

Transforming aerospace simulation with Simufact Additive's CAD export and geometry morphing

Authors: Annetta Job Kolady (Hexagon Manufacturing Intelligence), Kristina Domeij (GKN Aerospace), Andy Chinn (ITI, a Wipro Company)



In the aerospace industry, precision and efficiency are not just desirable – they are essential. GKN Aerospace, a global leader in supplying airframe and engine structures, landing gear and other critical components, faced the challenge of integrating complex CAD models across various engineering applications. To maintain their competitive edge, GKN Aerospace needed a solution that would enhance their design and manufacturing processes, ensuring seamless data exchange and integration. To tackle this challenge, GKN Aerospace used Simufact Additive, to bridge the gap between design and real-world performance.

Challenges in seamless integration and geometric fidelity

GKN Aerospace's engineering team was tasked with ensuring that their CAD models were accurately represented throughout the design and manufacturing lifecycle. They encountered several challenges:

- 1. Data Exchange and Re-use:** The need to ensure seamless integration of CAD models across different engineering applications, which is critical for modifying and maintaining design integrity and efficiency.
- 2. Accurate Simulation:** The necessity for precise simulation of deformations during the additive manufacturing process to predict and compensate for any discrepancies.
- 3. Workflow Integration:** The requirement for smooth integration of deformed geometries into the company's Product Lifecycle Management (PLM) system to ensure synchronization with assembly models.

Streamlining CAD and STL integration in aerospace design

In aerospace design, CAD (Computer Aided Design) and STL (Standard Tessellation Language) file formats serve distinct roles. CAD files, rich with geometrical data and parametric information, are essential for precise design and seamless integration across platforms. Conversely, STL files, comprising meshes of interconnected triangles, are ideal for 3D printing but present challenges for CAE systems and digital twins due to their lack of parametric data and feature information.

These limitations of STL files pose challenges such as poor workflow integration, geometric fidelity issues, and computational inefficiencies. CAD formats, on the other hand, are preferred for their ability to retain detailed features and parameters, facilitating high-quality meshing and integration.

To overcome these challenges, GKN Aerospace leveraged Simufact Additive's CAD Export feature which uses ITI's CADfix™ Geometry Morphing technology. This solution transforms deformed meshes from additive manufacturing simulation into accurate CAD geometries, ensuring that design features and metadata are preserved. This integration enhances workflow efficiency, bridges the gap between design and real-world performance, and supports seamless transitions across engineering applications, ultimately facilitating better design and manufacturing outcomes.



Figure 1: Deviation during simulation with reference to nominal CAD

The geometry shown in Fig.1 is a critical component designed by GKN Aerospace which was modeled in a CAD environment and exported as a STEP file to ensure seamless integration across their design workflow. The native CAD part was designed parametrically, allowing engineers to quickly optimize key features like curvature, and thickness to maximize efficiency. The exported STEP file retains exact geometric definitions ensuring fidelity during simulation and manufacturing.

Enhanced workflow with CAD Export feature

To address the challenges, GKN Aerospace leveraged Simufact Additive and its new CAD Export feature.

With **Simufact Additive**, part deformations are calculated accurately by simulating the additive build process virtually. The resulting deformed geometry is required for further design iterations propagating through downstream CAE simulations and digital twin update, allowing continuous integration into the company's PLM system ensuring synchronization with the assembly model. Due to the

challenges with STLs, the user preferred the deformed geometry in native CAD formats.

Using CAD Export with the integrated CADfix geometry morphing, the nominal CAD geometry was easily morphed to the displacements calculated during the analysis and exported in the same STEP format. The tool provides flexibility to the user by allowing modification of matching and fit tolerances, to ensure a perfect fit during geometry morphing. The exported part in STEP was successfully tested for smoothness and reflection and further optimized in design to reduce manufacturing process displacements.

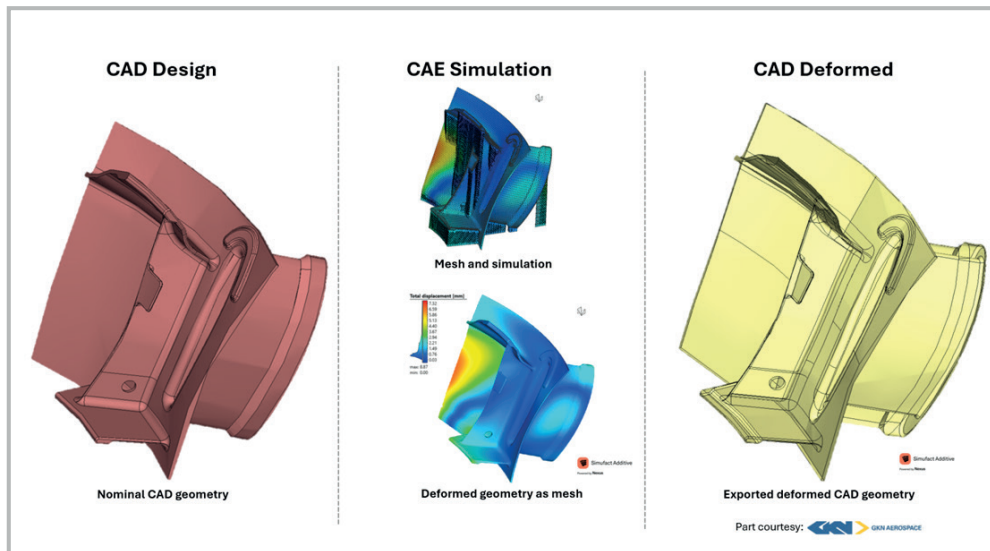


Figure 2: Part geometry simulated for deformations and exported as CAD format

Simufact Additive's CAD Export feature transforms the final mesh resulting from simulation into a deformed CAD geometry, ready for export! It is a powerful tool and a differentiator to CAE software providers who are capable of only generating surface meshes like STLs of the final deformed geometries, making it hard to integrate into a process workflow or continue in another CAD/CAE software. CAD Export generates smooth, well-defined and accurate model geometry that can be exported back to CAD as a usable model, or to CAE for re-meshing and further analysis. It also facilitates a direct comparison between the deformed CAD model and the scanned geometry, creating an effective way to assess and validate the results.

CAD Export uses ITI's CADfix Geometry Morphing technology to morph initial CAD geometries to final deformed simulation results aiding in retention of design features and meta data.

This powerful combination allowed the team to convert simulated deformed geometries into accurate CAD models, ready for further analysis and manufacturing.

The feature is very user friendly where morphing is applied within seconds ensuring better accuracy, smoothness, and continuity of the resulting geometry. In case of a morph failure, it warns the user and iteratively tests with new fit tolerances on the part to export a high quality morphed version of the original CAD geometry.

Significant time and cost savings in engineering workflows

The implementation of Simufact Additive with CAD Export resulted in significant improvements in GKN Aerospace's design and manufacturing processes:

Enhanced accuracy: Parametric features, design dimensions and relationships are preserved for easy further modifications. It provides more realistic, accurate and smooth representation of the deformed physical component.

Seamless integration: The ability to export deformed geometries as CAD models ensured easy digital twin integration and process workflows, enhancing overall efficiency. Also, in addition to deformed geometry, compensated geometries can be exported as CAD.

Time and cost savings: The solution drastically reduced manual efforts in adjusting CAD models and supporting structures to deformed meshes, leading to higher efficiency across the design, analysis and manufacturing lifecycle.

Data consistency: The approach ensured data consistency across CAD and CAE platforms, supporting manufacturing adjustments and facilitating seamless integration and better outcomes in engineering processes.

Conclusion

The collaboration between GKN Aerospace and Hexagon's Simufact Additive exemplifies the transformative power of advanced CAD and simulation technologies in aerospace design and manufacturing. By bridging the gap between design and real-world performance, the team achieved seamless integration and improved outcomes in their engineering processes. This case study underscores the importance of accurate data exchange and workflow integration in achieving precision and efficiency in aerospace engineering.

About ITI:

International TechneGroup, Inc. (ITI, a Wipro Company) specializes in conversion, integration, validation and migration solutions for product data and related systems. Our customers recognize the value of having a trusted solution partner that provides more than just software. ITI solves complex product data interoperability problems so that the world's leading manufacturers can focus on making great products. In 2019, ITI became a wholly owned subsidiary of Wipro Limited and now operates within the Wipro Engineering business that provides customers with a platform to innovate and engineer the next generation of products and platforms at scale.

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About GKN Aerospace:

GKN Aerospace is a leading global tier one supplier of airframe and engine structures, landing gear, electrical interconnection systems, transparencies, and aftermarket services. They supply products and services to a wide range of commercial and military aircraft and engine prime contractors, and other tier one suppliers. They are market leading and technology leading in aerostructures, supporting customers in making aircraft fly faster, further and greener. Their innovative engine system solutions offer significant improvements in performance and fuel consumption.



“The new CAD Export feature has significantly improved our workflow with the ability to export geometries in STEP format, substantially enhancing the surface quality crucial for subsequent support addition.”

Kristina Domeij

GKN Aerospace

Principal Engineer Analysis – Process Simulation



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

Hexagon's Manufacturing Intelligence division provides solutions that use data from design and engineering, production and metrology to make manufacturing smarter.

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