Fibersim
Composite design & manufacturing
Building what you design
Fibersim - A Complete Engineering Environment for Composites Design

- CFD & Structural Layout
  - Import from structural design
- Design Review
  - Weight calculations
  - Cost modeling
  - Materials & Processes
- Design methods ply, zone, grid
- Interface to analysis
- Design verification
- Producibility
  - Splicing, Core design
  - Offset surface mockup, mating

FIBERSIM

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Siemens PLM Software
Providing a Seamless Link to Manufacturing

FIBERSIM

Generate flat patterns

Create technical documentation

Generate laser projection data

Generate data for automated placement

RTM simulation

Engineering Release

Design Review

On time
On budget
On spec

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Siemens PLM Software
FiberSIM - Composite Design Process

1. Create Initial Composite Definition
2. Draping analysis
3. Documentation
4. Generate outputs
FiberSIM - Initial Composite Definition

- Create Initial Composite Definition
- Ply based design
- Draping analysis
- Overlay zone design
- Documentation
- Zone based design
- Generate outputs
Fibersim Ply Based Design

Challenges
• Ensure a producible design ahead of time
• Generate accurate flat patterns and manufacturing documentation

Capability and Value
• Captures complete design and manufacturing data including laminate, rosette, ply and core
• Identifies over 150 parameters per ply including ply contour, origin, name, material, orientation, manufacturing sequence and step
• Minimizes geometry creation and automate creation of dart/splice curves
• Enables producibility assessment early in the design process
  • Early warning of manufacturing issues (wrinkling, bridging, tow buckling)
Fibersim Zone Based Design

Challenges
• Large number of laminate specifications
• Complex zone transitions
• Time consuming ply updates on large skin panels (aircraft wings for example)

Capability and Value
• Zone-based design automates the generation of ply and drop-off curves
• Zone-to-ply functionality empowers automatic creation of plies
• Splice groups enable rapid and consistent management of splice curves across ply layup
• Dart management tool provides control of dart positions across ply layup
Fibersim Grid and Structure Based Design

Challenges
• Ensure a ply design consistent with stiffening substructures
• Keep all design rules enforced and consistent for many design updates

Capability and Value
• Driven from target laminate specifications
  • From NX Laminate Composites, or
  • External laminate requirements
• Uses existing simple parametric reference geometry
  • Stringers and frames (fuselage sections)
  • Spars and ribs (wing structures)
• Enables process specific design
  • Automated deposition
Fibersim Volume Fill Design Process

Airfoil

Airfoil Mean Surface

Layer “Fill” Generation

Surface Offset Generation

Shuffle Plies

Run Simulation (offset based on surface)

Create Flat Pattern
Additional Design Methods

Blade design
• Rapid geometry creation for a very large number of ply courses (wind blade design)

Spine based design
• Accurate producibility simulation for profile layup including stringers, frames and spars

Volume fill design
• Automated ply definition for thick and/or solid composite parts (for example, jet engine fan blades)
Initial Composite Definition - Demonstration

Create Initial Composite Definition

Draping analysis

Documentation

Generate outputs
Using FiberSIM, the designer will be able to:

- Capture the entire composite definition of the part in the CAD system with all necessary details.
- Capture design intent using specifications to drive drop offs and splicing
Fibersim – Draping Analysis

Create Initial Composite Definition

Draping analysis

Documentation

Producibility simulation

Splicing / Darting

Generate outputs
Fiber Orientation Changes

Fiber “Trellising”

Fabric on Flat Surface

Fabric draped doubly curved Surface

<90 deg.

Fiber trellising

Fiber “Deviations”

Cylindrical “mapping”

“Draped” from Center of surface
Accurate Mfg. Simulation Methods

- Standard: Simulation works outward in radial fashion. (Hand Laying)
- Geodesic: Simulation works outward from geodesic path. (Forming)
- To Curve: Simulation places cells along Fiber Direction Curve. (Steering)
- About Curve: Simulation propagates along Fiber Direction Curve
Process parameters can impact fiber orientations

Same Material - Same Shape

Difference only in Process Parameters

Initial Tool Contact

Flat Patterns

~15 Deg.
## NCF Material Simulation

<table>
<thead>
<tr>
<th>Uni conforms well</th>
<th>0/+45/-45 less compliant</th>
<th>0/+45/-45/90 Manufacturing problem</th>
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</table>

![Uni conforms well](image1)
![0/+45/-45 less compliant](image2)
![0/+45/-45/90 Manufacturing problem](image3)
Evaluation of producibility on full body ply
Features causing manufacturing issues

Compound curvature/steep draft angle cause deformation
Geometric changes – modification of draft angle

Before

26 degree draft angle reduction

After

Producibility Issues
Example – Black metal design
Comparison of design details
Composite friendly vs. black metal design
Ply Splicing and Splice Groups
Formed part development tools

- Formed Laminate indicates areas of relative motion between plies
- Blue indicates area with little to no relative motion, Red, significant relative motion between plies
- This information can be used to guide forming strategies
- 2D Laminate positions plies in 2D blank for proper forming to 3D
Draping Analysis – Demonstration

Create Initial Composite Definition

Draping analysis

Documentation

Generate outputs
Using FiberSIM, the designer will be able to:

- Evaluate the ply drapability based on the defined parameters to detect potential challenges
- Quickly test various draping options to find a satisfying solution to draping challenges
- Easily apply splicing and darting when necessary
- Send draping data back to Stress analysis for verification
Fibersim – Documentation

Create Initial Composite Definition

Draping analysis

Documentation

Generate outputs
Documentation – Demonstration

- Create Initial Composite Definition
- Draping analysis
- Documentation
- Generate outputs
Fibersim – Documentation

Using FiberSIM, the designer will be able to:

- Quickly generate cross sections and 3D annotations
- Generate documentation directly linked to the data defined in CAD system (avoid broken information link between the initial definition and the documentation)
Fibersim – Generate outputs

- Create Initial Composite Definition
- Draping analysis
- Documentation
- Generate outputs

- Export flat patterns to nesting systems
- Generate layup file for laser projection
- Export layup data to path planing softwares for automated draping
Seamless Link to the Shop Floor

- Ply cutting
- Laser templating
- Automated deposition
Generate outputs – Demonstration

- Create Initial Composite Definition
- Draping analysis
- Documentation
- Generate outputs
Using FiberSIM, the designer will be able to:

- Quickly generate export files for manufacturing systems
- Generate manufacturing outputs directly linked to the data defined in CAD system (avoid broken information link between the initial definition and downstream applications)
Fibersim – Documentation

- Reduced Engineering Time
- Improved Work Flow
- Efficient Design Process
- Reduce Time in Manufacturing
- Improved Flow of Engineering Information
Questions
Thank you

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Realize innovation.