Simulation solutions for Composites

Composite development workflow Aerospace From material to part



Functional Requirements Driven Topology Optimization



Digital twin across the entire life cycle – the art of what's possible



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Digital twin across the entire life cycle – the art of what's possible



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Challenge: Analyze complex composite materials while reducing product development cycle time and increasing number of parameter combinations

Solution: Integrated design and analysis environment allowing robust laminate composite modelling

40% WEIGHT REDUCTION

FASTER CREATION OF ANALYSIS MODELS

ACCURATE REPRESENTATION AND ANALYSIS OF LAMINATE COMPOSITE STRUCTURES



"The efficiency with which we can make design changes and verify their performance has dramatically increased"

"With composites there are so many options, and so a flexible interface that allows you to quickly specify and experiment with a variety of parameters is essential. Use of Simcenter Laminate Composites enables precisely that."

Alastair Komus, Principal Engineer



Dia 7

TM(SGEBP1 Tijssens, Martin (DI SW GS&CS EU BEN PRD); 28-1-2023

Simcenter for Structural Dynamics Test & Simulation





Nari Technology

introduces in-house testing to reduce costs by nearly half

Nari Technology establishes reliability test and certification platform to perform qualitative and quantitative testing and analysis.

80%

realized time savings using simulation-based testing

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Space Industry Using Simcenter 3D and Simcenter Test software to avoid failure





· Faster development with reduced risk

Correlation, Updating & Virtual testing

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Certification



Integrated Workflow for Progressive Damage

Delamination simulation

SIEMENS Ingenuity for life





Challenge: Reaching 50 percent weight reduction by 2020 or 2030

Solution: Evaluate relevancy of FRP materials for large weight reduction of an automobile body structure

Predictive damage models at the coupon level and at composite subsystem design concept level

Development of the parameter identification procedure, based on a limited amount of physical tests on coupons

Accurately predicted structure performance



"Not only at Honda, but many engineers in this field think that we can still make vehicles that have a 50 percent lighter body structure using composites while maintaining the mechanical properties of the replaced metallic parts."

Yuta Urushiyama, Composite body innovation programs

The solution

Materials Engineering in Simcenter 3D through acquisition of Multimech





Deutsches Zentrum für Luft- und Raumfahrt German Aerospace Center

Enabling material innovation with Simcenter Multimech

30% TIME AND COST SAVINGS ESTIMATED





Pyrolysis of Ceramic Matrix Composites







Which type of fiber and matrix? What material architecture?

Optimize fiber/matrix interface properties

What manufacturing conditions to **avoid** early **micro-cracking**?

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"There is no software available in the market that is as easy to use as Simcenter Multimech and can handle such complex multiscale problems."

Neraj Jain, Group Leader in Simulation & Engineering

Manufacturing Simulation: Curing of Thermoset Material Avoid costly scrap, rework and shimming at assembly



Challenge



Larger, more complex designs are at higher risk for dimensional

variation

Spring back can become a major issue at assembly adding excess cost and time



Simcenter 3D solutions



Take into account the material history during curing process:

- Determine the process induced deformations
- Evaluate the effects of • residual stress



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Redefining Simulation Strategy for Innovation



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Laminate Composite Optimization in Simcenter 3D

https://youtu.be/0kP3n_lfUwg

Discover Better Designs, Faster

Design Space Exploration

- Process Automation (Automate building of virtual prototype)
- Distributed Execution (Accelerate testing of virtual prototype)
- Efficient Search (Look for better design alternatives)
- Insight & Discovery
 (Ensure reliable product performance)





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Digital Twin for Performance



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Challenge

Increase turbine blade reliability and reduce operation and maintenance costs

Solution

Executable digital twin for blade design, and certification for static, dynamic and fatigue testing



Expansion of data points from 10s to 100s



Improve certification accuracy



Time reduction for model updating and instrumentation

Executable Digital Twin Measure the unmeasurable with smart virtual sensors

Challenge Improve accuracy of durability testing for composite blades



- Currently relies on a few physical sensors
- Suboptimal sensor positioning decreases accuracy of durability results
- Model updating can be lengthy and complex

Solution

Estimate full field stress and strain response with smart virtual sensor



Benefits Detect critical locations on the full blade



Expand strain data from 10's of data points to 100's



Accuracy of durability testing

Up to



Time reduction for model updating and instrumentation

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Executable Digital Twin Optimize product efficiency and performance in operation

Challenge Improve monitoring of composite blades in service



- Currently relies on a few physical sub optimally located sensors
- Information coming from one blade is not exploited for other assets in operation

Solution Estimate full field stress and strain response with smart virtual sensor



Benefits Detect critical locations on the full blade during operations



Expand strain data from 10s data point to 100s



Monitoring multiple blades on multiple turbines in multiple windfarms



xDT is self-updating to each separate asset

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Contact

Dr. Ir. Martin Tijssens Portfolio developer Simcenter CAE

Siemens Digital Industries Software Brainport Industry Campus 1 5657 BX, Eindhoven, Netherlands

Mob. : +31 (0)6 51651467 Tel +31 (0)88 241 8500 <u>martin.tijssens@siemens.com</u> <u>www.linkedin.com/in/tijssens</u>



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