SIEMENS

Siemens PLM Software

Fibersim Pro and Fibersim Elite

Streamlining development of composite products with specification-driven design

Benefits

- Develop composite products effectively with specification-driven design
- Implement design changes efficiently
- Use composite materials effectively during the design process
- Assess the best combination of product shape, material and process
- Eliminate waste and cost during manufacturing processes

Features

- Definition of plies and inserts, including up to 150 attributes
- Automated laminate definition and changes with zone, grid, multi-ply or volume-fill approaches

Summary

Advanced composite materials offer significant opportunities for lightweighting, cost reduction, performance enhancement and reduced maintenance. However, despite the benefits of composite materials, each part design is unique and requires a tailored solution in which the part and desired material are developed simultaneously. Effectively designing with composites requires that part geometry, material behavior and manufacturing process are understood together. The Fibersim™ portfolio of software for composites engineering includes Fibersim Pro and Fibersim Elite from Siemens PLM Software. These are specialized engineering environments that bring together all the aspects for realizing the successful development and manufacture of composite parts. The open architecture of Fibersim provides a specialized engineering environment for composites that are being developed using NX™ software, CATIA® V5 software and PTC Creo® software.

Manual design

Defining composite parts requires the engineer to bring intelligence to surface-, ply- and insert-boundary geometry. Composite designs are data rich, and are often referred to as an inseparable assembly of plies. Each one of those plies can contain up to 150 attributes that must be associated to the geometry.

Fibersim ply-based design ensures that the appropriate attributes consistently deliver that intelligence by using higher level composite object associations, a configurable composite materials database and industry-proven producibility simulations. Plies can be defined one-by-one, in groups or by using imported ply lists that automatically link to predefined geometry. Plies can be single-domain focused or multi-domain wrapped plies that overlap. The flexibility of ply-based design has proven to decrease development time by up to 60 percent in comparison to manual ply definition methods.

Fibersim Pro and Fibersim Elite

Features *continued*

- Automate the generation of the inner mold line
- Extremely accurate producibility simulations that mimic expected manufacturing processes
- Automated manufacturing resolution capabilities

Automated design

Geometry creation for iterative composite design processes is time consuming if done manually. Eliminating the majority of ply- and insert-boundary geometry creation provides an engineer with more time to focus on optimizing the part and making the right material and manufacturing process choices. Automating the design process ensures that changes can be made effortlessly and without error.

Zone- and grid-based design, the trademark Fibersim methods for developing panels and other parts that utilize specifications, support material stackups, drop-offs and drop-off profiles to drive geometry creation. Specifications are applied to interdependent regions of the part and Fibersim then solves for the ply shape. Changes during the iterative design process are made to the specifications, which immediately update the ply shapes.

Multi-ply design is a unique Fibersim automated composite design method that also uses the same specifications to drive geometry creation. However, unlike traditional zone- and grid-based design methods, independent base ply shapes or reinforcement regions can be placed on top of each other. Used in a hybrid approach with zone- and grid-based design, multi-ply can eliminate zone and grid redefinition due to added reinforcement. Also, unlike a ply-based approach, the design is updatable, eliminating rework. Traditional and multi-ply methods used in combination can deliver an unequaled level of flexibility and efficiency. Customers using these design approaches have experienced up to an 80 percent increase in design efficiency.

Volume fill is also a unique Fibersim automated composite design approach for thick parts that utilize multiple surfaces and the thickness of materials to drive the generation of ply boundaries. However, unlike solid slicing approaches, volume fill generates the surfaces for the stackup, including draping of larger plies over smaller plies, and is updatable during material or stackup order changes.

Manufacturing producibility simulations are done on these surfaces, providing the required accuracy needed to properly fill the part volume. Customers using volume fill have experienced a 75 percent increase in design efficiency.

In wind blade design, the Fibersim approach uses industry standard definition methods based on Excel® spreadsheet software that take into account material requirements and ply boundary locations from root-to-tip and leading-to-trailing edge. By consuming standard Excel part definitions, Fibersim can be used to create both the computer-aided design (CAD) geometry and the full definition of each ply layer. Several key industry leaders that have capitalized on the Fibersim capability previously used only a 2D process and found that using a 3D process resulted in up to 60 percent faster time-to-market because of the ability to create engineering and manufacturing documentation, and inner mold line (IML) surfaces for assembly and tooling.

Final part shape and tooling

The completion of a composite design requires the development of the IML. The IML is required for packaging, mating components and tooling. Manually creating the IML to achieve a final part shape definition requires an engineer to determine constant gauge region thicknesses and ramps between the regions. IML development is arduous and error prone and takes weeks of work. Improperly created inner mold lines can lead to significant problems downstream in the development process. Design changes in thickness, geometry or ply shape require additional weeks of rework.

Fibersim parametric surface offset (PSO) technology automates IML generation and any changes by using the results from specification-driven designs (zone, grid and multi-ply) as the basis. Uniquely, any part of the PSO can be manually modified and will remain updatable with the automated portion. Customers have experienced 75 percent or greater reductions in IML creation time by using Fibersim PSO technology.

Producibility simulation
Aligning reinforcement fibers to meet expected loading is critical to part performance, enabling the user to avoid overbuild and in-field failures. Therefore, in the context of part geometries and manufacturing processes, understanding material behavior is critical to developing composite parts that meet or exceed their economic and functional requirements. Fibersim simulation methods for hand and automated layup processes are industry proven to provide the most accurate results.

With a visual interface and modification capabilities, using Fibersim ensures that the layup process is simulated in accordance with expected manufacturing layup practice, and the resulting flat pattern and manufacturing data are accurate. The accuracy of Fibersim simulations has provided customers with up to a 60 percent reduction in scrap rates.

Manufacturing resolution
Material deformation is not always avoidable due to situations such as part geometries resulting from packaging, material lock angles or manufacturing process limitations. Using Fibersim provides capabilities to both dart and splice plies so flat patterns generated from the producibility simulation include the manufacturing resolution and are usable during the manufacturing process.

Automated manufacturing can pose challenges in terms of machine limitations. Fibersim includes a configurable machine database and the capability to determine course layup challenges so they can be addressed before path planning. Whether using hand or automated layup processes, designs that do not incorporate the manufacturing resolution will increase weight, scrapped material and decrease production throughput.

Data management
During design, plies, inserts and specifications, along with their vast set of attributes, need to be managed and easily accessible to facilitate an efficient design process. Fibersim supports the ease of managing data with capabilities such as persistent filtering by laminate in multi-laminate parts, and sorting or grouping by attributes, such as geometry for ease of identifying objects. Integrating the Fibersim specialized engineering environment with Teamcenter® software ensures composite parts and associated manufacturing outputs are revision controlled and accessible throughout the enterprise, maximizing productivity and improving product quality.

Supported CAD platforms

CAD	Fibersim Pro	Fibersim Elite
NX	X	X
CATIA	X	X
Creo	X	

Supported design methodologies

Design methods	Fibersim Pro	Fibersim Elite
Ply (manual)	X	X
Multi-ply (automated)	X	X
Zone/grid (automated)		X
Volume fill (automated)		X
Wind blade (automated)		X

Simulation and IML creation capabilities

Capabilities	Fibersim Pro	Fibersim Elite
Hand layup simulation	X	X
Fiber steering simulation	X	X
Fiber placement and tape laying course challenges	X	X
Forming ply slip	X	X
Splicing/darting	X	X
Flat pattern assessment (3D)	X	X
Parametric surface offset	X	X

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