SIEMENS
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Fibersim Automated Deposition Design

Facilitating design of composite parts that are manufactured with automated layup machines

Benefits

- Makes certain that parts are designed and manufactured according to specification
- Ensures that parts are properly designed for automated manufacturing
- Eliminates change notices for design changes due to machine characteristics typically not discovered until the path planning process
- Ensures that parts are easy to certify by maintaining a digital thread between the engineered and manufactured parts

Features

- Automatically applies material additions on corners to satisfy machine characteristics
- Automatically ramps edge of plies, ensuring roller conformance
- Automatically generates stagger origins identifying the location of the first ply course for path planning

Summary

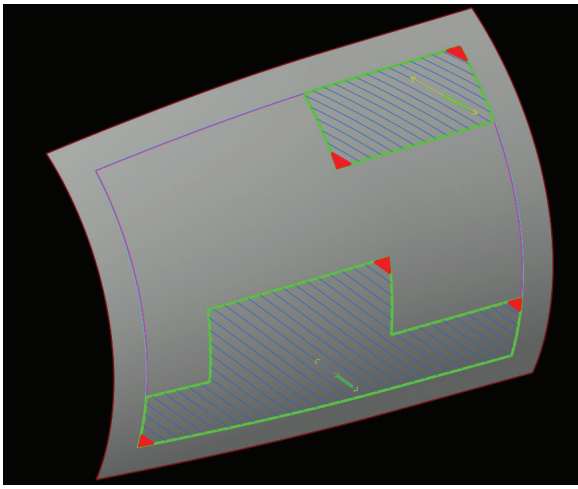
Automated manufacturing machines are increasingly being used to produce composite parts in an effort to enhance quality, rate and repeatability. Product designs consequently must take into consideration the capabilities of automated layup machines. For instance, designs must incorporate features that consider machine characteristics and production rate while also meeting part performance requirements, such as weight and strength. To accommodate machine characteristics, such as minimum or maximum material widths, minimum course lengths and minimum cut angles, engineers often have to make tedious and costly design changes to initial ply boundary shapes.

The Automated Deposition Design module in the Fibersim™ portfolio of software for composites engineering delivers tools that make it easy to design for manufacturing with automated layup machines. Automated Deposition Design (ADD) provides a digital thread between the composite engineering definition and the manufactured parts produced by automated fiber placement or tape laying machines, ensuring that parts are:

- Designed and manufactured according to specification
- Designed for automated manufacturing, eliminating change notices due to machine characteristics
- Easy to certify

Aids design

One of the most significant design-for-manufacturing requirements that affects ply boundaries, and consequently part cost, weight and center of gravity, is the minimum course length machine characteristic. ADD enables



The course challenges simulation feature of the Composite Engineering Environment module in the Fibersim portfolio has identified in red the locations on this fuselage panel at which there will be manufacturing issues due to machine characteristics. The simulation provides the feedback needed to find and make the required changes early in the design cycle.

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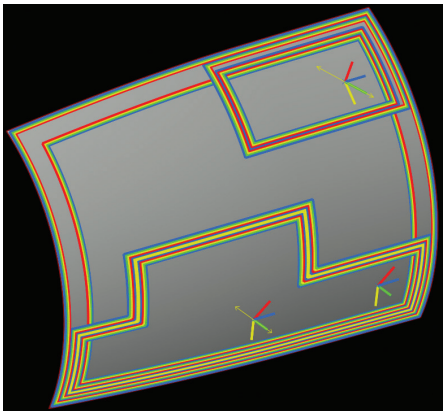
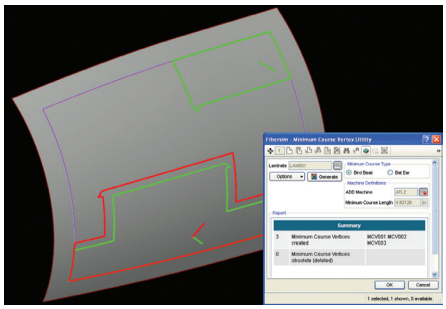
you to make decisions on how best to address minimum course length issues and automatically adds minimum course extensions – termed “bird beaks,” “bat ears,” “dog ears,” or chamfers – to the corners of ±45° ply boundaries.



ADD has automatically added extended ramps to the outside edge of the plies on this fuselage panel to eliminate cliff edges and avoid material lift and smear.

Optimizing machine rate

Automated layup machines often have difficulties when there is a large step or cliff edge between the tool surface and the top ply of material. In these cases, the roller can make contact with the edge of the part and lift up or smear top plies, thus impairing the layup of a part. Shims or extended boundary ramps typically alleviate this problem, but manually creating ramps by shimming is time-consuming and may require multiple shims per part, slowing the rate of production because of the need to repeatedly stop and start the machine. ADD automates the extension of ply boundaries in a staggered fashion, creating extended boundary ramps that ensure the best machine rate and material layup.



ADD has automatically identified where the machine will have minimum course limitations on this fuselage panel and has applied bird beaks to the corners of the ±45° plies.

Ensures part strength

Staggering courses between plies is critical to minimizing the effect of overlaps and gaps and ensuring the strength of the part. Designs typically require that a certain number of plies in the stackup have courses offset before having the same course coverage as the original ply. Courses are generated starting from an origin point within the ply that must be shifted or staggered for subsequent plies that have the same orientation and coverage area. Staggering is done orthogonally to the fiber direction and stagger distances are typically prescribed, such as 2 tow widths or 10 millimeters. ADD automates the creation of staggered origins, eliminating the time-consuming need to manually measure and create an origin for each ply.

Provides certifiable products

ADD provides a digital thread between the engineering definition and the part designed for automated manufacturing. You can easily obtain the specifications and certification of the part as designed and manufactured within a single composite CAD master model.

Eliminates change orders

Fibersim ADD works directly on the composite CAD model, automatically applying design changes based on automated layup machine characteristics and design requirements. The master model approach allows you to design for manufacturing early in the development cycle and eliminate design change orders that occur after manufacturing has begun path planning.

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