Frequently Asked Questions about the GENOA Software

Getting Started with GENOA

Q– What information is needed to start running GENOA?

A – The process is simple, once GENOA is installed on your PC or workstation, just import a finite element model (i.e. NASTRAN) to get started, or use one of the examples from the examples/verification library.

Q- Are any support libraries required for running GENOA?

A-You must have Java 1.5 installed on your PC or workstation in order to run the main GENOA GUI application. This application also requires Java 3D for all of the 3D graphics. This can be downloaded free from a link provided with the GENOA software.

Q- Does GENOA have its own built-in material library?

A- Yes, GENOA comes with a sample material library in a form of databank that contains constituent properties for fiber and matrix and lamina properties of typical composites and metals. We recommend that you utilize for your analysis properties that have been chosen by you.

Q- What type of documentation is made available to GENOA's users?

A- Documentation includes: 1) User's Manual, 2) Theoretical Manual, 3) Verification Manual, and (4) step-by-step manual (quick tutorial).

GENOA's Capabilities/Areas of Application

Q– What are the major capabilities of GENOA?

A- GENOA is used for assessing the durability and damage tolerance of metallic and composite structures. Several composites architectures are available. They include filament winding, braid, weave, and stitched 2D/3D.

Other capabilities of the software are: Probabilistic Design, Time Dependent Reliability, Random Fatigue, Progressive Failure Dynamic Analysis (PFDA), Progressive Failure Optimization (PFO), Virtual Testing, Virtual Crack Closure Technique (VCCT) and Discrete

Cohesive Zone Model (DCZM), Power Spectrum Density (PSD), Material Constituent Analyzer (MCA), Material Uncertainty Analysis (MUA) and Material Characterization Optimizer (MCO).

Q- What are typical areas of application of GENOA?

A- GENOA is ideal for aerospace, pressure vessels, cryogenic storage tanks, turbo machinery, automotive (i.e., crash and crush problems, and chopped fibers), virtual testing, manufacturing, construction, sporting goods, and biomedical applications.

Q- Does GENOA have pre- and post-processing capabilities?

A- Yes. GENOA utilizes a state of the art pre-processor to set up the input data and post processors to: 1) output data, 2) animate output, 3) produce contour plots of stresses, strains, and displacements, 4) damage progression and fracture animation, 4) detailed anatomy of damaged plies and associated failure modes, and 5) energy release rate plots.

Q– Can GENOA be used for general structural analysis?

A- Yes, GENOA can perform: static, buckling, dynamic, modal, fatigue (low and high cycle), creep, impact, and random vibration.

Q- Can GENOA be used to predict damage progression in buckled structures?

A- Yes. GENOA can be used to predict damage progression in buckled and post-buckled structures.

Q– What type of loadings can GENOA handle?

A- GENOA is devised to handle static (force, pressure, and edge traction), body force (centrifugal), time dependent, and temperature loading.

Modeling and Finite Element Analysis in GENOA

Q– What does a typical GENOA model look like?

A– *A typical GENOA model will contain finite element description (nodes, elements, loads and boundary conditions) and ply schedules and material specifications. For example, starting with a traditional NASTRAN finite element model, the GENOA graphics user interface (GUI) will generate for you the composite ply schedules and the fiber/matrix/interface or lamina properties.*

Q– What is a ply schedule?

A– *A ply schedule specifies the number of plies at selected nodal locations in the structure. It is in a ply schedule where you may assign different materials for different plies and the appropriate composite architecture. For each ply, some manufacturing details are specified, such as ply*

thickness, orientation, fiber volume fraction, and void volume fraction. Note that the GUI in GENOA is designed to assist the user in making the aforementioned selections.

Q– How do I supply the material properties in GENOA?

A– As stated earlier, the material properties are assigned in a databank. Just make sure that the material selected for a ply schedule has associated properties in the databank. The material properties can be specified as fiber/matrix/interface constituent properties or as lamina properties.

Q– Can GENOA handle finite element models from other commercial software?

A- Yes, GENOA is designed to import models developed for or by other programs such as MSC NASTRAN. Additionally GENOA allows you to import models from other programs, such as MSC MARC, LSDYNA, ABAQUS, and ANSYS. GENOA ensures that the translation process is inclusive of all options selected by the user.

Q– Does GENOA have its own finite element analyzer?

A- Yes, GENOA has its own finite element analyzer. The solution is obtained using a dedicated module in GENOA. The FEM analysis is based on a well established mixed iterative techniques. Its library of elements is comparable to those of commercial codes.

Q– What if I wish to have the FEM analysis done by other programs?

A- GENOA offers its users the option of utilizing commercial codes such as MSC NASTRAN, MSC MARC, LSDYNA, ABAQUS, and ANSYS as the finite element solver. The interface between GENOA and the other programs is automatic. No user interference is required. The user selected FEM solvers will be used to supply GENOA with the generalized stresses. The GENOA processors update the FEM model as needed based on damage progression analysis.

Q– Can GENOA handle non-uniform geometry?

A- Sure, GENOA is designed to accommodate all types of geometry. It can also easily handle thickness and step changes by assigning appropriate ply schedules to critical regions.

Q– Are there any limitations on the model size in GENOA?

A– No, there are no limitations. The model can be of any size.

Q– Are there any limitations on the number of ply schedules in GENOA?

A– No, there are no limitations. GENOA can handle any number of ply schedules.

On GENOA's Durability and Damage Tolerance (D & DT)

Q– How is the damage progression evaluation performed in GENOA?

A- GENOA judiciously combines the following disciplines: (1) composite micro and macro mechanics, (2) finite element analysis, (3) material degradation, (4) damage tracking/accumulation, and fracture.

Q- What is damage initiation load?
A - Damage initiation load is the load that causes the first ply damage. Properties are degraded automatically once damage occurs.

Q- What are the main criteria for ply damage?
Ply damage criteria include: ply failure because the fiber strength or ply strain limits have been exceeded, matrix failure due to transverse tensile, transverse compressive, or shear failures, in such event, only the matrix stiffness is degraded and the longitudinal stiffness of the fiber is retained, modified distortion energy (MDE), and relative rotation.

Q– How is ply delamination considered in GENOA?
A – Ply delamination is considered to be due to long compressive failure, out of plane shear failure, relative ply rotation, or normal tensile failure.
>>Change the transverse tensile failure to Long Compressive

Q- How is equilibrium established after damage growth?

A- Equilibrium is established when the structure does not sustain any additional damage under the present applied load. Material properties and geometry are updated at each establishment of equilibrium.

Q- What constitutes fracture initiation in GENOA?

A- *When all the plies at a particular nodal location have sustained fiber damage and cannot carry any load, nodal fracture is initiated.*

Q- When is an element removed?

A- *When two nodes within one element are fractured that element is eliminated. The model is re-meshed automatically.*

Q– What is damage tolerance in GENOA?
A - Damage tolerance is defined as the additional load that the structure can withstand from the point of damage initiation up to structural fracture.

Q- Describe simulation of crack initiation and growth to failure.

A- Progressive fracture involves detailed tracking of damaged nodes, detailed representation of a unit cell to track crack initiation, the sequence of growth to failure, and breakage (in matrix, interface, or fiber) within the unit cell.

Q- Can GENOA perform D & DT of sandwich panels?

A- Yes, GENOA is ideal for D & DT of sandwich panels.