

Barely visible damage in laminate structures

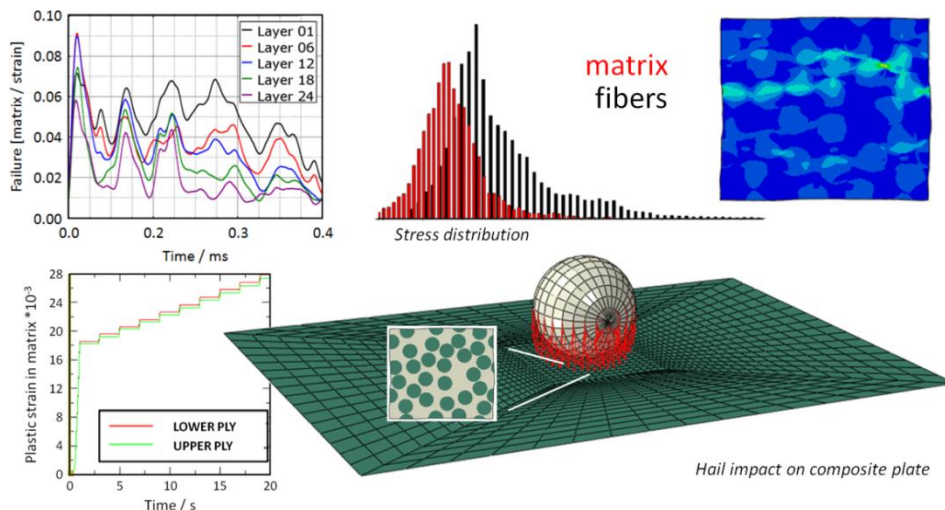
PRINCIPLE STUDY

- Multi-scale investigation of the effect of hail impact on a composite structure causing barely visible damage

CHALLENGE

- Micromechanical non-linear modeling of the composite behavior
- Understanding stochastic effects on the micro level
- Failure prediction on sub-ply level

WHAT IS THE ADVANTAGE ARISING FROM MULTI-SCALE MODELING?



DIGIMAT SOLUTION

- Nonlinear elasto-plastic modeling of the epoxy matrix phase
- Transversely isotropic modeling of the carbon fiber phase
- Failure indicators investigated
 - On ply level (Tsai-Hill 2D)
 - In the matrix phase (maximum principle strain)
 - In the carbon fiber phase (maximum principle stress)
- Cyclic loading of the composite structure
- Investigation of stress distribution of a stochastic fiber arrangement in a representative volume element (RVE)

RESULTS

- Failure indicators on microscopic (phase) level point out the critical plies
- Cyclic loading shows accumulation of plasticity in the composite matrix
- RVE shows the effect of stress concentration due to stochastic fiber arrangement

MATERIALS

UD composites

PERFORMANCES

Stiffness, Failure

DIGIMAT

Digmat-MF, Digmat-CAE

CAE TECHNOLOGY

Abaqus

INDUSTRY

Aerospace

APPLICATION

Impact



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

MSC Software 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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