Curing of Carbon Fiber Reinforced Plastics (CFRP)

CUSTOMER: ISEMP (Integrative Simulation and Engineering of Materials and Processes)

- ISEMP aims at the simulation of material details and not only the macroscopic overall properties
- ISEMP aims at considering manufacturing process by the simulation
- ISEMP uses commercially available software tools

CHALLENGE

- Processing of CFRP results in residual stresses in the material
- Residual stresses lead to micro-damage & failure of CFRP
- Goal is to simulate residual stresses of a carbon fiber composite material at the micro scale with realistic topology

HOW CAN DIGIMAT CONTRIBUTE TO THE INVESTIGATION OF THE CFRP CURING PROCESS?

RVE

Delamination & micro cracks due to residual stresses
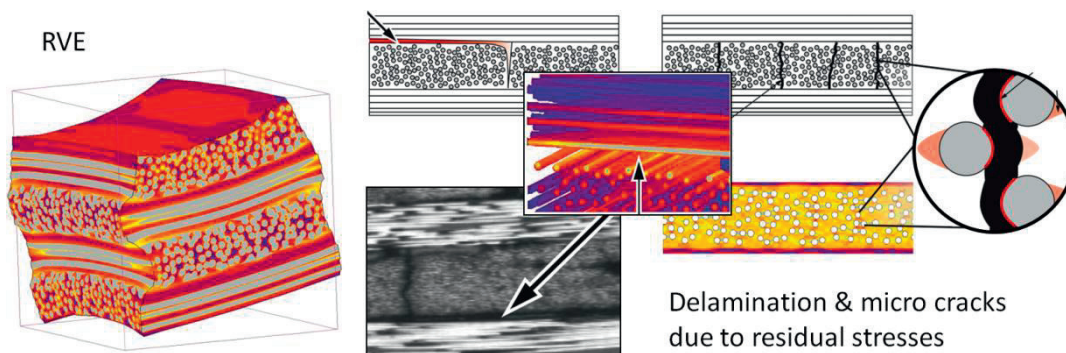
DIGIMAT SOLUTION

- Generation of RVE with continuous fibers & layered microstructure
- Realistic RVE with stochastically distributed fibers
- CAD geometry of RVE to be used with external solvers

RESULTS

- The FE-Simulation of laminate layers with inhomogeneous properties enables a detailed analysis of stress distribution and possible origins for different types of micro defect formation
- Highest stresses can be found at the fiber matrix interface
- Matrix areas between very close fibers are under higher load
- Fiber matrix interface between differently oriented laminate layers shows higher stresses

MATERIALS
Reinforced Plastics

PERFORMANCES
Residual stress
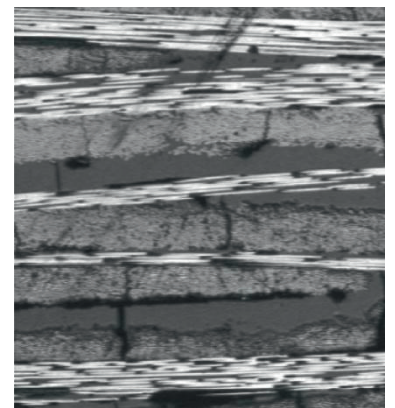
DIGIMAT
Digimat-FE

CAE TECHNOLOGY
MSC.Marc

INDUSTRY
Aerospace

APPLICATION
Manufacturing process simulation

Manufacturing process defects in CFRP: segmentation cracks, pores, matrix enrichment & delamination.

"*DIGIMAT enables us to perform in depth studies of complex and realistic microstructures. As an invest into the future we base our simulation approach on the DIGIMAT software, both for our research and the education of a new generation of simulation engineers who will be experts in the modeling of materials.*"

Prof. Vasily Ploshikhin, Airbus endowed chair for Integrative Simulation and Engineering of Materials and Processes (www.isemp.de)

www.e-Xstream.com

The nonlinear multi-scale material & structure modeling platform

Digimat material modeling platform means developing innovative, optimized and cost-effective products. As a unique nonlinear multi-scale material and structure modeling platform, Digimat offers:

Digimat MF: Mean-Field homogenization software used to predict the nonlinear behavior of multi-phase materials.

Digimat FE: Finite Element based homogenization software used to model the nonlinear behavior of Representative Volume Elements (RVE) of material microstructures.

Digimat MX: Material eXchange platform used to prepare, store, retrieve and securely exchange Digimat material models between material suppliers and end-users**.**

Digimat CAE: Digimat linear and nonlinear interfaces to major processing and structural FEA software to enable multi-scale analyses of composite structures.

Digimat MAP: Shell & 3D mapping software used to transfer fiber orientation, residual stresses and temperatures between dissimilar processing and structural meshes.

Digimat RP: Easy and efficient solution for the design of fiber reinforced plastic parts.

Digimat HC: Easy and efficient solution for the design of honeycomb sandwich panels.

The material modeling company

e-Xstream engineering is a provider of simulation software & engineering services, 100% focused on advanced material modeling. e-Xstream was founded in 2003 in Belgium and Luxembourg. e-Xstream is an MSC Software company since September 2012 with more than 1100 associates working from over 20 offices around the world.

e-Xstream engineering develops and commercializes Digimat – the nonlinear multi-scale material and structure modeling platform that fastens the development of optimal composite materials and parts.

Digimat customers are material experts and structural engineers who accurately predict the behavior of multi-phase composite materials and structures. Digimat is used by all major material suppliers and users across all industries (Automotive, Aerospace, Electric & Electronics, Leisure, Defense ...).

With this important customer base worldwide, e-Xstream combines deep expertise in material modeling and numerical simulations with the business understanding of the large variety of materials used across all industries.

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