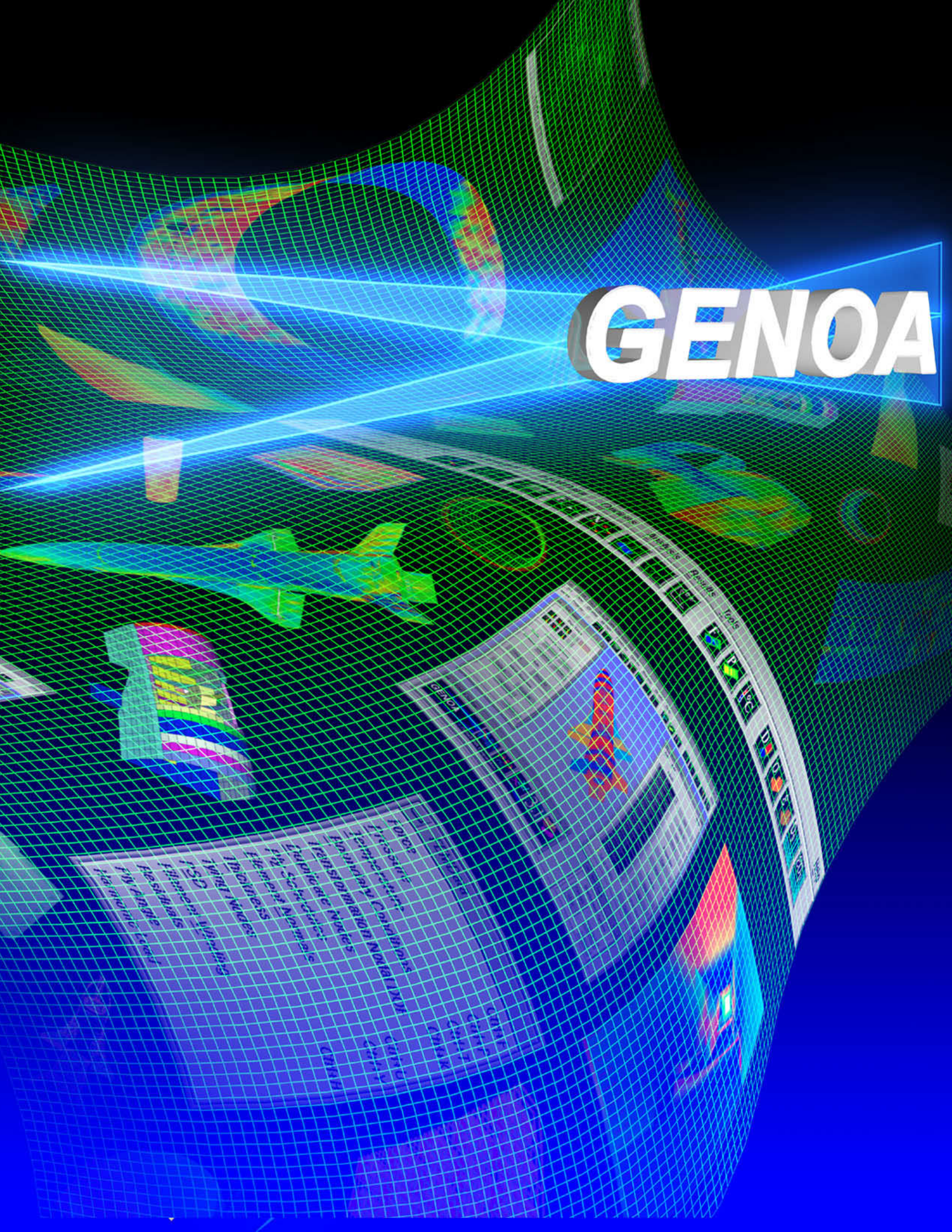
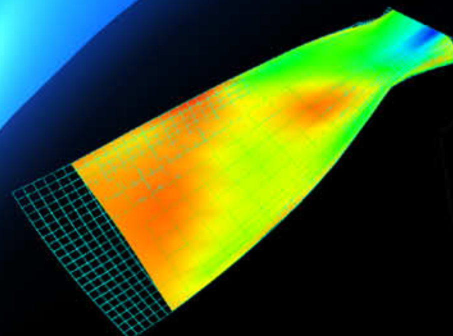

GENOA

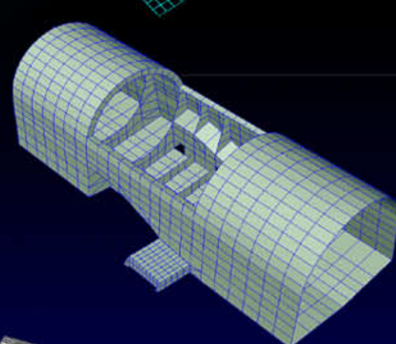
Welcome to AlphaSTAR Corporation

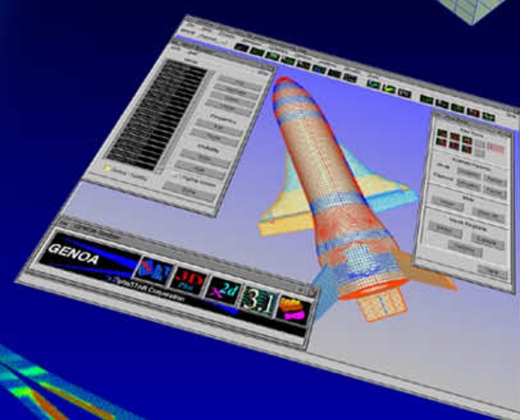
The **Alpha STAR Corporation (ASC)** was established in 1988 as a software developer in the field of simulation technology and advanced research. **Alpha Star** has developed specialized software solutions in Computational Structural Mechanics, Computational Fluid Dynamics and Computational Composite Manufacturing. **Alpha Star's** flagship product is ***GENOA*** – a Virtual Testing Software System for composite and metallic structures which simulates physical tests to reduce test time and costs, and improves product quality through in-service performance simulations. Simulation software can be legitimately called virtual testing software when it has been shown to consistently duplicate actual tests. ***GENOA*** meets this criterion.

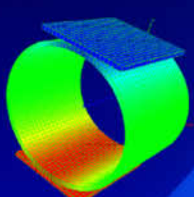
Whereas, other commercially available structural analysis software can predict stiffness and response, they fall short in accurately predicting structural residual strength, including margins of safety, reliability, durability, damage tolerance and life. Consequently, these quantities are conventionally established through tests, which can be very expensive.

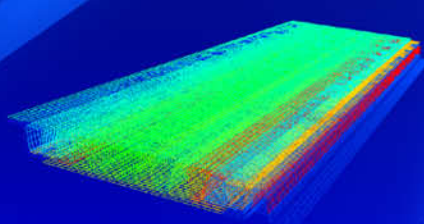
GENOA is especially powerful for laminate and textile composites, and for cases where material properties and failure mechanisms are uncertain. The software performs progressive failure simulations using a unique full multi-scale hierarchical approach, which is able to track failure down to the micro-mechanics level where failure has its physical source. The software system accounts for degradation of material and structural properties due to damage initiation, growth and accumulation. Moreover, probabilistic and sensitivity analyses enrich the virtual test data beyond what can be achieved in a physical test.

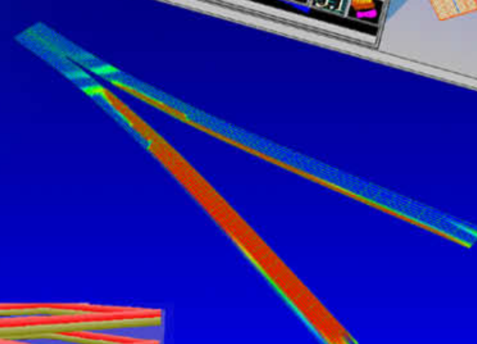


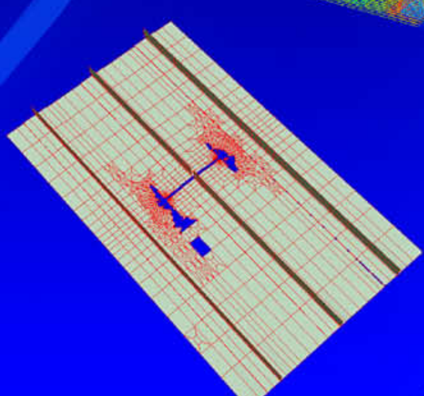


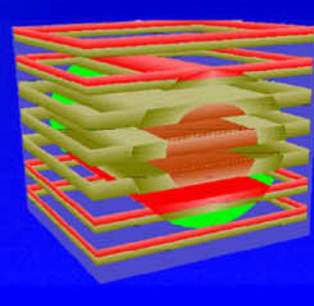


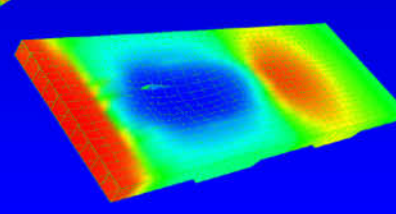








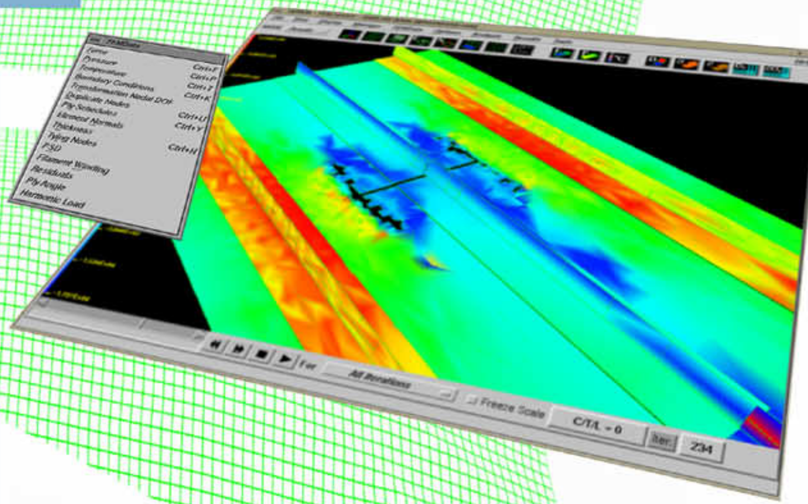


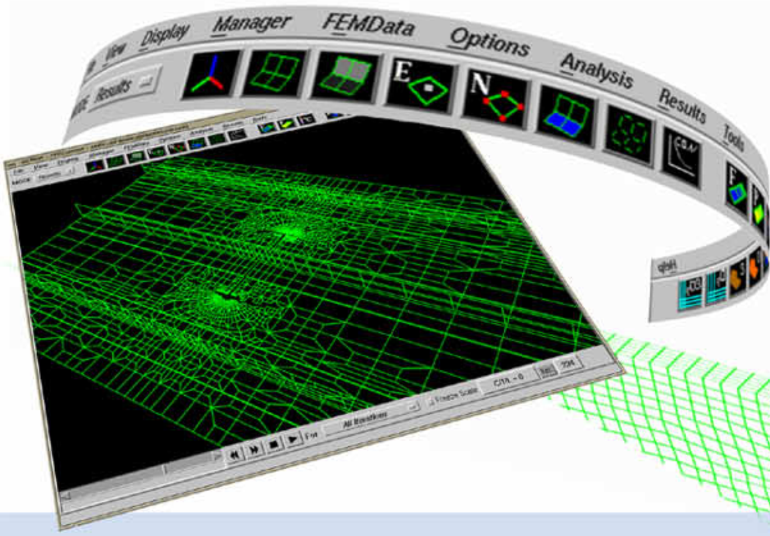


GENOA CAPABILITIES

VIRTUAL TESTING (VT)

- Reduces material and structural testing through accurate and dependable virtual tests
- Performs virtual testing on FEM models derived from any of the popular commercial finite element software packages.
- Establishes reduced-cost test plans
- Enriches testing by providing insight into design innovations and material selection
- Improves product quality through comprehensive in-service virtual testing
- Identifies product life design enhancements through probabilistic/sensitivity analysis
- Provides durability, damage tolerance and impact resistance assessment for product safety and life
- Identifies critical material properties, and lamina/ laminate design changes to improve structural durability, damage tolerance, impact resistance and residual strength
- Generates photo-elastic fringe simulations (isochromatic, isoclinic and thermographic)





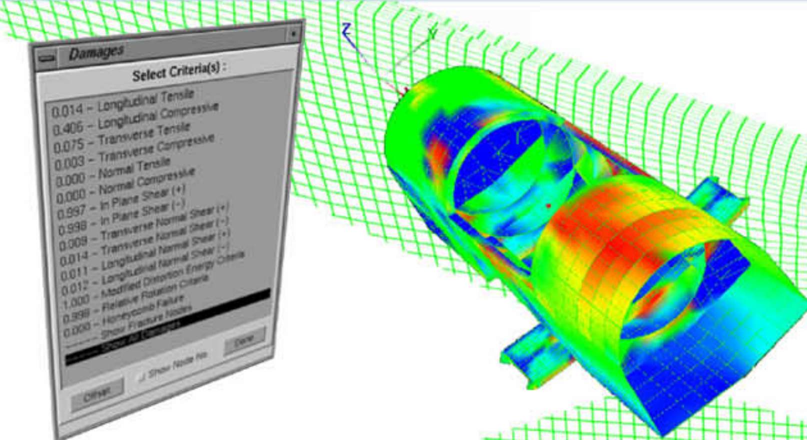
PROGRESSIVE FAILURE AND RELIABLITY ANALYSIS

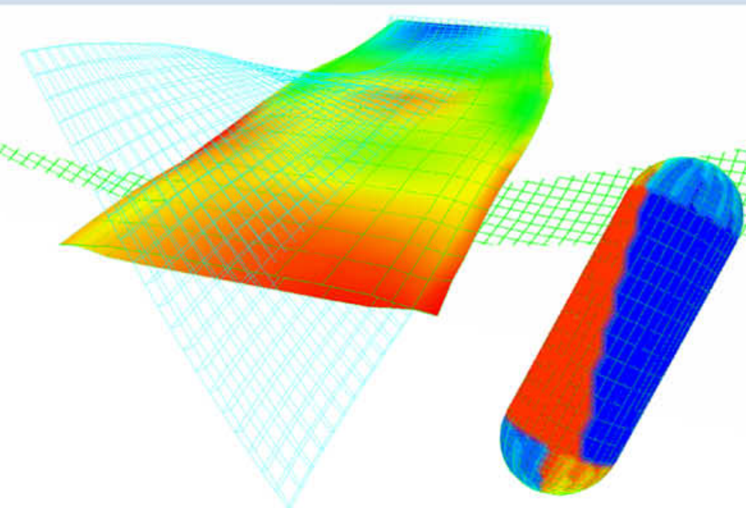
- Predicts strength, margins of safety, durability and structural life
- Establishes damage tolerance, fracture toughness, damage growth, and inspection intervals
- Predicts impact damage, residual strength and residual life of damaged structure
- Tracks failure at the micro scale where failures originate
- Predicts micro-cracking, multiple crack accumulation and crack join-up
- Performs buckling, post-buckling and nonlinear analyses
- Performs random vibration fatigue and creep analysis
- Identifies manufacturing anomalies, load and geometry parameters, and design uncertainties
- Identifies, through probabilistic progressive failure analysis, sensitivity of reliability/risk and material properties

COLLABORATIVE VIRTUAL TESTING (CVT)

Among geographically dispersed team members via World Wide Web

- Storing, archiving and easy retrieval of presentations, reports, and publications
- Uploading of virtual model and physical test data
- Generating simulation input by JAVA-run advanced engineering simulations
- Executing advanced engineering simulations
- Sharing simulation results as 2D/3D graphics
- Requires only a single-secure Net Meeting Capability
- CVT doesn't require installation on participant's machine but only on a single web server





MANUFACTURING-BASED MODELING

- Simulates manufacturing processes, accounting for critical modeling details e.g. changes in thickness, ply drops, gaps, voids, overlaps and a variety of defects
- Provides fiber orientation and volume fraction changes due to reshaping
- Provides data to minimize occurrences of manufacturing defects including fiber buckling and wrinkling
- Identifies the best-fit-to-shape that is attainable
- Simulates interleaving of multiple preforms of different sizes including woven sheet strips
- Provides seamless transfer of fiber orientation data directly to design and manufacturing process software

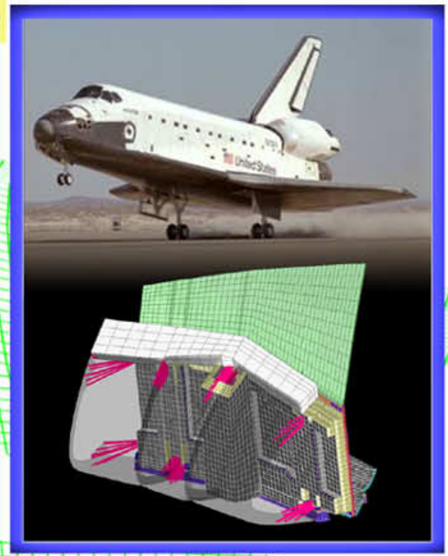
INDUSTRIAL VERIFIED CASES

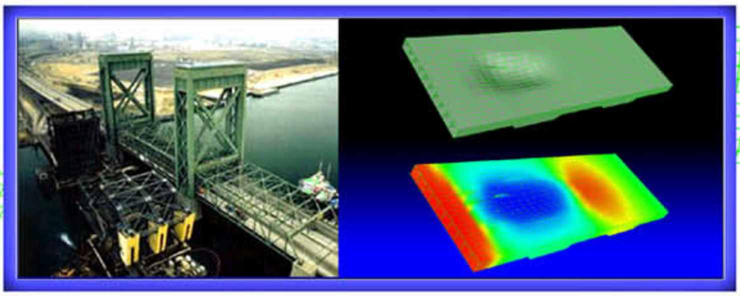
GENOA Chosen to Simulate Shuttle Columbia Accident

Boeing chose ***GENOA*** to extensively investigate the potential damage caused by foam impacting the Orbiter's left wing leading edge and the resultant consequences to the shuttle's integrity. ***GENOA*** successfully predicted results, which were provided to the CAIB.

Results:

- Analytic predictions of impact and penetration of the RCC leading edge were consistent with multiple post accident ground tests in terms of hole size and fracture pattern.
- T-Seal impact simulation showed post-impact debris that was consistent with actual imagery analysis of a flat, plate-like piece of debris, floating away from the wing leading edge.
- Predicted internal structural temperatures due to a hole in the leading edge were consistent with recorded flight data.
- Simulations showed that a hole in the RCC leading edge allowed aeroheating to create a hole in the front spar web. As a result, the wing leading edge attachments failed. The time of predicted loss of the Shuttle aerodynamic characteristics matched the time when flight data indicated that vehicle control was lost.
- Using GENOA's probabilistic and risk assessment capability in conjunction with impact location uncertainty and variability in RCC material properties, the probability of vehicle loss due to a foam impact was high.





Virtual Testing of the Schuyler Heim Bridge Yields Reliable Results

GENOA investigated the structural response, strength and fatigue life of a composite replacement lift span.

Results:

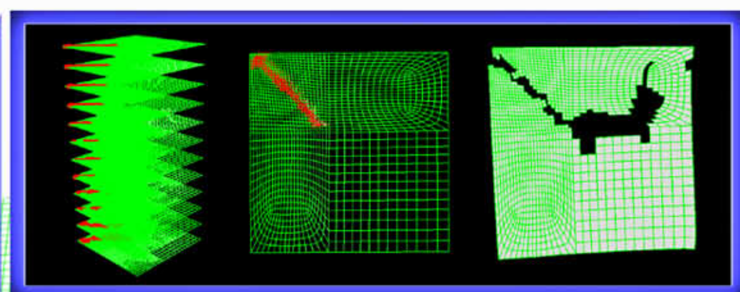
- ***GENOA*** virtual test results were generated simultaneously with the physical tests to ensure independence of test and analysis
- Strength prediction from virtual testing was within a few percent of the actual test
- Failure mode in the virtual test replicated that observed in the actual test
- ***GENOA*** was used with confidence to determine the fatigue life of the composite replacement span

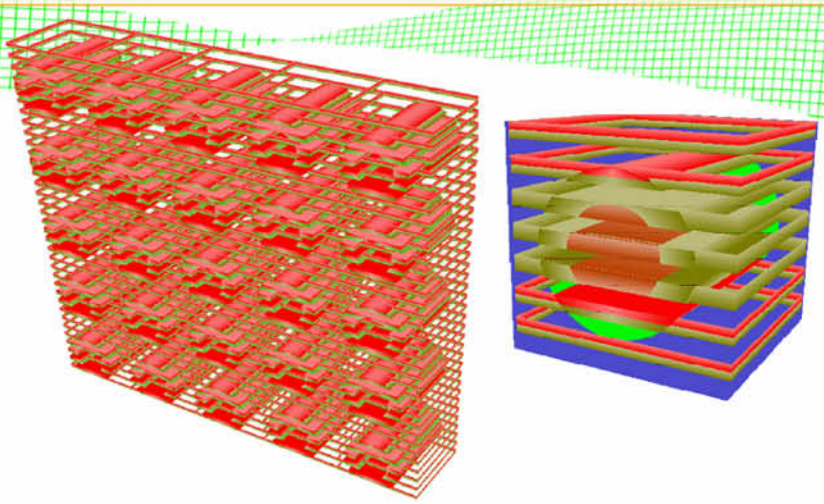
Dependable Impact and Residual Strength Predictions for Launch Vehicle Composite Panels

Composite panels, representative of launch vehicles were subject to low-speed impacts; e.g., accidental tool drops, Impact and subsequent tensile strength testing was carried out on a series of woven laminated panels. Prediction of residual strengths of composite panels after such impacts is necessary in order to assess panel integrity while in service.

Results: *GENOA* dependably predicted impact damage and residual strength after impact.

- Penetration depth of the impact damage was predicted within 7.9% of measured values.
- Residual strength predictions were within 9% of tests over a range of low-speed impact velocities.





MATERIAL CONSTITUENT ANALYZER

- Provides accurate material property predictions of laminated composites based upon fiber and matrix properties
- Utilizes with progressive failure and reliability analysis to predict and track failures at the micro fiber/matrix scale and integrate these up to the lamina and laminate scales

MATERIAL UNCERTAINTY ANALYZER

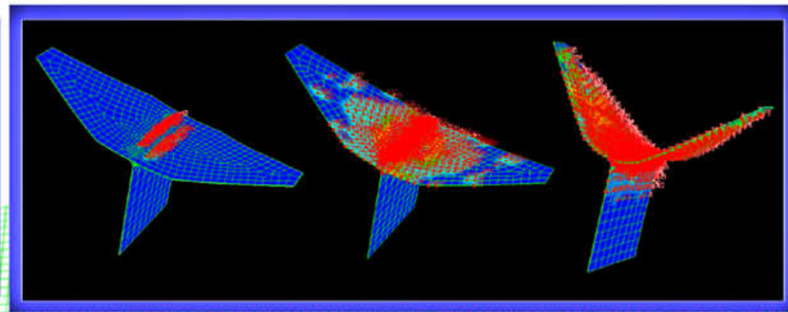
- Predicts material and structural reliability from the scatter of measured fundamental material parameters (e.g., fiber and matrix stiffness and strength, fiber volume ratio, void ratio, environmental conditions of temperature and moisture)
- Manufacturing parameters (e.g. fiber volume ratio, void volume ratio, ply angle, cool down process)
- Service parameters (fiber, matrix stiffness and strength)
- Design parameters (e.g. fiber architecture, ply thickness)
- Determines sensivity of failure type and service parameters

Accurate Life Predictions of Composite T-Joints

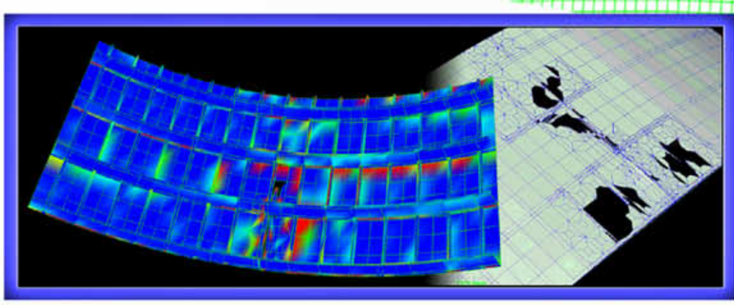
GENOA was used to predict the strength and fatigue life of composite T-Joints for Navy and Air Force applications. Strength and life predictions of these commonly used joints are critical since stress concentrations typically occur on all joints. T-Joints possess sharp radii in their corners and co-curing/secondary bonding is required to join the T-Joint and skins together.

Results:

- ***GENOA's*** progressive failure analysis capability predicted failure to within 5% of Navy tests
- Simulated 130,000 cycles of AF joint
- Joint lost stability at an early stage of fatigue cycling
- Damage initiated in the top skin via transverse tensile failure
- Final failure occurred when the joint lost its stability and both wings of the T section folded up



Accurate Damage Tolerance and Life Prediction of Pressurized Composite Fuselage Panels



Virtual and actual testing were employed to determine the damage tolerance and life of stiffened composite fuselage crown panels. A 38-inch saw cut in each panel was used to represent discrete source damage. Strength tests and life cycle tests were carried out.

Results:

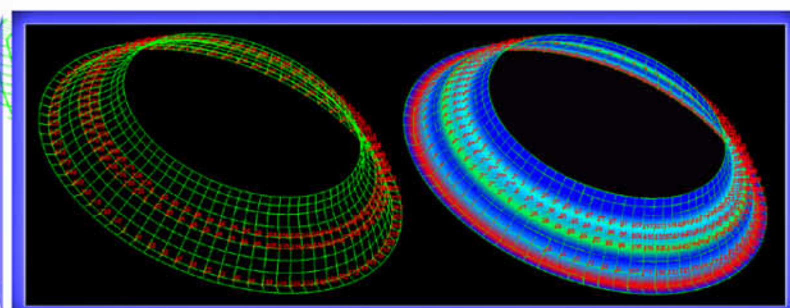
- Maximum pressurization capabilitiesof damaged fuselage panels were predicted to within 2% of actual tests
- Life cycles of the damaged fuselage panels were predicted to within 4% of actual test results

Durability, Reliability and Life Prediction of Ceramic Composite Combustor Liner

Predicting durability, reliability and life of ceramic composites in an aerospace engine's extreme temperature environment is a difficult task, which is made even more difficult by high-temperature material creep.

Results:

- ***GENOA*** demonstrated its ability to predict durability, reliability and life of the combustor liner in elevated engine temperatures ranging from 1700 to 2300 F. ***GENOA*** accurately predicted material strength within 3% over the full range of temperatures from ambient to 2300 F.
- ***GENOA*** predicted material life due to creep at stress levels at the elevated engine temperatures.



GENOA

GENOA is a modular software dealing with linear and non linear technology, pre & post processor with animation capabilities, interfacing with most major commercial CAE. GENOA is available on all SGI, HP, SUN and MS Windows platform with OpenGL.

AlphaSTAR Corporation www.alphastarcorp.com

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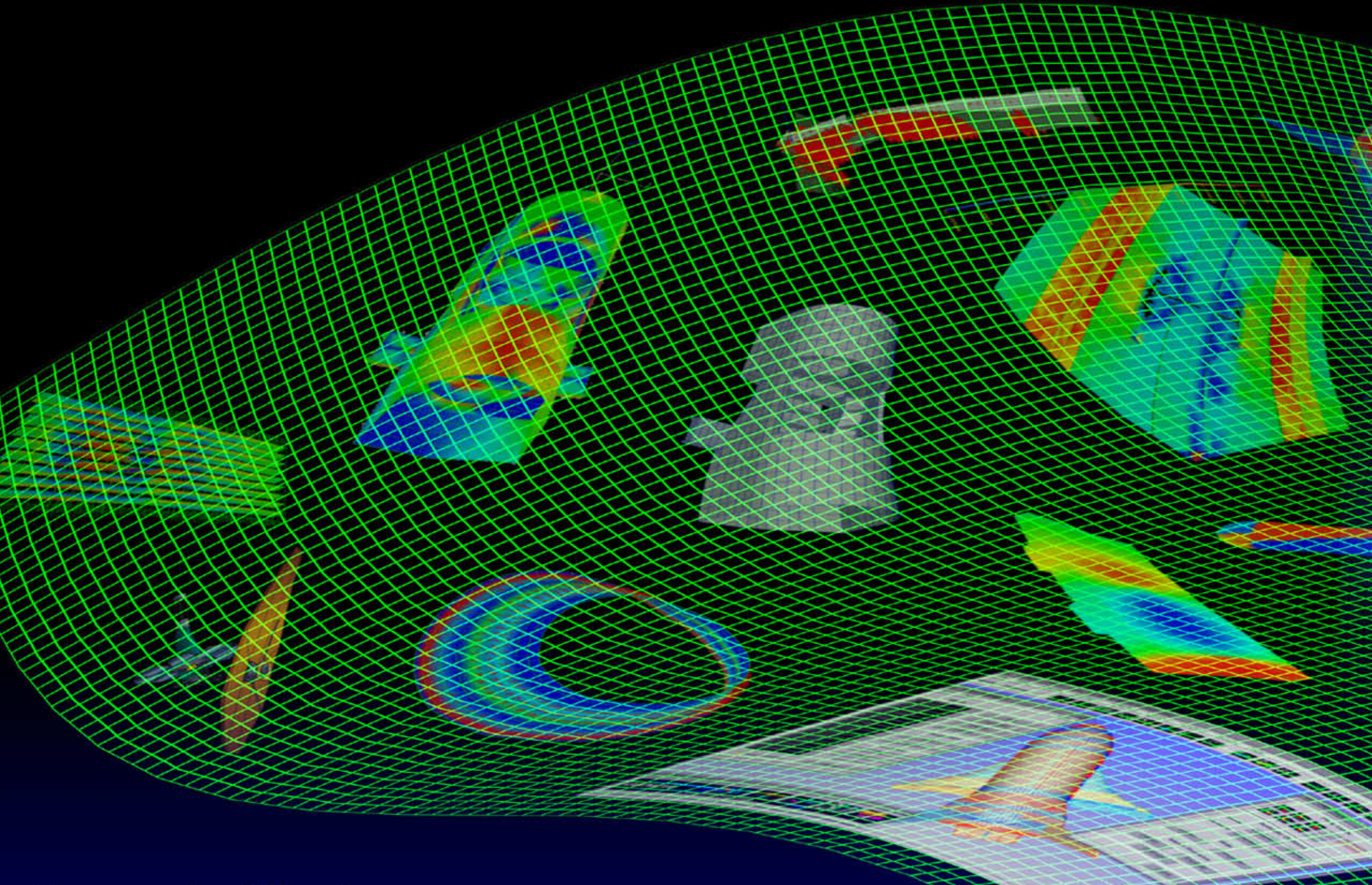

Corporate Clients

NASA	Prat & Whitney	Goldswary International
CalTrans	Allison / Rolls Royce	Delphia
Boeing	Solar Turbine	BMW
Lockhead	STI Optronics	Ford Motor Company
General Electric	Northrop Grumman	NASDA
TRW	Sandia National Lab	Toyota
Honey Well	NIST	Mitsubishi Heavy Industry

AWARDS

NASA Software of the Year **(1999)**
NASA Best of the 90's **(1999)**
NASA Turning Goals into Reality **(2000)**
R&D 100 Award **(2000)**
Tibbetts Award by the US SBA/Senate **(2001)**

"The only tool that can accurately model the progressive aging and failure of any monolithic or laminated metallic, ceramic or polymeric material in 2D or 3D structures".