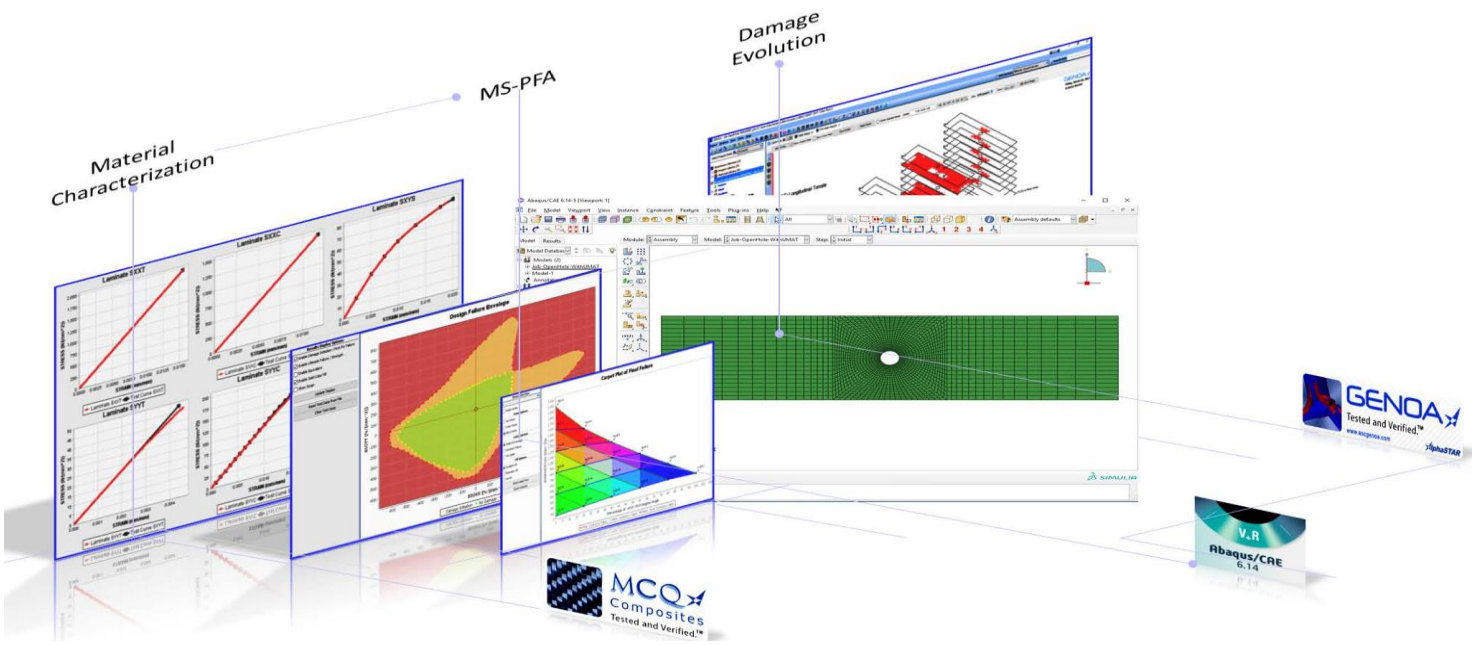
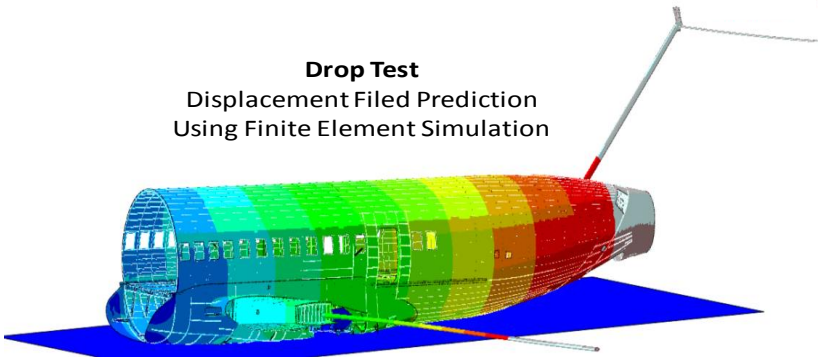
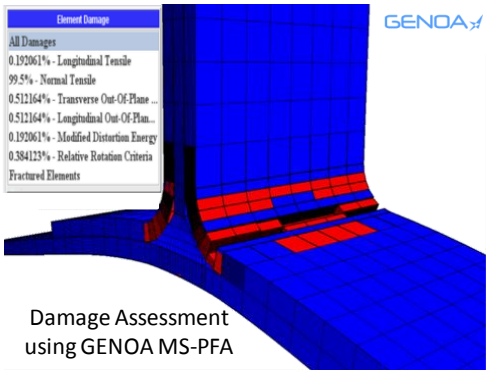
GENOA UMAT/VUMAT



GENOA ABAQUS UMAT/VUMAT allows engineers to perform Multi Scale Progressive Failure Analysis (MS-PFA) as ABAQUS subroutines. This capability augments Implicit and Explicit Dynamics finite element analysis with composite damage micromechanics. The resulting output identifies the "root cause" of damage in the matrix and fiber using dedicated physics based failure criteria, which determine when, where and why failure occurs. Further it provides a mechanism to track all 5 stages of damage evolution under static, impact, crush, or crash loading conditions and also calculates micro-cracks in the matrix, delamination within the plies, and fiber failure in tension and compression.



Drop Test
Displacement Filed Prediction
Using Finite Element Simulation



Damage Assessment
using GENOA MS-PFA

Highlights:

- ✓ Supports 2D/3D composite architectures
  - Laminates/Tapes *(polymer, metals, ceramics, hybrid)*
  - Fiber Architecture (*woven, triaxial, harness, weave, braided, stitched)*
  - Fiber Coating (*InterPhase*)
  - Effects of manufacturing defects/ residual stresses
- ✓ Determines composite damage
  - Laminate and Ply Damage initiation and propagation to final failure
  - Damage types *(fiber, matrix, several delamination)*
  - Change ply layups to meet design requirements
  - Residual strength behavior *(TAI, CAI, FAI)*
- ✓ Supports Failure Criteria (In-built/User Defined)
  - Translaminar/Interlaminar/Delamination
  - Interactive Strength (Tsai-Wu, Tsai-Hill, Puck, MDE, Hoffman, Hashin)
  - Interactive Strain (Strain Invariant Failure Theory)
- ✓ Supports Detailed Micromechanical Degradation
  - Fiber Defects; Matrix Defects
  - Residual Stresses (i.e. curing effects)
  - Interphase Mechanics (fiber bridging)
- ✓ Supports Service Loads (Static, Impact and Fatigue)
- ✓ UMAT and VUMAT support solid and shell elements

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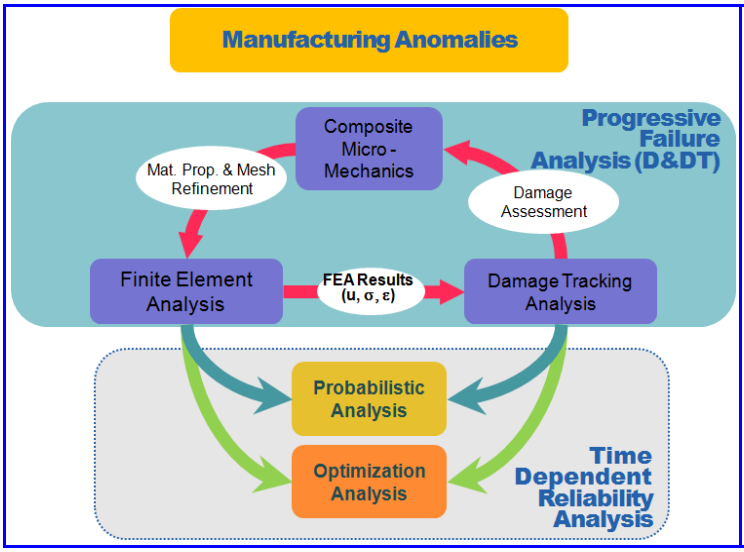
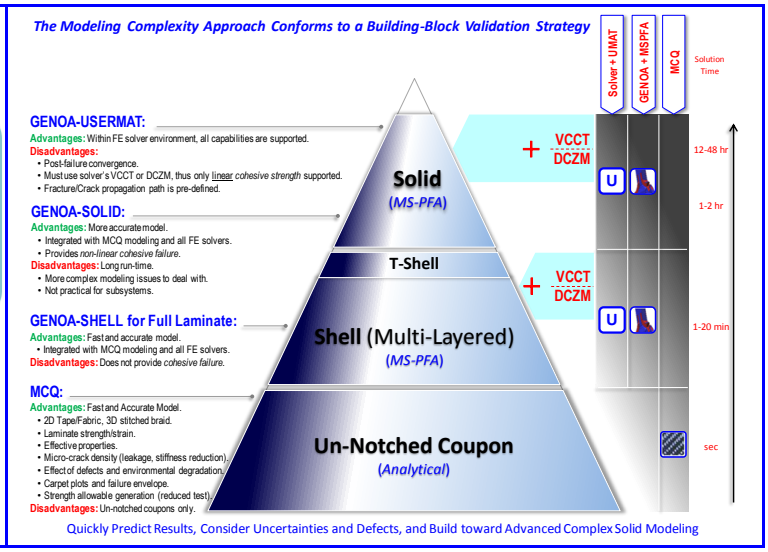
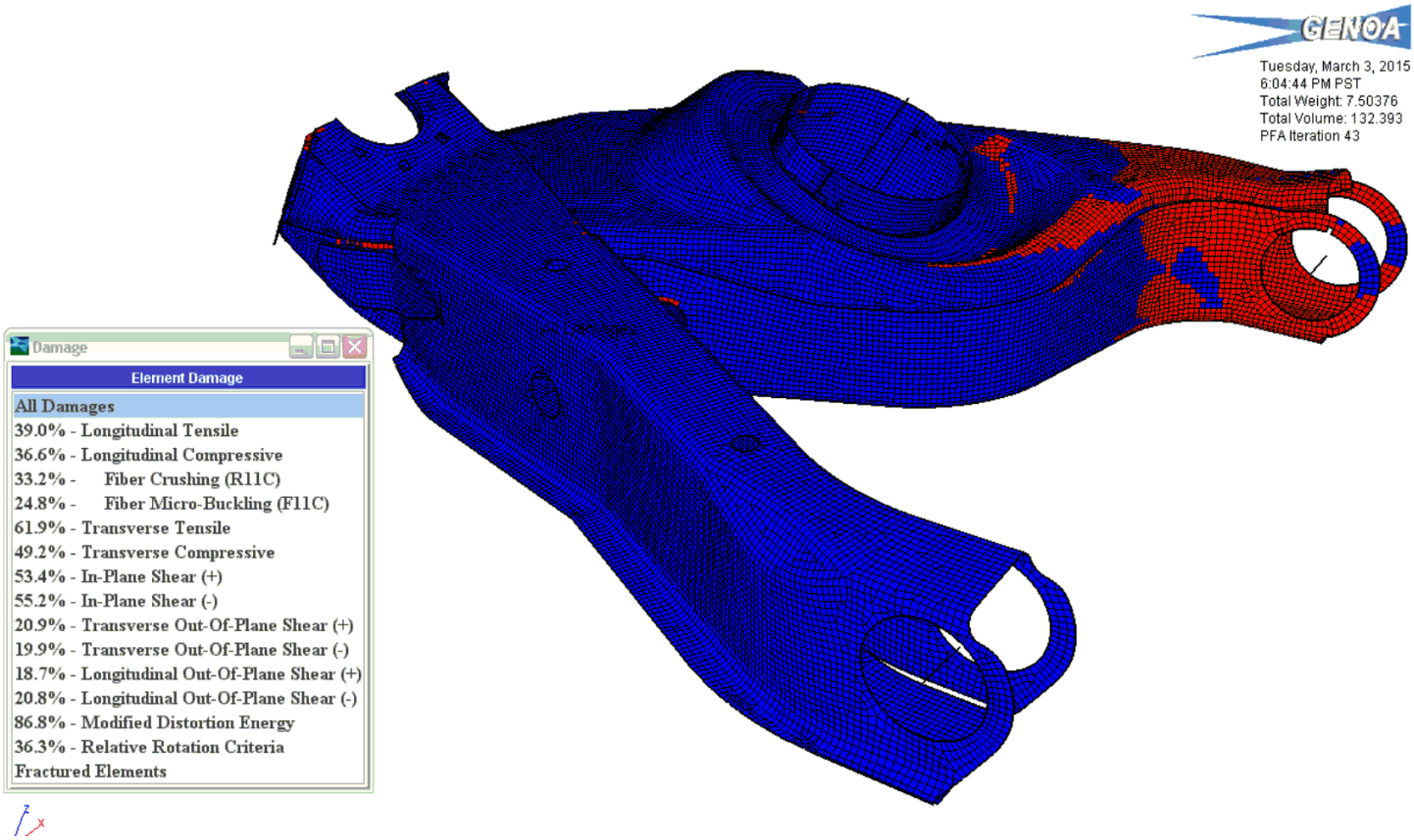
GENOA UMAT/VUMAT

Key Benefits:

- ✓ Rapid assessment of composite static, impact and post impact damage tolerance
- ✓ Reduction in physical tests by over 65%-70%
- ✓ Verification of results with test for Polymers (chopped/continuous, thermoset, thermoplastic); Elastomer, Ceramic
- ✓ Multi-scale Progressive Failure Analysis Modeling/Prediction Capabilities
- ✓ Identification of damage initiation and propagation to final failure & modes of damage/failure
- ✓ Identification of damage types and magnitude to assess risk







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