the Keras library, now includes generative AI capabilities, allowing engineers to create their own designs and significantly streamline the design process while enhancing customization.

The AI/ML capabilities in MeshWorks facilitate early-stage design iterations, enabling training and generation of predictive information tailored to specific needs. A key feature of the module is its ability to generate models from geometric data alone. The software handles multiple neural networks seamlessly, with increased accuracy as more models are used. Once the data is uploaded, the process is streamlined into a one-time effort, delivering ongoing benefits.



AI/ML FRAMEWORK



Intelligent model creation technology

1. The current fierce market competition has drastically shortened the cycle of new product development, and there is no spare time for detailed simulation analysis and solution iteration in the concept stage.
2. The intelligent prediction capability realized by MeshWorks AI/ML technology has a visual interface, which can provide efficient performance prediction capabilities in the conceptual design stage, quickly iterate solutions, and eliminate time-consuming simulation calculations! Users can get real-time prediction of performance parameters!
3. MeshWorks AI/ML technology is a mechanism composed of multiple algorithms/models, including multiple neural network technologies, such as CNN/PINN/UNET/GNN/Graph Neural/Encoder/ Decoder, genetic algorithms, approximation models, etc. The models are adaptive and can be trained on customers' data continuously for rapid & accurate results.
4. DEP's intelligent prediction platform has extremely high accuracy. Currently, the accuracy of CFD prediction of wind resistance coefficient is in the range of 97%.
5. DEP has also developed automatic parameter identification and automatic optimization functions. Combined with AI/ML intelligent prediction, it can form a perfect optimization solution.
6. Without the need for a cyclic solution iteration process, sensitivity and optimization analyses can be completed in a very short time, the optimal design solution can be obtained, and the resultant model can be automatically generated.
7. The application of this technology will bring revolutionary changes to traditional optimization work!



AI/ML Library:

- Create a comprehensive AI/ML model family quickly.
- Addresses multiple disciplines: crash, NVH, durability, vehicle dynamics, aerodynamics.
- MeshWorks parametric CAE technology facilitates rapid data generation and training.



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Uniqueness of MeshWorks

- The link between the parametric geometric FE model and an underlying AI/ML model is the uniqueness of the framework in MeshWorks.
- The parametric CAE capability within MW also provides the unique ability to generate multi-sample data for customers who do not have extensive in-house data.
- MeshWorks combines traditional AI/ML with physics-informed decision-making for better precision.
- Machine learning is integrated with CAE tools and engineering expertise.
- The advanced technology offers a straightforward and intuitive user experience.

Value Proposition for MeshWorks Users

- Design advisors with a visual interface enabled by MeshWorks AI/ML technology provide critical guidance during early stages in the new product development.
- Applying the right AI/ML model for the right output response greatly increases the predictive ability of design advisors.
- In-house expertise from existing data can be institutionalized.

Enhanced MeshWorks AI/ML Platform

Adaptive Training:

- Links between MeshWorks AI/ML platform and SDMs enable adaptive training.

Predictive Capabilities:

- Inputs -> Predictive AI/ML model -> Outputs: Pressure contours, flow lines.
- Types of predictions: Scalar, Vector, Field responses, Time history, Matrices.

Parameterization:

- Rapid design changes.
- Quick performance assessment.

Auto-Parameterization:

- Customized for incoming geometric data.
- Automatically parametrizes most sensitive parameters for fast iterations.

Optimizer:

- AI/ML model + parameterized geometry + optimizer = Fast optimization.
- Easy optimization applicable throughout design stages, especially early stages.

Generative AI:

- Input: Provide initial design details.
- Process: Generative AI uses these details to create a point cloud.
- Output: The point cloud is refined into a detailed, manufacturable design.

