GENOA

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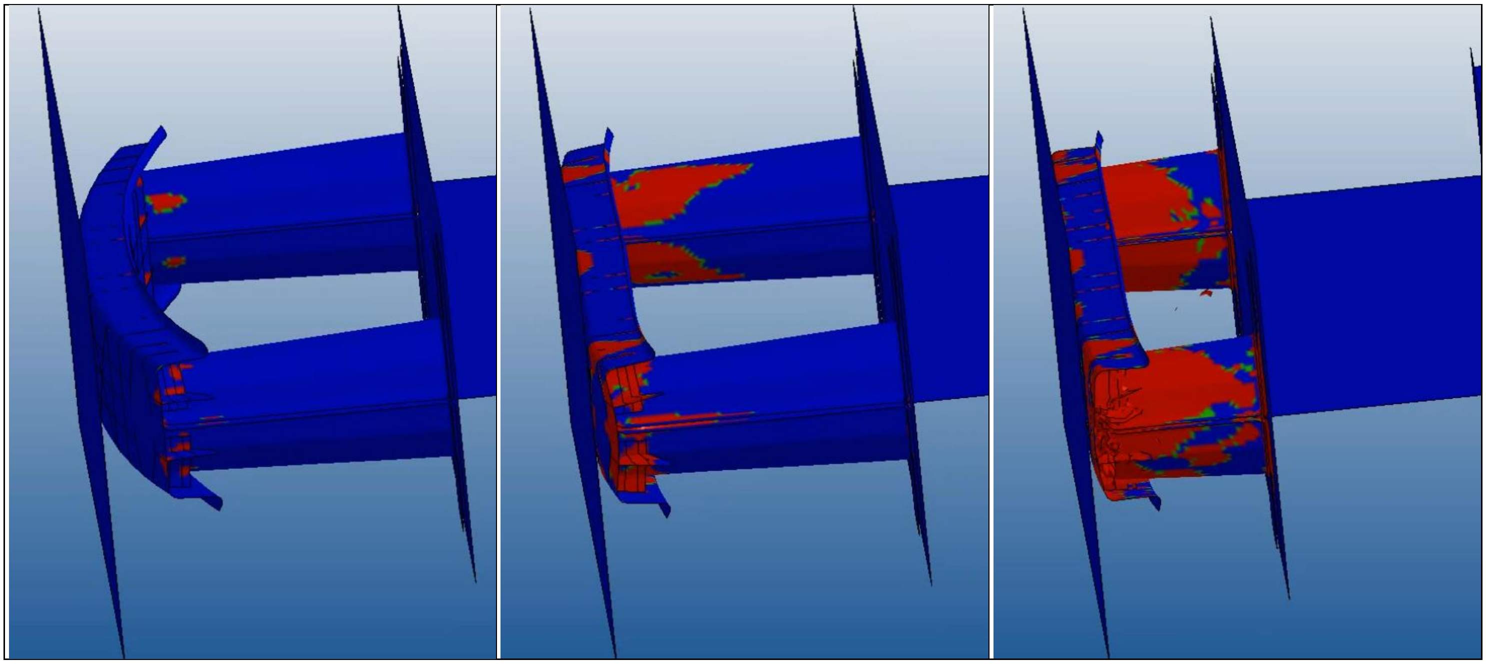
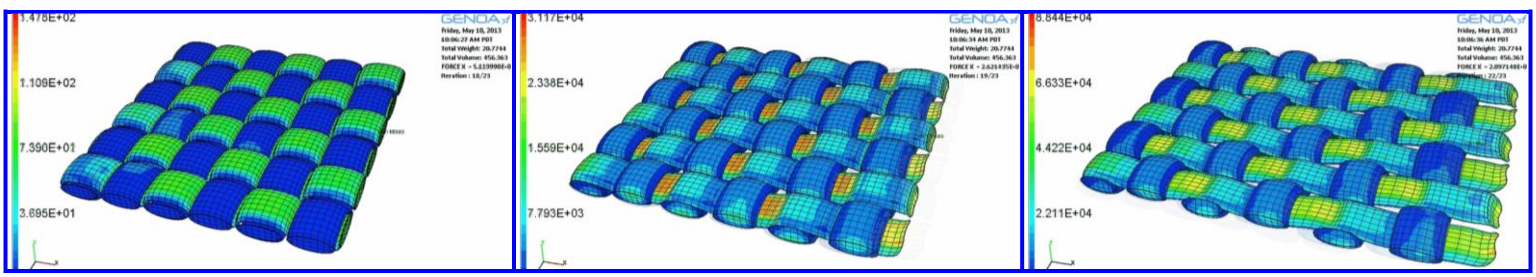


GENOA is a durability & damage tolerance, progressive failure, and reliability software that provides engineers with predictive computational technology to characterize and qualify advanced composite materials and structures. Through GENOA's true De-Homogenized Multi-Scale Progressive Failure Analysis, engineers are able to assess failure at the macro, micro and nano levels for advanced materials and composite structures subject to static, fatigue, impact and environmental loadings. Using a closed-form, de-homogenized, analytical methodology, the software is integrated with building block strategies which result in the accurate assessment of failure and test reduction. GENOA's ability to assess damage, fracture initiation and evolution, integrate the damage & fracture mechanics, and determine percent damage contribution make it a unique tool for advanced structural design.



Key Features:

- ✓ Multi-scale, Micromechanics Toolset
- ✓ De-Homogenized: examines fiber, matrix, interface, interphase
- ✓ Augments commercial finite element solvers (Abaqus, Ansys, LS-Dyna, Nastran, etc.)
- ✓ Damage/Fracture Evolution
- ✓ Assess Durability and Damage Tolerance
- ✓ Identifies Where, When, Why and How Failure Occurs
- ✓ Includes failure mechanism percentage contribution

Key Benefits:

- ✓ Predict structural performance considering defects (void, fiber waviness, curing and residual stress)
- ✓ Modeling and simulation of complex parts and materials
- ✓ Address design envelope parameters
- ✓ Compatible with HPC for parallel processing of large complex models
- ✓ Guides test by analysis to reduce testing up to 65%
- ✓ Optimizes design of lightweight structures and vehicles
- ✓ Delivers greater accuracy with minimal computational overhead

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GENOA MS-PFA

Modules

• GUI	Base GUI for project management, setup and post-processing results
• Progressive Failure (Static)	Predicts the maximum loads that composite and metallic elements and structures can sustain using a step-by-step virtual loading procedure that takes into consideration material degradation, nonlinearity and changes in structural geometry.
• Random Fatigue (Spectrum Loading)	Determines the fatigue life of composite or metal structures subject to a sequence of external cyclic excitations with variable amplitude and period
• Power Spectrum Density	Evaluates various mode shapes for the fatigue life of composite and metal structures subject to dynamic loads of constant amplitude and vibration frequencies
• Progressive Failure Dynamic Analysis	Performs progressive failure analysis of composite structures using an explicit transient dynamic algorithm, integrating GENOA with the LS-DYNA software.
• Aging	Effective evaluation of the aging with time of metallic and composite structures subjected to either static loads of constant amplitude, or sequence of external cyclic excitations with variable amplitude and period.
• Quasi-Static (Low Cycle)	Effective evaluation of the fatigue life of composite and metal structures subject to static loads of constant amplitude
• Harmonic Fatigue (High Cycle)	Evaluates the fatigue life of composite and metal structures subject to dynamic loads of constant amplitude
• Fatigue with Fracture Mechanics	Effectively evaluates the fatigue life of a metal structure by combining the Progressive Failure Analysis-Virtual Crack Closure Technique (PFA-VCCT) and Fatigue Crack Growth (FCG) modules together
• Virtual Crack Closure Technique	Fracture mechanics based approach for the progressive crack growth analysis integrated into GENOA-PFA.
• Discrete Cohesive Zone Model	Cohesive damage model for delamination and crack growth analysis integrated into GENOA-PFA
• A- & B-Basis Allowables Simulation	Effectively reduces the number of coupon testing by simulating the scatter in composite material properties and fabrication parameters
• Parametric Carpet Plot	Generates carpet plots of laminate properties as a function of percent 0°, +/-45° and 90° plies
• Filament Winding	Design and analysis of composite over-wrapped pressure vessels (COPVs). GENOA-FW combines advanced composite mechanics with a special module for filament winding analysis
• Probabilistic (PA)	Permits the simulations of progressive failure in composite structures taking into consideration uncertainties in material properties, loading conditions and service and manufacturing environments
• Material Non-Linearity	Predicts the in-situ matrix stress strain curve from in-plane shear ASTM standard test data. The analysis can be used to reverse engineer any fiber or ply nonlinearity as well.
• 3-D Printing	Imports G-Code printer data and creates FEM simulations based on Thermal and Structural analysis with user material properties
• Orientation Tensor Mapping	Map donor mesh to receiver mesh and perform transform layup based on orientation tensors and material properties
• Abaqus (V)UMAT	Perform Multi-Scale Progressive Failure Analysis & Progressive Failure Dynamic Analysis (MS-PFA & MS-PFDA) as an ABAQUS Subroutine
• Ansys UMAT	Perform Multi-Scale Progressive Failure Analysis (MS-PFA) as an ANSYS Subroutine
• LS-Dyna UMAT	Perform Multi-Scale Progressive Failure Dynamic Analysis (MS-PFDA) as a LSDYNA Subroutine