

MP21795-R

Composite Roundtable with Collaboration from Sim and OCTO Teams

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Learning Objectives

- Learn about the current state of industry
- Discover the future direction of the composites industry
- Discover the current state of composites-related design and manufacturing software
- Learn about the future direction of composites-related design and manufacturing software

Description

This is an interactive discussion between a large, diverse group of interested parties to further the composites cutting industry. The Composite Team will lead discussion in conjunction with the Sim, OCTO, and Delcam Teams. We will cover the current state of the industry, the future direction of the composites industry, the current state of composites-related design and manufacturing software, and the future direction of composites-related design and manufacturing software (including a streamlined composites manufacturing solution).

Your AU Expert(s)

- *Massimiliano Moruzzi, Autodesk, Principal Research Scientist*
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Introduction to Composite Manufacturing

Composite manufacturing combines conventional manufacturing techniques with advanced workflows in order to produce high quality parts. Composite manufacturing methods include forming, hand laying, injection molding, automated tape laying and more. Due to the high variability in the end product, the industry is moving toward design methods that incorporate downstream manufacturing techniques to determine feasibility. TruPlan and TruFiber allow the user iterate through different manufacturing scenarios of each part without costly attempts at determining the ideal manufacturing process.

What are Composites?

Composite materials are defined as a material with two or more constituents with significantly different properties. These constituents can be defined as identifiable materials within the homogenized material. For the purpose of this discussion, our “constituents” are fibers and a polymer matrix. Composite materials are traditionally manufacturing by placing multiple layers, called lamina, together in a specific sequence of orientations to make up the laminate.

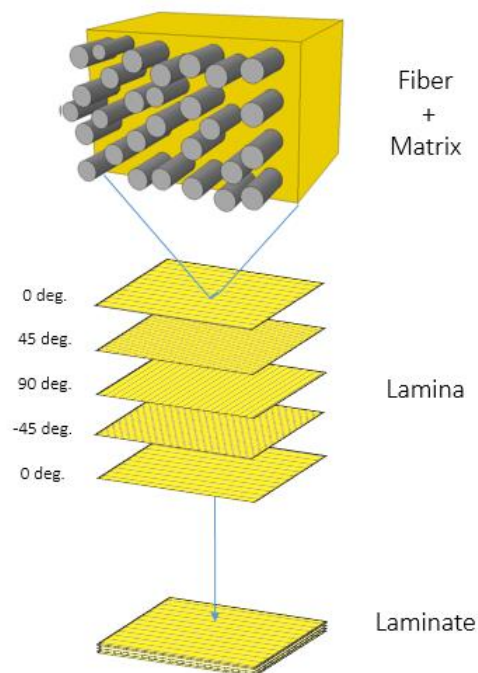


FIGURE 1: DIAGRAM DESCRIBING A STANDARD COMPOSITE LAYUP

Why Composites?

Composite materials allow designers and manufacturers to tailor the properties of the material to their needs. You can tune the material properties to meet engineering requirements for thermal expansion, high strength to weight ratios, stiffness, environmental response, and more. The fibers in the composite material provide the strength, stiffness, and other mechanical properties while the matrix provides the shape, protection from the environment, and transverse the loads the material may experience. Since we have the ability to design the lamina, we can narrowly design the material for our needs.



FIGURE 2: EXAMPLE OF A COMPOSITE MATERIALS

Basics and advantages

- Favorable strength/weight ratio
- Tailor material properties to intended use
 - Customize compression, extension, torque characteristics
 - Warp/weft density
 - Direction of plies (0,-45,+45,90)
 - Mix materials
- Structural elements
 - Fibers
 - Bonding matrix
 - Core
- Cost vs. performance

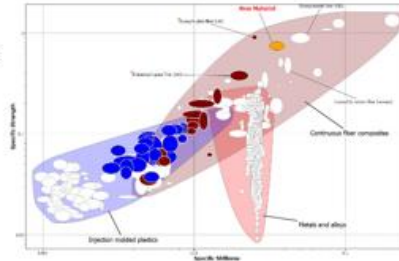


FIGURE 3: EXAMPLE OF A COMPOSITE MATERIALS



FIGURE 4: EXAMPLE OF A COMPOSITE MANUFACTURING SOLUTIONS

Composite Workflows

Much like traditional parts, composite parts start off with a conceptual design. The conceptual design envisions the geometry, mechanical properties, factor of safety, etc. targeted for the part specifications. Once the constraints for the part are envisioned, ply design and structural simulation are next. The ply design consists of the rosette definition, boundaries, orientations, and materials used to construct the composite laminate. The composite laminate definition greatly influences the structural simulation of the part and causes an iterative process to form between the two components until the composite laminate design has been finalized. Next in the composite workflow is the design for process step. TruPlan incorporates the finalized composite laminate design and provides detailed analytics for the potential manufacturing techniques that can be used for production. Depending on the manufacturing techniques available, users can go through the hand laying manufacturing workflow or one of the automated material laying workflows available. In this course, we will be focusing on the automated material laying workflow that includes analyzing material defects, fiber path generation, and machine simulation.

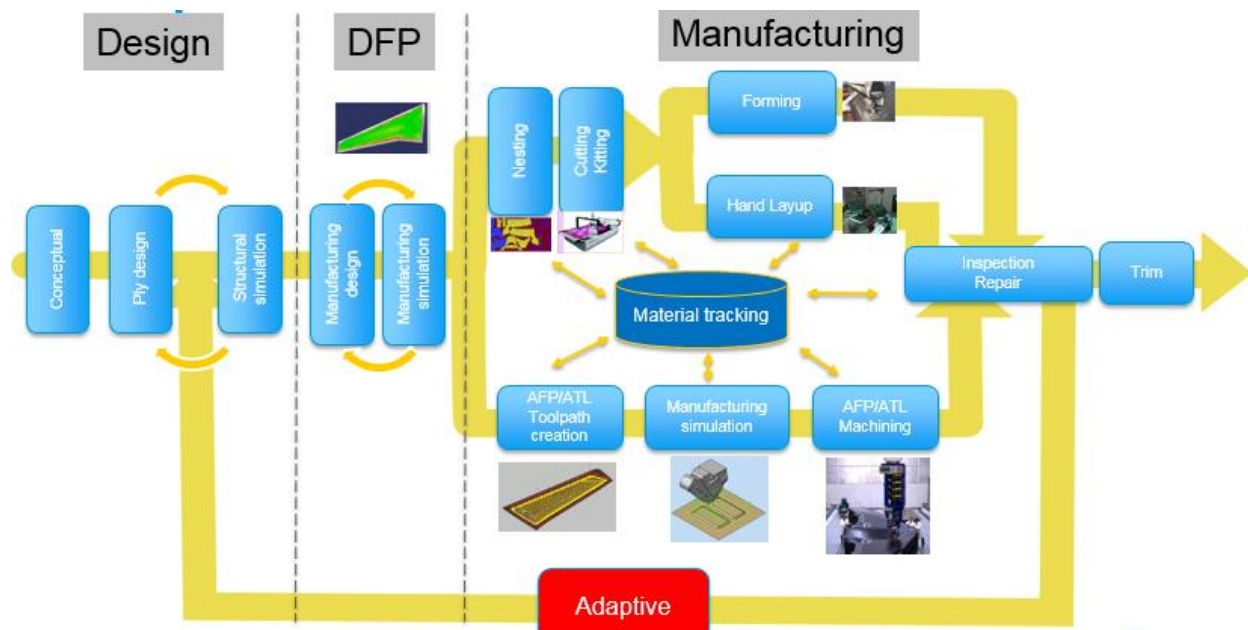


FIGURE 5: COMPOSITE WORKFLOW

Questions

- 1) What type of composite processes are you using and what are you interested in?
- 2) How do you acquire material characteristics for your processes?
- 3) How do you evaluate cost for your process?
- 4) What techniques do you use for light weighting?
- 5) Comment on the use of virtual reality in composites.
- 6) Comment on compliance requirement for composite use and specifications.
- 7) What simulation processes are of interest ex: Autoclave, Spring-back?