Thermo-mechanical Design of an Ultra-light Satellite Antenna

CUSTOMER: ESA ESTEC

• The ESA ESTEC (European Space Research and Technology Center) is the incubator of the European space effort
• The ESA ESTEC supports European space industry and works closely with universities, research institutes and space agencies all over the world
• The ESA ESTEC implements R&D studies to develop technologies for future space missions

CHALLENGE

• Satellite antennas have to be designed in a sturdy and reliable manner
• There is no easy way to repair a satellite once it breaks down
• The extreme sensitivity of the structure towards thermal loads has to be investigated under environmental conditions

HOW CAN DIGIMAT SUPPORT VIRTUAL DESIGN OF ULTRA-LIGHT SATELLITE ANTENNA?

DIGIMAT SOLUTION

• Multi-scale modeling of advanced woven composite material on 3 scales
• Carbon/epoxy composite: homogenization of yarn properties
• Triaxial woven fabrics (TWF): detailed analysis of a representative cell
• Satellite antenna: simulation of the full structure based on an equivalent multi-layer shell model representative for TWF

RESULTS

• Mean-field homogenization gives high quality prediction of yarn properties (stiffness & CTE)
• Yarn properties used to compute accurate results for stiffness & CTE for TWF
• Good prediction of displacement behaviour of the satellite antenna due to thermal loading

MATERIALS
Woven composites

PERFORMANCES
Stiffness, CTE

DIGIMAT
Digimat-MF, Digimat-CAE

CAE TECHNOLOGY
Abaqus

INDUSTRY
Aerospace

APPLICATION
Robustness

“DIGIMAT is able to bridge the micro to the Macro world. A great example of high-quality european know-how”

Dr Julian Santiago Prowald,
TEC-MSS Structures Section ESA/ESTEC

Venus Satellite, Courtesy of ESA/ESTEC

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**: the Mean-Field homogenization software used to predict the nonlinear constitutive behavior of multi-phase material
- **Digimat-FE**: the Finite Element modeling of realistic Representative Volume Elements (RVE) of material microstructures
- **Digimat-MX**: the Material eXchange platform to reverse engineer, store, retrieve and securely exchange DIGIMAT material models between material experts and end users
- **Digimat-CAE**: the module that gathers interfaces to all major injection molding and structural FEA software codes
- **Digimat-MAP**: the shell and 3D mapping software to transfer fiber orientation, residual stresses, temperatures and weld lines from injection molding simulation onto a structural FEA
- **Micross**: a user-friendly tool for the design of honeycomb core composite sandwich panels based on FE analyses to compute bending and shear scenarios

The Material Modeling Company

e-Xstream engineering is a provider of simulation software & engineering services, 100% focused on advanced material modeling. Headquartered in Louvain-la-Neuve (Belgium) since 2003, today the company presence is worldwide through its branches in Luxembourg, Michigan (USA) and a large network of channel partners in Europe and Asia.

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 & Electronic, 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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