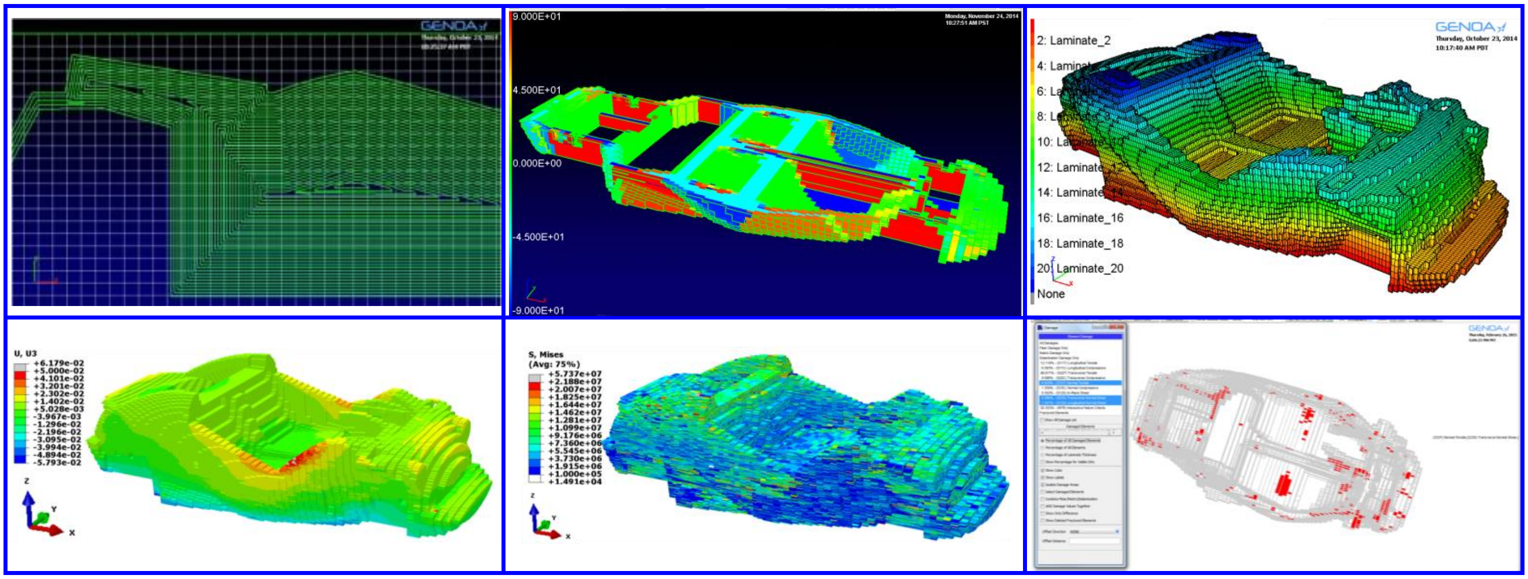

GENOA 3DP Simulation is an additive manufacturing design tool and software suite that simulates the 3D printing process, for both polymers and metals, to accurately predict the deflection, residual stress, damage initiation, and crack growth formation associated with as-built AM parts. Advanced Multi-Scale Progressive Failure Analysis methods are used to replicate the entire 3D printing process from the level of Material Characterization to Advanced Structural Analysis in order to determine voids, delamination, manufacturing anomalies, and other irregularities and inefficiencies from micro to macro scales. More significantly, GENOA 3DP Simulation provides the end user with an ability to import an STL file/G-Code; generate a structural mesh, run analysis and optimize the build in order to reduce weight, reduce scrap rate, improve performance and meet specification.

Highlights

- ✓ Generate structural Mesh from STL file or printer G-CODE to mesh and simulate the manufacturing process
- ✓ Supports validated database of powder metals, chopped fiber (thermoplastics), and graphene platelet (thermosets)
- ✓ Predicts presence of residual stress, deformation, and delamination (initiation/propagation)
- ✓ Predicts fracture, failure type and percentage of contribution of failure type (when, where, why)
- ✓ Identifies location and extent of damage and fracture; i.e. diffusion creep, void and surface roughness
- ✓ Calculate voids and corresponding material degradation
- ✓ Generates stress-strain curve for static analysis/prediction
- ✓ Generates Fatigue + Defects: a-N,S-N Curve for fatigue analysis/prediction
- ✓ Supports thermal profile validation performed for wall model
- ✓ Provides coupled structural-thermal solution (sequentially coupled)
- ✓ Identifies scatter, uncertainty, sensitivity for process and material optimization
- ✓ Identifies parameters to be changed to improve manufacturing process; i.e. printing speed, intrusion distance, material temperature, ambient temperature, material type, inclusion orientation, aspect ratio (i.e. fiber length); etc.

Key Benefits

- ✓ Characterize AM materials in coordination with an ICME framework
- ✓ Integrates AM process simulation with structural design and design analysis
- ✓ Provides process improvement for robust design optimization in order to minimize defects
- ✓ Design, model, and fabricate AS-BUILT Parts
- ✓ Manufacture optimized part topology
- ✓ Addresses performance and manufacturing constraints
- ✓ Validate developed/enhanced model for AS-IS Performance

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Technology and Features

Process

FE Mesh Generator (model-based layer, scan pattern, and mesh generator); Model Generation for Internal/External FE Mesh; Local Global Analysis: Local (Delaney Grain) Model Mapped to Global Mesh using Surrogate Approach; Dynamic Moving Grid Srategy; Predict AM-Fabricated Material Stress-Strain; Supports ABAQUS FEM; Coupled Thermal-Structural Analysis; Integration with Commercial Topology Optimization; Allowable Generation (Probabilistic Analysis); Potential to Simulate Big Parts; Pre-Process Operating Parameters as Inputs (Excluding Parameters Embedded in G-Code); Low and High Fidelity Solutions;

Metal Powder

Material Properties Database; Sub-Grain Size Meshing Technique; Intergranular/Transgranular Void Nucleation/Growth; Environmental Effect (e.g. Oxidation); Material Fracture Toughness Prediction; Fatigue Crack Growth Prediction; Fatigue Loading Prediction (S-N); Diffusional Creep Prediction (a-N)

Thermoplastic

Material Properties Database (strength, stiffness); Test Validated Thermal Analysis; Simulated Big Part (Stratti Car); Residual Stress, Defelection, Residual Strain, Threshold Crack, and Service Load Performance

Thermoset

Material Properties Database (Graphene); Multi-scale Material Modeling (Nano-Micro-Macro); Material Strength Modulus, Fracture Toughness, Wrinkles, Delamination Prediction

Validated Database

Composite: AS4-8552 , AS4-ABS13, PP-LGF20, PBT-GF30, PA6, GPN-Epoxy;

Metal Powder: Ti-6Al-4V, Inconel 625, Steel (316, PH 17-4-)