GENOA 5

Tested and Verified.™

GENOA USER MATERIAL FOR EXPLICIT RADIOSS SIMULATIONS (URD)

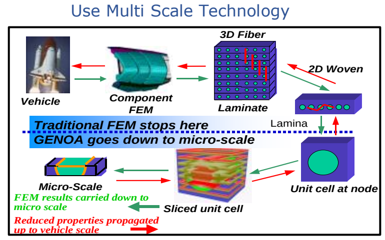
- **Obtain Integrated Explicit Dynamics Solutions with RADIOSS using GENOA libraries in RADIOSS subroutines**
- **Augments Explicit Dynamics (ED) finite element analysis (FEA) with multi-scale composite mechanics.**
- **Damage tracking and fracture to determine all stages of damage evolution under static, impact, crush, or crash loading condition.**
- **Predict and simulating all 5 stages of the damage process.**
- **Switch solvers/boundary condition/analysis type before or after simulation and keep residual damage and stresses.**
- **Calculates crack density, micro-cracks in the matrix, delamination within the plies, and fiber failure in tension and compression including micro-buckling.**
- **The damage tracking is done by identifying and accumulating damage at the "root cause" of the composite in matrix and fiber using dedicated physics based damage and failure criteria.**

GENOA URD allows engineers that use RADIOSS to stay within their environment and perform a GENOA Multi Scale Progressive Failure Analysis PFA using GENOA libraries inside of RADIOSS subroutines. At the end of the simulation a GENOA PFA file is produced that is used to characterize static and impact behavior of composite structures. This analysis determines: laminate and ply damage (types: fiber, matrix, delamination – transverse shear, interlaminar shear, relative rotation , fiber microbuckling, fiber pullout), damage and fracture initiation, energy absorbed, and residual strength. GENOA PFA will accurately predict the behavior of advanced composite laminates (2-D/3-D) considering effects of (1) defects, voids, fiber waviness, (2) micro-crack density (leakage, stiffness reduction), (3) residual stresses (winding, curing).

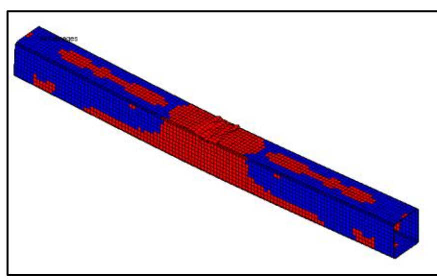
GENOA UAB Highlights

- ✓ **Supports full breadth of 2D/3D composite architectures**
  - Laminated Tape Lay-Up, Polymer, Metals, Ceramics
  - Fiber Architecture (Woven, Triaxial, Harness Satin Weave, Braided,and Stitched)
  - Fiber Coating (InterPhase)
  - Effects of manufacturing defects and residual stresses
- ✓ **Determines composite damage**
  - Laminate and Ply Damage initiation and propagation to final failure
  - Damage types (fiber, matrix, several delamination types)
  - Change ply layups to meet design requirements
  - Residual strength behavior (TAI, CAI, FAI)
- ✓ **Supports Failure Criteria (In-built and User Defined)**
  - Translaminar (Matrix, Fiber, Ply)
  - Interlaminar/Delamination (Tension, Shear, Relative Rotation)
  - Interactive Strength (Tsai-Wu, Tsai-Hill, Puck, MDE, Hoffman, Hashin)
  - Interactive Strain- Strain Invariant Failure Theory (SIFT)
  - Maximum Stress, Maximum Strain, User Defined
- ✓ **Supports Detailed Micromechanical Degradation**
  - **Matrix Defects** – Void shape, size distribution reducing stiffness and strength, matrix creep, fatigue
  - **Residual Stresses** – Curing and other manufacturing effects
  - **Fiber Strength Statistics** – Gradual failure "Rope effect" – Probabilistic Weibull distribution
  - **Interphase Mechanics** – Fiber bridging
- ✓ **Supports Service Loading**
  - Static, Impact, Post Impact
  - **Export Damage/Residual Stresses use in another simulation/solver**
  - Change boundary conditions/solver/ analysis type
  - Static or Impact to static/fatigue/creep (any combination and sequence)
- ✓ **Includes Tutorials/Solutions**

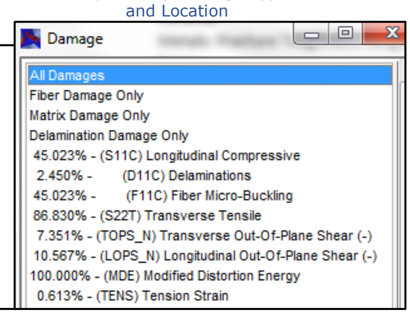
Use Multi Scale Technology



Predict Damage

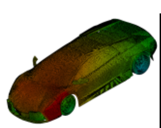


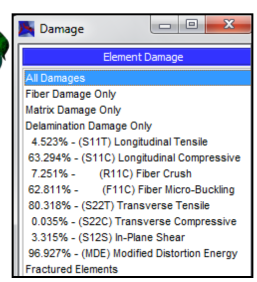
Easily Identify Damage Types and Location

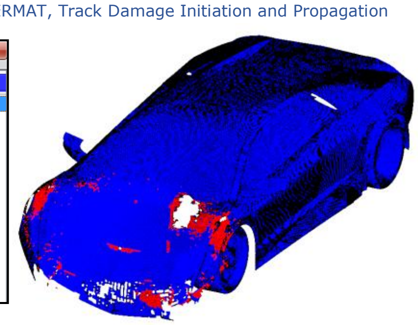


Build in HyperCrash Or Other Environment

Run RADIOSS with GENOA USERMAT, Track Damage Initiation and Propagation







Key Benefits

- Rapid assessment/selection of composite static, impact and post impact damage tolerance to meet design requirements
- Reduce physical test by over 65-70% thus saving significant cost
- Ease of use, results verified with test data for class of materials:
  Polymer: chopped, continuous, thermoset, thermoplastic, elastomer
  Ceramic
  Metals: Fracture Toughness, fatigue crack growth
  Nano
  Hybrid Composite (Glare)
- Compression, Tension, Fatigue, and Reliability After Impact
- Identification of damage initiation and propagation to final failure & modes of damage/failure
- Identify damage types and magnitude to asses risk

User Friendliness

- GUI is easy to learn with navigation tutorials and videos. Manages multiple projects, input and output for material characterization
- Quick import/export of material properties and laminate layups with commonly used third-party FE Solvers: NASTRAN (.bdf), ABAQUS (.inp), ANSYS (.cdb), GENOA (.dat) formats, RADIOSS (), User Material formats, Optistruct (.fem)
- **Easy creation, editing of composite laminates. Quickly study multiple designs.**

System Requirements

- Windows 2000/XP/Vista/7/8 or Linux (64-bit)
- Java 1.7 minimum Runtime Libraries
- Java3D 1.5

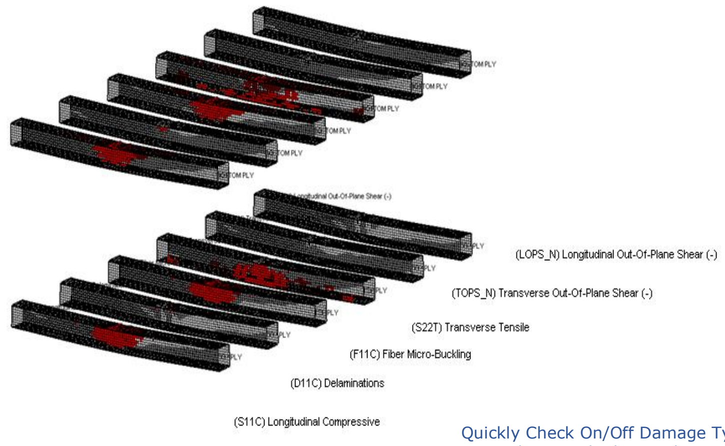
Minimum Configuration

With the minimum configuration, performance and functionality may be less than expected.

- 1 GHz or higher CPU, 1GB RAM, 10GB disk space

Easily Identify Damage Types and Location

Peel the Onion To Determine Ply Damages, Type, and Location

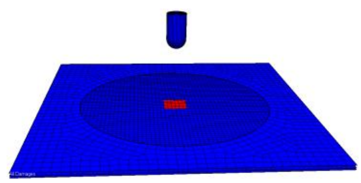


Quickly Check On/Off Damage Types and Run Multiple Simulations (Fiber, Matrix, Delamination; By Stress, Strain, Interactive, User)

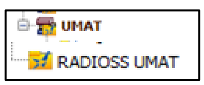
Maximum Stress Based Failure Criteria	true
Fiber Failure Criteria	
(S11T) Longitudinal Tensile	true
(S11C) Longitudinal Compressive	true
(F11C) Fiber Micro-Buckling	true
(R11C) Fiber Crush	true
(D11C) Delaminations	false
Matrix Failure Criteria	
(S22T) Transverse Tensile	true
(S22C) Transverse Compressive	true
(S33C) Normal Compressive	true
(S12S) In-Plane Shear	true
Delamination Failure Criteria	
(S33T) Normal Tensile	true
(S23S) Transverse Normal Shear	true
(S13S) Longitudinal Normal Shear	true
(RROT) Relative Rotation	true
Maximum Strain Based Failure Criteria	true
Fiber Failure Criteria	
(EPS11T) Longitudinal Tension Strain	true
(EPS11C) Longitudinal Compression Strain	true
Matrix Failure Criteria	
(EPS22T) Transverse Tension Strain	true
(EPS22C) Transverse Compression Strain	true
Delamination Failure Criteria	
(EPS33T) Normal Tension Strain	false
(EPS33C) Normal Compression Strain	true
(EPS12S) In-plain Shear Strain	true
(EPS13S) Long. Out-of-plain Shear Strain	true
(EPS23S) Trans. Out-of-plain Shear Strain	false
Interactive Failure Criteria	
(MDE) Modified Distortion Energy	true
(TSAI) Tsai Wu	false
(HILL) Tsai Hill	false
(HOFF) Hoffman	false
(HASH) Hashin	false
(PUCK) PUCK	false
(SIFT) Strain Invariant Failure Theory	false
Honeycomb Failure Criteria	false
(WRNK) Wrinkling for Honeycomb	false
(CRMP) Crimping for Honeycomb	false
(DIMP) Dimpling for Honeycomb	false
Miscellaneous	
(UDFC) User Defined Failure	false

Fully Supports Complex Models

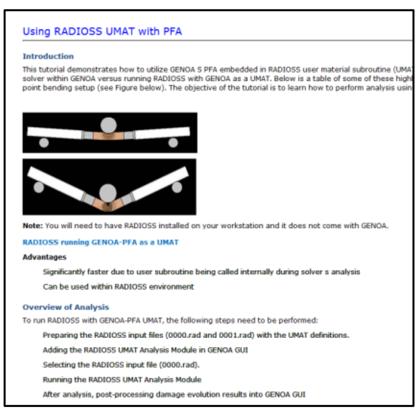
Ballistic Impact



Tutorials with Solutions



Step By Step Instructions



Using RADIOSS UMAT with PFA

Introduction

This tutorial demonstrates how to utilize GENOA S PFA embedded in RADIOSS user material subroutine (UMA solver within GENOA versus running RADIOSS with GENOA as a UMAT. Below is a table of some of these high point bending setup (see Figure below). The objective of the tutorial is to learn how to perform analysis usin

Note: You will need to have RADIOSS installed on your workstation and it does not come with GENOA.

RADIOSS running GENOA-PFA as a UMAT

Advantages

Significantly faster due to user subroutine being called internally during solver s analysis

Can be used within RADIOSS environment

Overview of Analysis

To run RADIOSS with GENOA-PFA UMAT, the following steps need to be performed:

Preparing the RADIOSS input files (0000.rad and 0001.rad) with the UMAT definitions.

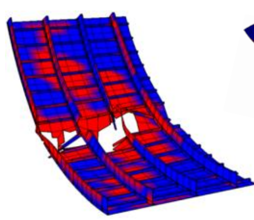
Adding the RADIOSS UMAT Analysis Module in GENOA GUI

Selecting the RADIOSS input file (0000.rad).

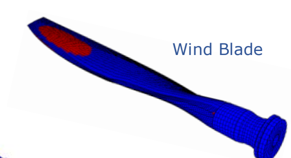
Running the RADIOSS UMAT Analysis Module

After analysis, post-processing damage evolution results into GENOA GUI

Stiffened Panel



Wind Blade



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More of Alpha STAR's Test Validated products:

MCQ: Composites, Ceramics, Metals, Nano, Chopped

GENOA: PFA, PFDA, UAB, URD, ABS, PCP, PA, Quasi Static Fatigue & Random Fatigue, Harmonic & PSD Fatigue, Fatigue with Fracture Mechanics, PFA_AGING, VCCT, DCZM, Filament Winding, Jobspooler, GENOA_CLOUD