# ANSYS®

Realize Your Product Promise®

# 2019 R1

# CAPABILITIES

# CONTENT

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# STRUCTURES

| | MECHANICAL ENTERPRISE | MECHANICAL PREMIUM | MECHANICAL PRO | AUTODYN | LS-DYNA | AIM |
|---|---|---|---|---|---|---|
| **Geometric Idealization** | | | | | | |
| Spring | • | • | ▲ | • | • | • |
| Mass | • | • | • | • | • | • |
| Damper | • | • | | • | • | |
| Spar | • | • | • | | | |
| Beam | • | • | • | • | • | |
| Pipe/Elbow | • | • | • | | | |
| Shell - Thin | • | • | • | • | • | • |
| Layered Shell - Thin (Composite) | • | • | | • | • | |
| Shell - Thick (Solid Shell) | • | • | • | | | |
| Layered Shell - Thick (Solid Shell) (Composite) | • | • | | | | |
| 2D Plane / Axisymmetric | • | • | • | • | • | |
| 3D Solids | • | • | • | • | • | • |
| Layered 3D Solids (Composite) | • | • | | | | |
| Infinite Domain | • | • | • | • | • | |
| 2.5D | • | • | | | | |
| Reinforced | • | • | | • | • | |
| ROM | • | | | | | |
| Substructuring / Matrix | • | | | | | |
| **Modeling Capabilities** | | | | | | |
| Contact - Linear | • | • | • | • | • | • |
| Contact - Nonlinear | • | • | • | • | • | • |
| Joints | • | • | • | • | • | • |
| Spot Welds | • | • | • | • | • | |
| Element Birth and Death | • | • | | | | |
| Gasket Elements | • | | | | | |
| Rezoning and Adaptive Remeshing | • | | | • | • | |

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|---|---|---|---|---|---|---|
| **Materials** | | | | | | |
| Basic Linear Materials (Linear, Anisotropic,Temperature Dependent) | • | • | • | • | • | • |
| Basic Nonlinear Materials (Hyper, Plasticity, Rate Independent, Isotropic, Concrete) | • | • | | • | • | ▲ |
| Advanced Nonlinear Materials (Rate dependent, Anisotropic, Damage Models, Geomechanics Materials, Multiphysics) | • | | | • | • | |
| Field Dependent | • | • | | | | |
| Reactive Materials | • | | | • | | |
| Fracture Mechanics and Crack Growth | • | | | | | |
| Material Designer | • | | | | | |
| **Composite Materials** | | | | | | |
| Material Definitions | • | • | | • | • | |
| Layers Definitions | • | ▲ | | • | • | |
| Interface Plies | • | | | | | |
| Advanced Modeling Features | • | | | | | |
| Variable Material Data | • | | | | | |
| Solid Extrusion | • | | | | | |
| Lay-up Mapping | • | | | | | |
| Draping | • | | | | | |
| Lay-up exchange interfaces | • | | | | | |
| Advanced Failure Criteria Library | • | | | | | |
| First-ply Failure | • | • | | | | |
| Last-Ply failure | • | | | | | |
| Delamination | • | | | • | • | |
| Composite Cure Simulation | ▫ | | | | | |

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|---|---|---|---|---|---|---|
| **Structural Solver Capabilities** | | | | | | |
| Linear Static | • | • | • | | | • |
| Nonlinear Static | • | • | • | | | • |
| Pre-Stress effects, Linear perturbation | • | • | • | ▲ | ▲ | |
| Nonlinear Geometry | • | • | • | • | • | • |
| Buckling - Linear Eigenvalue | • | • | • | | | |
| Buckling - Nonlinear Post Buckling Behavior | • | • | • | | • | • |
| Buckling - Nonlinear Post Buckling Behavior - Arc Length | • | • | | | | |
| Steady State Analysis Applied to a Transient Condition | • | | | | | |
| Advanced Wave Loading | • | | | | | |
| **Topology Optimization** | | | | | | |
| Structural optimization | • | • | • | | | • |
| Modal optimization | • | • | • | | | • |
| Thermal Loads | • | • | • | | | |
| Inertial Loads | • | • | • | | | |
| Optimized Design Validation | • | • | • | | | • |
| Manufacturing Constraints | • | • | • | | | ▲ |
| Stress Constraints | • | • | • | | | • |
| Symmetry | • | • | • | | | • |
| Lattice Optimization | ▫ | | | | | |
| Overhang/Additive constraints | ▫ | | | | | |
| **Multi Analysis** | | | | | | |
| Submodeling | • | • | • | | | |
| Data Mapping | • | • | • | | | • |
| Multiphysics Data Mapping | • | • | | | | |
| Initial State | • | • | | • | • | |
| Advanced Multi-Stage 2D to 3D Analysis | • | • | | | | |

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| **Vibrations** | | | | | | |
| Modal | • | • | • | | | • |
| Modal - Pre-Stressed | • | • | • | | | • |
| Modal - Damped/Unsymmetric | • | • | | | | |
| Transient - Mode-Superposition | • | • | | | | |
| Harmonic - Mode-Superposition | • | • | | | | |
| Harmonic - Full | • | • | | | | |
| Spectrum | • | • | | | | |
| Random Vibration | • | • | | | | • |
| Mistuning | • | • | | | | |
| Rotordynamics | • | • | | | | |
| Modal Acoustic | • | | | | | |
| Harmonic Acoustic | • | | | | | |
| | | | | | | |
| **Nonlinear Transient Dynamics** | | | | | | |
| Rigid Body Mechanisms | • | • | | | | |
| Rigid Body Dynamics with CMS l Components for Flexible Bodies | • | | | | | |
| Full Transient | • | • | | • | • | |
| CMS with Substructuring | • | | | | | |

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|---|---|---|---|---|---|---|
| **Explicit Dynamics** | | | | | | |
| FE (Lagrange) Solver | • | | | • | • | |
| Euler Solvers | ▲ | | | • | | |
| Meshless Solvers | | | | • | | |
| Implicit-Explicit Deformations | • | | | • | • | |
| Implicit-Explicit Material States | • | | | • | | |
| Fluid-Structure Interaction (FSI) | • | | | • | | |
| Mass Scaling | • | | | • | • | |
| Natural Fragmentation | • | | | • | | |
| Erosion Based on Multiple Criteria | • | | | • | • | |
| De-Zoning | | | | • | • | |
| Part Activation and Deactivation (Multi Stage Analysis) | | | | • | | |
| Remapping in Space | | | | • | | |
| Remapping Solution Methods | | | | • | | |
| | | | | | | |
| **Durability** | | | | | | |
| Stress-Life (SN) | • | • | • | | | • |
| Strain-Life (EN) | • | • | • | | | • |
| Dang Van | □[1] | □[1] | □[1] | | | |
| Safety Factor | • | • | • | | | • |
| Adhesive Bond | □[1] | □[1] | □[1] | | | |
| Crack Growth Linear Fracture Mechanics | □[1] | □[1] | □[1] | | | |
| Seam Weld | □[1] | □[1] | □[1] | | | |
| Spot Weld | □[1] | □[1] | □[1] | | | |
| Thermo-Mechanical Fatigue | □[1] | □[1] | □[1] | | | |
| Vibration Fatigue | □[1] | □[1] | □[1] | | | |
| Virtual Strain Gauge Correlation | □[1] | □[1] | □[1] | | | |
| Python Scripting Customization | □[1] | □[1] | □[1] | | | |

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|---|---|---|---|---|---|---|
| **Wave Hydrodynamics** | | | | | | |
| Diffraction and Radiation | • | | | | | |
| Frequency & Time Domain Motions Analysis | • | | | | | |
| Moorings, Joints & Tethers | • | | | | | |
| Load Transfer to Structural Analysis | • | | | | | |
| | | | | | | |
| **Thermal** | | | | | | |
| Steady State Thermal | • | • | • | | | • |
| Transient Thermal | • | • | • | | | • |
| Conduction | • | • | • | • | • | • |
| Convection | • | • | • | | | • |
| Radiation to Space | • | • | • | | | • |
| Radiation - Surface to Surface | • | • | • | | | |
| Phase Change | • | • | • | • | • | |
| Thermal Analysis of Layered Shells and Solids | • | • | | | | |
| | | | | | | |
| **Additional Physics** | | | | | | |
| 1-D Thermal-flow | • | • | • | | | |
| 1-D Coupled-field Circuits | • | | | | | |
| 1-D Electromechanical Transducer | • | | | | | |
| MEMS ROM | • | | | | | |
| Piezoelectric | • | | | | | |
| Piezoresistive | • | | | | | |
| Electroelastic | • | | | | | |
| Electromagnetic | • | | | | | ▲ |
| Vibro-acoustics | • | | | | | |
| Electro-Migration | • | | | | | |
| Diffusion-Pore-Fluid | • | | | | | |
| Diffusion-Thermal Structural-Electric | • | | | | | |
| Structural-Thermal-Electric-Magnetic | • | | | | | ▲ |
| 1-Way Fluid-Structure Interaction | ▫ | ▫ | ▫ | | | • |
| 2-Way Fluid-Structure Interaction | ▫ | | | | | |

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|---|---|---|---|---|---|---|---|
| **Optimization** | | | | | | | |
| DesignXplorer Included | • | • | • | ▫ | ▫ | • | |
| Parameters | • | • | • | • | • | • | |
| Design Point Studies | • | • | • | • | • | • | |
| Correlation Analysis | • | • | • | • | | • | |
| Design of Experiments | • | • | • | • | | • | |
| Sensitivity Analysis | • | • | • | • | | • | |
| Goal Driven Optimization | • | • | • | • | | • | |
| Six Sigma Analysis | • | • | • | • | | • | |
| | | | | | | | |
| **Miscellaneous and Usability** | | | | | | | |
| ANSYS SpaceClaim | • | ▫ | ▫ | ▫ | ▫ | • | |
| ANSYS Customization Suite (ACS) | • | ▫ | ▫ | ▫ | ▫ | • | |
| Support ACT Extensions | • | • | • | • | • | • | |
| Command Snippet Support | • | • | • | | | • | |
| Batch run capability | • | • | • | • | • | • | |
| External Code Interfaces | • | • | | • | • | | |
| On the Fly Post Processing | • | • | | | • | | |
| CDB and 3rd Party FE Model Import | • | • | | | • | | |
| | | | | | | | |
| **HPC - Structures** | | | | | | | |
| Default Number of Cores | 4 (DMP + SMP) MAPDL 4 for Explicit 4 for RBD MAPDL 4 for AQWA | 4 (DMP + SMP) | 4 (DMP + SMP) | 1 | 1 | 4 (DMP + SMP) MAPDL | |
| Parallel Solving on Local PC | • | • | • | • | • | • | |
| Parallel Solving on Cluster | • | • | • | • | • | | |
| GPU Acceleration | ▫[6] MAPDL - Yes Explicit - No RBD - No Aqwa - No | ▫[6] | ▫[6] | | | | |
| Parallel Solving Over Cloud Launched from Desktop | MAPDL - Yes Explicit - No RBD - No Aqwa - No | | | | | | |

1 = ANSYS nCode DesignLife Products
2 = ANSYS Fluent
3 = ANSYS DesignXplorer
4 = ANSYS SpaceClaim
5 = ANSYS Customization Suite (ACS)
6 = ANSYS HPC, ANSYS HPC Pack or ANSYS HPC Workgroup

DMP = Distributed-memory parallel
SMP = Shared-memory parallel
MAPDL = Mechanical APDL
Explicit = Autodyn
RBD = Rigid Body Dynamics
Aqwa = Aqwa

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|---|---|---|---|---|---|---|---|---|
| **General Solver Capabilities** | | | | | | | | |
| Comprehensive Inlet and Outlet Conditions | • | • | • | • | • | • | • | |
| Steady-State Flow | • | • | • | • | • | • | • | |
| Transient Flow | • | • | • | • | • | • | • | |
| 2D and 3D Flow | • | ▲ | • | ▲ | • | ▲ | ▲ | |
| Reduced Order Models (ROM) | • | | | | | | • | |
| Time Dependent Boundary Conditions | • | • | • | • | • | ▲ | • | |
| Customizable Materials Library | • | • | • | • | • | • | • | |
| Fan Model | • | • | | | • | | | |
| Periodic domains | • | • | • | • | • | • | • | |
| Flow-Driven Solid Motion (6DOF) | • | • | | | • | | | |
| Pressure-Based Coupled Solver | • | • | • | • | • | • | • | |
| Density-Based Coupled Solver | • | | | | | | • | |
| Dynamic/Moving-Deforming Mesh | • | • | • | • | • | | • | |
| Overset Mesh | • | | | | | | | |
| Immersed-Solid/MST Method for Moving Parts | | • | • | | • | | | |
| Automatic On-the-Fly Mesh Generation with Dynamic Refinement | • | | | • | | | • | |
| Dynamic Solution-Adaptive Mesh Refinement | • | • | | • | ▲ | | • | |
| Polyhedral Unstructured Solution-Adaptive Mesh Refinement | • | | | | | | | |
| | | | | | | | | |
| **Single Phase, Non-Reacting Flows** | | | | | | | | |
| Incompressible Flow | • | • | • | | | • | • | |
| Compressible Flow | • | • | | • | • | • | • | |
| Porous Media | • | • | • | | | | | |
| Non-Newtonian Viscosity | • | • | • | | | | | |
| Turbulence - Isotropic | • | • | • | • | • | • | • | |
| Turbulence - Anisotropic (RSM) | • | • | | | | | | |
| Turbulence - Unsteady (LES/SAS/DES) | • | • | | | | | • | |
| Turbulence - Laminar/Turbulent Transition | • | • | | | • | • | • | |
| Flow Pathlines (Massless) | • | • | • | | | • | | |
| Fan Model | • | • | | | • | | | |
| Acoustics (Source Export) | • | • | | | • | | | |
| Acoustics (Noise Prediction) | • | ▲ | | | | | | |

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|---|---|---|---|---|---|---|---|---|
| **Heat Transfer** | | | | | | | | |
| Natural Convection | • | • | | | • | • | • | |
| Conduction & Conjugate Heat Transfer | • | • | | | • | • | • | |
| Shell Conduction (Including Multi-Layer Model) | • | | | | | | | |
| Internal Radiation - Participating Media | • | • | • | | • | | • | |
| Internal Radiation - Transparent Media | • | • | | | | | • | |
| External Radiation | • | • | | | | • | • | |
| Solar Radiation & Load | • | • | | | | | | |
| Simplified Heat Exchanger Model | • | | | | | | | |
| Non-equilibrium Thermal Model | • | | | | | | | |
| Prorous Media | • | | | | | | | |
| **Particles Flows (Multiphase)** | | | | | | | | |
| Coupled Discrete Phase Modeling Including Thin Wall Films | • | • | | • | • | ▲ | • | |
| Macroscopic Particle Model | • | | | | | ▲ | | |
| Inert Particle Tracking (with Mass) | • | • | | | | ▲ | | |
| Liquid Droplet (Incl. Evaporation) | • | • | | • | • | | • | |
| Combusting Particles | • | • | | • | | | • | |
| Multicomponent Droplets | • | • | | • | • | | • | |
| Discrete Element Model (DEM) | • | | | | | | | |
| Break-Up And Coalescence | • | • | | • | • | | • | |
| Erosion | • | • | | | | | | |
| **Free Surface Flows (Multiphase)** | | | | | | | | |
| Implicit VOF | • | • | • | | | | | |
| Explicit VOF | • | • | • | | | | | |
| Coupled Level Set/VOF | • | • | | | • | | | |
| VOF to DPM Spray Model | • | | | | | | | |
| Open Channel Flow And Wave | • | • | | | | | | |
| Surface Tension | • | • | | • | • | | | |
| Phase Change | • | • | | • | • | | | |
| Cavitation | • | • | | • | • | | | |
| Cavitation Where Multiple Fluids and Non-Condensing Gases Are Present | • | | | | | | | |

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|---|---|---|---|---|---|---|---|---|
| **Dispersed Multiphase Flows (Multiphase)** | | | | | | | | |
| Mixture Fraction | • | • | | | | | | |
| Eulerian Model including Thin Wall Films | • | • | | • | • | | | |
| Boiling Model | • | • | | • | | | • | |
| Surface Tension | • | • | | • | | | • | |
| Phase Change | • | • | | • | • | | • | |
| Drag And Lift | • | • | | • | • | | • | |
| Wall Lubrication | • | • | | • | | | • | |
| Heat And Mass Transfer | • | • | | • | • | | • | |
| Population Balance | • | • | | • | | | • | |
| Reactions Between Phases | • | • | | • | | | • | |
| Granular Model for Dense Bed of Solids | • | • | | | | | | |
| Dense Particulate Coupling (DDPM) | • | • | | | | | | |
| | | | | | | | | |
| **Reacting Flows** | | | | | | | | |
| Species Transport | • | • | • | • | | | • | |
| Non-Premixed Combustion | • | • | | • | | | • | |
| Premixed Combustion | • | • | | • | | | • | |
| Partially Premixed Combustion | • | • | | • | | | • | |
| Composition PDF Transport | • | • | | | | | | |
| Finite Rate Chemistry | • | • | • | • | | | • | |
| Pollutants and Soot Modeling | • | • | | • | | | • | |
| Sparse Chemistry Solver with Dynamic Cell Clustering and Dynamic Adaptive Chemistry | • | | | • | | | • | |
| Ability to Use Model Fuel Library Mechanisms | • | | | • | | | • | |
| Flame-Speed from Fuel-Component Library | • | | | • | | | • | |
| DPIK Spark-Ignition Model | | | | • | | | • | |
| Flame-Propagation Using Level-Set Method (G-Equation) | | | | • | | | • | |
| Internal Combustion Engine Specific Solution | • | • | | • | | | • | |
| 0-D/1-D/2-D Reactor Models and Reactor Networks | | | | | | | • | |
| Plasma Reactions | | | | | | | • | |
| Comprehensive Surface-Kinetics | • | | | | | | • | |
| Chemical and Phase Equilibrium | • | | | | | | • | |
| Flamelet Table Generation | • | | | | | | • | |
| Flamespeed and Ignition Table Generation | | | | | | | • | |
| Reaction Sensitivity, Uncertainty and Path Analysis | | | | | | | • | |
| Surrogate Blend Optimizer | | | | | | | • | |
| Mechanism Reduction | | | | | | | • | |

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|---|---|---|---|---|---|---|---|---|
| **Turbomachinery** | | | | | | | | |
| MRF/Frozen-Rotor | • | • | | | | | | |
| Sliding-Mesh/Stage | • | • | | | | | | |
| Transient Blade Row | | • | | | | | | |
|   Pitch Change | | • | | | | | | |
|   Time Transformation | | • | | | | | | |
|   Fourier Transformation | | • | | | | | | |
|   Harmonic Analysis | | • | | | | | | |
| Blade Flutter Analysis | | • | | | | | | |
| Forced Response Analysis | | • | | | | | | |
| Flank Milled Blades | | • | | | | | | |
| | | | | | | | | |
| **In-Flight Icing** | | | | | | | | |
| Simulates Droplet Sizes | | | | | • | | | |
| Simulates Ice Growth and Performs Visibility Studies | | | | | • | | | |
| Models Heat Transfer Anti- and De-icing Heat Loads | | | | | • | | | |
| Rotating Frame of Reference for the Analysis of Turbomachines, Rotors and Propellers | | | | | • | | | |
| Model Ice Accretion at Engine Face (Fan and IGV) and within Any Number of Successive Compressor Stages | | | | | ▲ | | | |
| Aerodynamic Degradation (CFD) Meets the Requirements of Appendix C, Appendix D (Ice Crystals) and Appendix O (SLD) | | | | | • | | | |

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|---|---|---|---|---|---|---|---|---|
| **Optimization** | | | | | | | | |
| Parameters | • | • | • | | | • | • | |
| Design Point Studies | • | • | • | | | • | • | |
| Correlation Analysis | • | • | • | | | • | | |
| Design of Experiments | • | • | • | | | • | | |
| Sensitivity Analysis | • | • | • | | | • | • | |
| Goal Driven Optimization | • | • | • | | | • | | |
| Six Sigma Analysis | • | • | • | | | • | | |
| Adjoint Solver for Shape Optimization | • | | | | | | | |
| Adjoint Solver Supports Rotating Reference Frames & Conjugate Heat Transfer | • | | | | | | | |
| Multi-Objective-Constrained Optimization | • | | | | | | | |
| Mesh Morphing (RBF Morph) | ▫ | | | | | | | |
| | | | | | | | | |
| **High Rheology Material** | | | | | | | | |
| Viscoelasticity | | | • | | | | | |
| Specialty Extrusion Models | | | • | | | ▲ | | |
| Specialty Blow Molding Models | | | • | | | ▲ | | |
| Specialty Fiber Spinning Models | • | | | | | | | |
| | | | | | | | | |
| **HPC – Fluids** | | | | | | | | |
| Parallel Solving on Local PC Option | • | • | • | • | • | • | • | |
| Parallel Solving Over Network Option | • | • | • | • | • | • | | |
| Parallel Solving Over Cloud Launched from Desktop | • | | | | | | | |
| GPU Support | • | | • | | | | | |
| | | | | | | | | |
| **Pre and Post Processing** | | | | | | | | |
| Photo Realistic Rendering | • | • | • | • | • | | • | |
| SpaceClaim Direct Modeler | • | • | • | • | • | • | • | |
| Compare Multiple Runs, Datasets, Physics, Graphs in a Single Window | • | • | • | • | • | | • | |

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|---|---|---|---|---|---|---|---|---|
| **Multiphysics** | | | | | | | | |
| Advanced, Automated Data Exchange | • | • | • | | • | • | | |
| Accurate Data Interpolation Between Dissimilar Meshes | • | • | | | • | • | | |
| Drag-n-Drop Multiphysics | • | • | • | | | | | |
| Direct Coupling Between Physics | • | • | | | | • | | |
| Collaborative Workflows | • | • | | | | • | | |
| Fully Managed Co-Simulation | • | • | | | | | | |
| Flexible Solver Coupling Options | • | • | | | • | | | |
| | | | | | | | | |
| **Fluid-Structure Interaction** | | | | | | | | |
| Force Induced Motion/Deformation | ▫ | ▫ | • | | | • | | |
| Fluid Thermal Deformation | ▫ | ▫ | | | | • | | |
| | | | | | | | | |
| **Electro-Thermal Interaction** | | | | | | | | |
| Convection Cooled Electronics | • | • | | | | | | |
| Conduction Cooled Electronics | • | • | | | | | | |
| High Frequency Thermal Management | • | • | | | | | | |
| Electromechanical Thermal Management | • | • | | | | | | |
| | | | | | | | | |
| **Other Coupled Interactions** | | | | | | | | |
| Aero-Vibro Acoustics | • | | | | | | | |
| Acoustics-Structural | • | • | | | | | | |
| Fluid Magnetohydrodynamics | • | • | | | | | | |
| | | | | | | | | |
| **Ease of Use and Productivity** | | | | | | | | |
| Support ACT Extensions | • | | | | | | | |
| Mosaic-Enabled Meshing Technology | • | | | | | | | |
| Task-Based Workflow - Watertight Geometries | • | | | | | | | |
| Task-Based Workflow - Fault Tolerant (Beta) | • | | | | | | | |
| Directly Enter Expressions | • | • | | | | • | | |

• = Fully Support     ▲ = Limited Capability     ▫ = Requires more than 1 product

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# ELECTRONICS

| | MAXWELL | HFSS | SIwave | Q3D EXTRACTOR | ICEPAK | AIM | | |
|---|---|---|---|---|---|---|---|---|
| **Low Frequency Electromagnetics** | | | | | | | | |
| Electrostatics | • | | | | | • | | |
| AC Conduction | • | | | | | • | | |
| DC Conduction | • | | | | | • | | |
| Magnetostatics | • | | | | | • | | |
| Adaptive Field Mesh | • | • | • | • | | • | | |
| AC Harmonic Magnetic | • | | | | | • | | |
| Electric Transient | • | | | | | | | |
| | | | | | | | | |
| **Magnetic Transient** | | | | | | | | |
| Translational Motion | • | | | | | | | |
| Fully Automatic Symmetrical Mesh Generation | • | | | | | | | |
| Rotational Motion | • | | | | | | | |
| Non-Cylindrical Motion | • | | | | | | | |
| Advanced Embedded Circuit Coupling | • | | | | | | | |
| Circuit Coupling with Adaptive Time Stepping | • | | | | | | | |
| Direct and Iterative Matrix Solvers | • | | | | | | | |
| | | | | | | | | |
| **Advanced Magnetic Modeling** | | | | | | | | |
| Vector Hysteresis Modeling | • | | | | | | | |
| Hysteresis Modeling for Anisotropic Material | • | | | | | | | |
| Frequency Dependent Reduced Order Models | • | | | | | | | |
| Equivalent Model Extraction (Linear-Motion, Rotational-Motion, No-Motion) | • | | | | | | | |
| Functional Magnetization Direction | • | | | | | | | |
| Magnetization/De-magnetization Modeling | • | | | | | | | |
| Manufacturing Dependent Core l Loss Models | • | | | | | | | |
| Noise - Vibration Modeling | □ | | | | | | | |
| Temperature De-magnetization Modeling | • | | | | | | | |
| Core Loss computation | • | | | | | • | | |
| Lamination Modeling | • | | | | | | | |
| Magnetostriction and Magnetoelastic Modeling | • | | | | | | | |
| Hardware in the Loop modeling | • | | | | | | | |
| Integrated Motor Synthesis and Design Kit | • | | | | | | | |
| Integrated Planar Magnetics Synthesis and Design Kit | • | | | | | | | |

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# ELECTRONICS

| | MAXWELL | HFSS | SIwave | Q3D EXTRACTOR | ICEPAK | AIM | | |
|---|---|---|---|---|---|---|---|---|
| **High Frequency Electromagnetics** | | | | | | | | |
| Fully Automated Adaptive Mesh Refinement | | • | | | | | | |
| Multi-Frequency Broadband Adaptive Meshing | | • | | | | | | |
| Frequency Domain Finite Element (FEM) Analysis | | • | | | | | | |
| Frequency Domain Integral Equation (MoM) Analysis | | • | | | | | | |
| Time Domain FEM Analysis | | • | | | | | | |
| FEM Eigenmode Analysis | | • | | | | | | |
| MoM Characteristic Mode Analysis | | • | | | | | | |
| Physical Optics (PO) Analysis | | ▫ | | | | | | |
| Shooting and Bouncing Ray+ (SBR+) Analysis | | ▫ | | | | | | |
| Physical Theory of Diffraction (PTD) correction for SBR | | ▫ | | | | | | |
| Uniform Theory of Diffraction (UTD) Correction for SBR | | ▫ | | | | | | |
| Visual Ray Tracing for SBR+ Analysis | | ▫ | | | | | | |
| Domain Decomposition Method (DDM) for Frequency Domain FEM Analysis | | • | | | | | | |
| Hybrid Finite Element/Integral Equation Analysis | | • | | | | | | |
| UI Coupled Finite Element and/or IE with SBR+ Analysis | | • | | | | | | |
| Modal Wave Port Excitation | | • | | | | | | |
| Terminal Wave Port Excitations | | • | | | | | | |
| Lumped, Voltage and Current Excitations | | • | | | | | | |
| Parametric Antenna Excitations for SBR+ | | • | | | | | | |
| Floquet Excitations | | • | | | | | | |
| Incident Wave Excitation | | • | | | | | | |
| Magnetic Ferrite Bias Excitation | | • | | | | | | |
| Perfect Electric and Magnetic Boundary | | • | | | | | | |
| Finite Conductivity Boundary | | • | | | | | | |
| Lumped RLC Boundary | | • | | | | | | |
| Symmetry Boundary | | • | | | | | | |
| Periodic Boundary | | • | | | | | | |
| ***Continued on next page*** | | | | | | | | |

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# ELECTRONICS

| | MAXWELL | HFSS | SIwave | Q3D EXTRACTOR | ICEPAK | AIM | | |
|---|---|---|---|---|---|---|---|---|
| **High Frequency Electromagnetics** *(continued)* | | | | | | | | |
| Frequency Dependant Materials | | • | | | | | | |
| Higher and Mixed Order Elements | | • | | | | | | |
| Curvilinear Element Mesh Correction | | • | | | | | | |
| S,Y,Z Matrix Results | | • | | | | | | |
| E, H, J, P Field Results | | • | | | | | | |
| Direct and Iterative Matrix Solvers | | • | | | | | | |
| Antenna Parameter Calculation | | • | | | | | | |
| Infinite and Finite Antenna Array Calculations | | • | | | | | | |
| Radar Cross Section Calculation | | • | | | | | | |
| FSS, EBG and Metamaterial Calculation | | • | | | | | | |
| Specific Absorption Rate Calculation | | • | | | | | | |
| EMI/EMC Calculation | | • | | | | | | |
| System Level EMI and RFI Analysis | | • | | | | | | |
| Linear Circuit Analysis with EM Dynamic Link | | • | | | | | | |
| Integrated Antenna Synthesis and Design Kit | | • | | | | | | |
| 3D Component Libraries with User Controled Parametrics | | • | | | | | | |
| 3D Component with Encryption Creation | | • | | | | | | |
| 3D Component with Encryption Utilization | | • | | | | | | |

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## ELECTRONICS

| | MAXWELL | HFSS | SIwave | Q3D EXTRACTOR | ICEPAK | AIM | | |
|---|---|---|---|---|---|---|---|---|
| **Power and Signal Integrity Board Simulation Capabilities** | | | | | | | | |
| Electronics Desktop 3D Layout GUI | | • | • | | • | | | |
| ECAD Translation (Altium, Cadence, Mentor, Pulsonix, & Zuken) | | • | • | | | | | |
| MCAD (.sat) Generation from ECAD | | • | • | | | | | |
| Lead Frame Editor | | • | • | | | | | |
| DC Voltage, Current and Power Analysis for PKG/PCB | | | • | | | | | |
| DC Joule Heating with ANSYS Icepak | | | • | • | • | | | |
| Passive Excitation Plane Resonance Analysis | | | • | | | | | |
| Driven Excitation Plane Resonance Analysis | | | • | | | | | |
| Automated Decoupling Analysis | | | • | | | | | |
| Capacitor Loop Inductance Analysis | | | • | | | | | |
| AC SYZ Analysis - PI, SI, & EMI | | | • | | | | | |
| Dynamically Linked Electromagnetic Field Solvers | | | • | | | | | |
| Chip, Package, PCB Analysis (CPM) | | • | • | | | | | |
| Near-Field EMI Analysis | | | • | | | | | |
| Far-Field EMI Analysis | | | • | | | | | |
| Characteristic Impedance (Zo) l PKG/PCB Scan | | | • | | | | | |
| Full PCB/PKG Cross-talk Scanning | | | • | | | | | |
| TDR Analysis | | • | • | • | | | | |
| Transient IBIS Circuit Analysis | | • | • | | | | | |
| SerDes IBIS-AMI Circuit Analysis | | | • | | | | | |
| Macro-Modeling (Network Data Explorer) | | | • | | | | | |
| Steady State AC (LNA) Analysis | | | • | | | | | |
| Virtual Compliance - DDRx, GDDRx, & LPDDRx | | | • | | | | | |
| Synopsys HSPICE Integration | | | • | | | | | |
| Cadence PSPICE Support | | | • | | | | | |
| Electromagnetically Circuit Driven Field Solvers | | • | • | | | | | |

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## ELECTRONICS

| ELECTRONICS | MAXWELL | HFSS | SIwave | Q3D EXTRACTOR | ICEPAK | AIM | | |
|---|---|---|---|---|---|---|---|---|
| **RLCG Parasitic Extraction** | | | | | | | | |
| DCRL, ACRL & CG Solver | | | | • | | | | |
| IC Packaging RLCG IBIS Extraction for Signals & Power | | | | • | | | | |
| Touchpanel RLCG Unit Cell Extraction | | | | • | | | | |
| Adaptive Meshing for Accurate Extraction | | | | • | | | | |
| Bus Bar RLCG Extraction | | | | • | | | | |
| Power Inverter & Converter Component Extraction | | | | • | | | | |
| Specialized Thin Plane Solver for Touchpanel Extraction | | | | • | | | | |
| 3D Component Library | | • | | • | | | | |
| Reduced RLCG Matrix Operations | | | | • | | | | |
| SPICE equivalent Modeling Export | | | | • | | | | |
| DCRL & ACRL Joule Heating Analysis with Icepak | | | | • | | | | |
| Macro-Modeling (Network Data Explorer) | | | | • | • | | | |
| 2D Transmission Line Modeling Toolkit | | | | • | | | | |
| 2D Cable Modeling Toolkit | | | | • | | | | |
| | | | | | | | | |
| **Electronics Cooling** | | | | | | | | |
| Multi-Mode Heat Transfer | | | | | • | | | |
| Steady-State and Transient | | | | | • | | | |
| CFD Analysis | | | | | • | | | |
| Turbulent Heat Transfer | | | | | • | | | |
| Multiple-Fluid Analysis | | | | | • | | | |
| Species Transport | | | | | • | | | |
| Solar Loading | | | | | • | | | |
| Reduced Order Flow and Thermal | | | | | • | | | |
| Network Modeling | | | | | • | | | |
| Joule Heating Analysis | ▫ | ▫ | ▫ | ▫ | • | | | |
| Thermo-electric Cooler Modeling | | | | | • | | | |
| Thermostat Modeling | | | | | • | | | |
| Package Characterization | | | | | • | | | |
| Data Center Modeling | | | | | • | | | |

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# ELECTRONICS

| | MAXWELL | HFSS | SIwave | Q3D EXTRACTOR | ICEPAK | AIM | | |
|---|---|---|---|---|---|---|---|---|
| **HPC for Electronics** | | | | | | | | |
| GPU Support | □ | □ | | | | | | |
| HPC Accelerated Frequency Sweeps | | • | • | | | | | |
| HPC Distributed Hybrid Solving | | • | | | | | | |
| HPC Enabled Domain Decomposition Method | • | • | | | | | | |
| HPC Time Decomposition Method | • | | | | | | | |
| HPC Enabled Multi-port Excitation Acceleration | | • | | | | | | |
| HPC Acceleration for DCRL, ACRL and CG | | | | • | | | | |
| HPC Enabled Parallel Processing | • | • | | • | • | | | |

## SYSTEMS MODELING - ELECTRONIC PRODUCTS

| | MAXWELL | HFSS | SIwave | Q3D EXTRACTOR | ICEPAK | AIM | | |
|---|---|---|---|---|---|---|---|---|
| **System Modeling for Power Electronics** | | | | | | | | |
| Circuit Simulation | • | • | • | • | • | | | |
| Block Diagram Simulation | • | • | • | • | • | | | |
| State Machine Simulation | • | • | • | • | • | | | |
| VHDL-AMS Simulation | • | • | • | • | • | | | |
| Integrated Graphical Modeling Environment | • | • | • | • | • | | | |
| Power Electronics Component Libraries | • | • | • | • | • | | | |
| Reduced Order Modeling | • | • | • | • | • | | | |
| Power Electronic Device and Module Characterization | • | • | • | • | • | | | |
| Co-Simulation with MathWorks Simulink | • | • | • | • | • | | | |
| | | | | | | | | |
| **System Modeling for RF/Microwave** | | | | | | | | |
| Radio Frequency Interference (RFI) System Solver | | □ | | | | | | |
| Electromagnetic Interference System Solver | | □ | | | | | | |
| RF Link Budget Analysis | | □ | | | | | | |
| RF Co-Site and Antenna Coexistence Analysis | | □ | | | | | | |
| Automated Diagnostics for Rapid Root-Cause Analysis | | □ | | | | | | |
| RF Component Library | | □ | | | | | | |
| Wireless Propagation Models | | □ | | | | | | |
| Multi-Fidelity Parametric Radio Models | | □ | | | | | | |
| Antenna-to-Antenna Coupling Models | | □ | | | | | | |

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# ELECTRONICS

| | MAXWELL | HFSS | SIwave | Q3D EXTRACTOR | ICEPAK | AIM |
|---|---|---|---|---|---|---|
| **System Modeling for SI/PI** | | | | | | |
| SerDes Channel Modeling - IBIS-AMI, QuickEye and VerifEye | | □ | • | | | |
| Multi-Drop & Parallel Bus Modeling - IBIS, HSPICE, Spectre, PSPICE, and Nexxim Transient | | □ | • | | | |
| Network Data Exploration | | • | • | • | | |
| TDR Analysis | | □ | • | | | |
| Steady State AC (LNA) Analysis | | □ | • | | | |
| Virtual Compliance - DDRx, GDDRx, & LPDDRx | | □ | • | | | |
| | | | | | | |
| **MULTIPHYSICS** | | | | | | |
| **Platform Technologies** | | | | | | |
| Advanced, Automated Data Exchange | • | • | | • | • | |
| Accurate Data Interpolation Between | • | • | | • | • | |
| Dissimilar Meshes | • | • | | • | • | |
| Drag-n-Drop Multiphysics | • | • | | • | • | |
| Direct Coupling Between Physics | • | • | | • | • | |
| Collaborative Workflows | • | • | | • | • | |
| Fully Managed Co-Simulation | • | • | | • | • | |
| Flexible Solver Coupling Options | • | • | | • | • | |
| | | | | | | |
| **Electro-Thermal Interaction** | | | | | | |
| Convection Cooled Electronics | | • | | | • | |
| Conduction Cooled Electronics | | • | | | • | |
| High Frequency Thermal Management | | • | | • | • | |
| Electromechanical Thermal Management | • | | | • | • | |
| | | | | | | |
| **Miscellaneous** | | | | | | |
| Integrated Windows HPC Support | • | • | • | • | • | |
| Integrated IBM Spectrum LSF Support | • | • | • | • | • | |
| Customizable 3rd Party Scheduler Support | • | • | • | • | • | |
| Support ACT Extensions | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ |

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## SYSTEMS & EMBEDDED SOFTWARE

| SYSTEMS & EMBEDDED SOFTWARE | TWIN BUILDER | medini ANALYZE | ARCHITECT | SCADE SUITE | SCADE DISPLAY | VRXPERIENCE | | |
|---|---|---|---|---|---|---|---|---|
| **System Simulation, Validation and Digital Twins** | | | | | | | | |
| Integrated Graphical Modeling Environment | • | | | | | | | |
| Standard Modeling Languages and Exchange Formats | • | | | | | | | |
| Multi-Domain Systems Modeler | • | | | | | | | |
| Extensive 0D Application-Specific Libraries | • | | | | | | | |
| 3rd Party (1D) Tool Integrations | • | | | | | | | |
| 3D ROM | • | | | | | | | |
| Embedded Software Integration | • | | | | | | | |
| Multi-Domain System Simulation | • | | | | | | | |
| Rapid HMI Prototyping | • | | | | | | | |
| System Optimization | • | | | | | | | |
| XIL Integration | • | | | | | | | |
| IIoT Connectivity | • | | | | | | | |
| Digital Twin Runtime Deployment | • | | | | | | | |
| | | | | | | | | |
| **Functional Safety Analysis** | | | | | | | | |
| Safety Concept Modelling | | • | | | | | | |
| Model Based Safety Analysis | | • | | | | | | |
| Reliability Prediction and Analysis | | • | | | | | | |
| Traceability and Validation Teamwork | | • | | | | | | |
| Integration into Engineering Environment | | • | | | | | | |
| Customization and Process Adaption | | • | | | | | | |
| ANSYS Product Integration | | • | | | | | | |
| Reporting and Documentation | | • | | | | | | |

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| SYSTEMS & EMBEDDED SOFTWARE | TWIN BUILDER | medini ANALYZE | ARCHITECT | SCADE SUITE | SCADE DISPLAY | VRXPERIENCE | | |
|---|---|---|---|---|---|---|---|---|
| **Model-based Systems Engineering** | | | | | | | | |
| Model-Based System Design | | | ▲ | ▲ | | | | |
| Functional Decomposition | | | ▲ | ▲ | | | | |
| Architecture Decomposition | | | • | • | | | | |
| Allocation of Functions to Components | | | • | • | | | | |
| Model Checks | | | • | • | | | | |
| Model Diff/Merge | | | • | • | | | | |
| System / Software Bi-Directional Sync | | | • | • | | | | |
| Model Sharing and IP Protection | | | • | • | | | | |
| Model-Based Interface Control Document Production | | | • | • | | | | |
| Configurable for Industry Standards (IMA, AUTOSAR, Etc.) | | | • | • | | | | |
| Product Configuration for Automotive Developers | | | • | • | | | | |
| | | | | | | | | |
| **Embedded Control Software Development** | | | | | | | | |
| Data Flow and State Machine Design and Simulation Capabilities | | | | • | | | | |
| Extensive Set of Libraries Delivered as Design Examples | | | | • | | | | |
| Simulation Capabilities | | | | • | | | | |
| Record and Playback Scenarios | | | | • | | | | |
| Plant Model Co-Simulation Including FMI | | | | • | | | | |
| Coverage Analysis For Requirements Based Tests | | | | • | | | | |
| Formal Verification | | | | • | | | | |
| Timing And Stack Optimization | | | | • | | | | |
| Worst Case Execution Time Estimates On Target | | | | • | | | | |
| Verification of Stack Space Requirements | | | | • | | | | |
| Certified Code Generation for DO-178C, EN 50128, ISO 26262, IEC 61508 | | | | • | | | | |
| Certification Kits For DO-178C, EN50128, ISO 26262, IEC 61508 | | | | • | | | | |

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## SYSTEMS & EMBEDDED SOFTWARE

| | TWIN BUILDER | medini ANALYZE | ARCHITECT | SCADE SUITE | SCADE DISPLAY | VRXPERIENCE | | |
|---|---|---|---|---|---|---|---|---|
| **Man-Machine Interface Software** | | | | | | | | |
| Model-Based Prototyping and Specification of MMIs | | | | | • | | | |
| Support Of OpenGL, OpenGL SC and OpenGL ES | | | | | • | | | |
| Font Management | | | | | • | | | |
| Optimization of Graphical Specifications | | | | | • | | | |
| Plant Model Co-Simulation Including FMI | | | | | • | | | |
| Automatic Generation of iOS and Android Projects | | | | | • | | | |
| Certified Code Generation For DO-178C, EN 50128, ISO 26262, IEC 61508 | | | | | • | | | |
| Certification Kits For DO-178C, EN50128, ISO 26262, IEC 61508 | | | | | • | | | |
| Testing Capabilities | | | | | • | | | |
| | | | | | | | | |
| **VRXPERIENCE** | | | | | | | | |
| **Photometry** | | | | | | | | |
| Illuminance | | | | | | • | | |
| Luminance | | | | | | • | | |
| 3D Illuminance | | | | | | • | | |
| | | | | | | | | |
| **Human Vision** | | | | | | | | |
| Glare Simulation | | | | | | • | | |
| | | | | | | | | |
| **Optical Sensors** | | | | | | | | |
| Ground-Truth sensor | | | | | | • | | |
| Camera Sensor | | | | | | • | | |
| LiDAR Sensor | | | | | | ▲ | | |
| Sensor Fusion | | | | | | ▫ | | |
| | | | | | | | | |
| **Head-up Display** | | | | | | | | |
| HUD Visualisation | | | | | | • | | |

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## SYSTEMS & EMBEDDED SOFTWARE

| SYSTEMS & EMBEDDED SOFTWARE | TWIN BUILDER | medini ANALYZE | ARCHITECT | SCADE SUITE | SCADE DISPLAY | VRXPERIENCE | | |
|---|---|---|---|---|---|---|---|---|
| **Driving** | | | | | | | | |
| Automatic Driving | | | | | | • | | |
| Multi-Vehicles | | | | | | • | | |
| Scenario, Traffic, Vehicle Dynamic, Road Editor (SCANeR) | | | | | | ▫ | | |
| CarSim & SensoDrive Interface (SCANeR) | | | | | | ▫ | | |
| | | | | | | | | |
| **Rendering / Simu** | | | | | | | | |
| CAD Material & CAD Rendering | | | | | | • | | |
| SPEOS Results Visualization | | | | | | • | | |
| Physical Material & Shadics Rendering | | | | | | • | | |
| Physical Material & Ray-Tracing Rendering | | | | | | • | | |
| Advanced Physical Material & Progressive/Hybrid Rendering | | | | | | • | | |
| | | | | | | | | |
| **Headlamp Simulation** | | | | | | | | |
| Headlamp performance assessment | | | | | | • | | |
| Digital Lighting (Matrix Beam, Pixel beam) | | | | | | • | | |
| IIHS Test | | | | | | • | | |
| | | | | | | | | |
| **Tracking** | | | | | | | | |
| Head Tracking | | | | | | • | | |
| Finger Tracking | | | | | | • | | |
| Body Tracking | | | | | | • | | |
| Manikin | | | | | | • | | |
| | | | | | | | | |
| **Distributed Rendering** | | | | | | | | |
| Workstation | | | | | | • | | |
| HMD | | | | | | • | | |
| Powerwall, CAVE | | | | | | • | | |

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# SYSTEMS & EMBEDDED SOFTWARE

| | TWIN BUILDER | medini ANALYZE | ARCHITECT | SCADE SUITE | SCADE DISPLAY | VRXPERIENCE | | |
|---|---|---|---|---|---|---|---|---|
| **Experience** | | | | | | | | |
| Trigger & Animation | | | | | | • | | |
| Physics Engine - Collision & Kinematics | | | | | | • | | |
| Hard & Soft Switches Interaction | | | | | | • | | |
| | | | | | | | | |
| **Engine / Solver Embedded or Interface** | | | | | | | | |
| Variation Engine (Aesthetica) | | | | | | • | | |
| System Co-Simulation | | | | | | ▫ | | |
| Sensor Data Fusion Co-Simulation Display Content Co-Simulation | | | | | | ▫ | | |
| | | | | | | | | |
| **Acoustics Sounds** | | | | | | | | |
| Analyze, Listen & Modify(LEA) | | | | | | • | | |
| Psychoacoustics, Automatic Detection and Separation, Play 3D Sound (LEA) | | | | | | • | | |
| Engine Sound Design (ASD) | | | | | | • | | |
| 3D Sound for Listening Room and VR (GeneVR) | | | | | | • | | |
| Interactive Sound for Driving Simulator (GeneCARS) | | | | | | • | | |
| Measure Sound Perception (JURY) | | | | | | • | | |

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# GEOMETRY

| | DESIGN MODELER | SPACECLAIM DESIGN MODELER | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Direct Modeling Technology | | • | | | | | | | |
| Feature Based Modeling Technology | • | | | | | | | | |
| Open Data from All Major CAD Systems | • | • | | | | | | | |
| Export Data to Neutral File Formats | • | • | | | | | | | |
| Modify Imported Geometry | • | • | | | | | | | |
| Defeaturing and Simplification Tools | • | • | | | | | | | |
| Model Repair | • | • | | | | | | | |
| Add Parameters for Design Exploration | • | • | | | | | | | |
| Extract Mid-Surfaces/Shells and Beams | • | • | | | | | | | |
| Extract Volumes & Create Inner Fluid Domains | • | • | | | | | | | |
| Extract Outer Air Enclosures | • | • | | | | | | | |
| Shared Topology for Conformal Meshing | • | • | | | | | | | |
| Booleans and Slicing | • | • | | | | | | | |
| Create Weld Bodies | • | • | | | | | | | |
| Boundary Condition Mapping | • | • | | | | | | | |
| Scripting | • | • | | | | | | | |
| Sketching and Editing Tools | • | • | | | | | | | |
| 3D Comparison Tools | | • | | | | | | | |
| Repair and Edit Faceted Data | | • | | | | | | | |
| Icepak Integration | • | • | | | | | | | |
| Reverse Engineering Faceted Data | | • | | | | | | | |

• = Fully Support     ▲ = Limited Capability     ▫ = Requires more than 1 product

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## DESIGN TOOLS

| | DISCOVERY ESSENTIALS | DISCOVERY STANDARD | DISCOVERY ULTIMATE |
|---|:---:|:---:|:---:|
| **Structural** | | | |
| Static Structural Analysis | | • | • |
| Modal Analysis | | • | • |
| Pre-Stressed Modal Analysis | | | • |
| Random Vibration | | | • |
| Shells, Springs, Point Masses | | | • |
| Spatially Varying Loads | | | • |
| Nonlinear Contact & Joints | | | • |
| Pre-tension Bolts & Multi-step Analsysis | | | • |
| Basic Plasticity | | | • |
| Large Deformation | | | • |
| Fatigue Analysis | | | • |
| Topology Optimization | | • | • |
| | | | |
| **Fluid** | | | |
| Steady-State Flow | | • | • |
| Transient Flow | | • | • |
| Time-dependent Fluid Conditions | | | • |
| Incompressible Flow | | | • |
| Compressible Flow[1] | | ▲ | • |
| Non-Newtonian Fluids | | | • |
| Periodic Domains | | | • |
| Porous Media | | | • |
| Particle Flow | | | • |
| | | | |
| **Thermal** | | | |
| Steady State Thermal | | • | • |
| Transient Thermal | | • | • |
| Time Dependent Thermal Conditions | | | • |
| Conduction | | • | • |
| Convection | | • | • |
| Radiation to Space | | | • |

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| DESIGN TOOLS | DISCOVERY ESSENTIALS | DISCOVERY STANDARD | DISCOVERY ULTIMATE | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Electromagnetics** | | | | | | | | |
| DC Conduction | | | • | | | | | |
| AC Conduction | | | • | | | | | |
| Electrostatics | | | • | | | | | |
| Magnetostatics | | | • | | | | | |
| AC Harmonic Magnetics | | | • | | | | | |
| | | | | | | | | |
| **Multiphysics** | | | | | | | | |
| Thermal-Stress | | | • | | | | | |
| Fluid-Structure Interaction | | | • | | | | | |
| Fluid-Solid Thermal (Conjugate Heat Transfer) | | | • | | | | | |
| Thermal-Electric | | | • | | | | | |
| Thermal-Electric-Stress | | | • | | | | | |
| Thermal-Electromagnetic | | | • | | | | | |
| Thermal-Electromagnetic-Stress | | | • | | | | | |
| | | | | | | | | |
| **Design & Concept Modeling** | | | | | | | | |
| Concept Modeling or Detail Design | • | • | • | | | | | |
| Part/Assembly Creation or Import | • | • | • | | | | | |
| Large Assembly Importing | • | • | • | | | | | |
| 2-D Drawings, BOM, Exploded Views | • | • | • | | | | | |
| Geometric Parameterization | • | • | • | | | | | |
| Sheet Metal Design | • | • | • | | | | | |
| | | | | | | | | |
| **Manufacturing** | | | | | | | | |
| Repair & Defeature Tools | • | • | • | | | | | |
| Sheet Metal Editing and Unfolding | • | • | • | | | | | |

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## DESIGN TOOLS

| | DISCOVERY ESSENTIALS | DISCOVERY STANDARD | DISCOVERY ULTIMATE |
|---|:---:|:---:|:---:|
| **3-D Printing²** | | | |
| Import, Repair, Edit Faceted Data | • | • | • |
| Shelling and Infills | • | • | • |
| Thickness Eetection | • | • | • |
| | | | |
| **Reverse Engineering** | | | |
| Autosurface of Scanned Data | • | • | • |
| Build Solid/Surfaces on Scanned Data | • | • | • |
| | | | |
| **Interfaces and Add-ons** | | | |
| Algoryx Momentum³ | • | • | • |
| Keyshot Rendering³ | • | • | • |

(1)  Discovery Live supports mildly compressible fluid flow up to ~Mach 0.3

(2)  Included with Discovery Standard and Ultimate

(3)  Add-on Module"

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## ADDITIVE SOLUTIONS

| | ADDITIVE PRINT | ADDITIVE SUITE* | MECHANICAL ENTERPRISE |
|---|---|---|---|
| **Topology and Lattice Optimization** | | | |
| Structural Optimization | | | • |
| Modal Optimization | | | • |
| Thermal Loads | | | • |
| Inertial Loads | | | • |
| Optimized Design Validation | | | • |
| Manufacturing Constraints | | | • |
| Stress Constraints | | | • |
| Symmetry | | | • |
| Lattice Optimization | | • | □ |
| Overhang/Additive Constraints | | • | □ |
| | | | |
| **Geometry and STL File Handling** | | | |
| SpaceClaim Direct Modeler | • | • | • |
| | | | |
| **Workbench Additive** | | | |
| Nonlinear and Temperature Dependent Material Properties | | • | |
| Thermo-Mechanical Coupled Strain Solution | | • | |
| Native Mechanical Environment | | • | |
| Stress-Based Automatically Generated Supports | | • | |
| Part Distortion & Residual Stress (As-Built) | | • | |
| Part Distortion & Residual Stress After Support Removal | | • | |
| Distortion Compensation | | • | |
| Blade Crash Detection | | • | |
| Identification of High Strain (Crack) Locations | | • | |
| Layer by Layer Stress & Distortion Visualizations | | • | |
| Option to Output Only the Last Layer of the Build or Every Nth Layer | | • | |
| User-Defined Step Option as 1st or Last Sequence Step | | • | |
| Layered Tetrahedral Meshing | | • | |
| Post Build Heat Treatment | | • | |

• = Fully Support     ▲ = Beta     □ = Requires more than 1 product

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# ADDITIVE SOLUTIONS

| | ADDITIVE PRINT | ADDITIVE SUITE* | MECHANICAL ENTERPRISE | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Additive Print** | | | | | | | | |
| Nonlinear and Temperature Dependent Material Properties | • | • | | | | | | |
| Uniform Assumed Isotropic Strain | • | • | | | | | | |
| Scan Pattern Based Anisotropic Strain | • | • | | | | | | |
| Thermal Ratcheting Based Anisotropic Strain | • | • | | | | | | |
| Desktop & Cloud Stand-Alone Environments | • | • | | | | | | |
| Stress-Based Automatically Generated Supports | • | • | | | | | | |
| Part Distortion & Residual Stress (As-Built) | • | • | | | | | | |
| Part Distortion & Residual Stress After Support Removal | • | • | | | | | | |
| Distortion Compensation | • | • | | | | | | |
| Blade Crash Detection | • | • | | | | | | |
| Identification Of High Strain (Crack) Locations | • | • | | | | | | |
| Layer by Layer Stress, Distortion & Blade Crash Visualizations | • | • | | | | | | |
| Build File Readers for Multiple AM Machines | • | • | | | | | | |
| Auto Queue Multiple Successive Simulations | • | • | | | | | | |
| Input Strain Hardening Factor | • | • | | | | | | |
| User Defined Support Import | • | • | | | | | | |
| Subvoxel Material Density Assignment | • | • | | | | | | |
| **Additive Science** | | | | | | | | |
| Nonlinear and Temperature Dependent Material Properties | | • | | | | | | |
| Meltpool Dimensions | | • | | | | | | |
| Detailed Thermal History | | ▲ | | | | | | |
| % Porosity | | • | | | | | | |
| Sensor Measurement Predictions | | ▲ | | | | | | |

\* Additive Suite requires a
  Mechanical Enterprise license

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## OPTICAL

| | SPEOS | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Photometry** | | | | | | | | |
| Intensity | • | | | | | | | |
| Illuminance | • | | | | | | | |
| Luminance | • | | | | | | | |
| 3D Illuminance | • | | | | | | | |
| 3D Energy Density | • | | | | | | | |
| | | | | | | | | |
| **Human Vision** | | | | | | | | |
| Dynamic Adaptation | • | | | | | | | |
| Glare Simulation | • | | | | | | | |
| | | | | | | | | |
| **Wavelength Range** | | | | | | | | |
| UV-FIR (50nm-100μm) | • | | | | | | | |
| | | | | | | | | |
| **Optical Design** | | | | | | | | |
| Parabolic Surface | • | | | | | | | |
| TIR Lens | • | | | | | | | |
| Projection Lens | • | | | | | | | |
| Optical Lens | • | | | | | | | |
| Optical Surface | • | | | | | | | |
| Light Guide | • | | | | | | | |
| Sharp Cut-Off Reflector | • | | | | | | | |
| Poly-Ellipsoidal Surface | • | | | | | | | |
| Micro Optical Stripes | • | | | | | | | |
| | | | | | | | | |
| **Optical Sensors** | | | | | | | | |
| Field Of View | • | | | | | | | |
| Camera Sensor | • | | | | | | | |
| LiDAR Sensor | • | | | | | | | |
| Sensor Fusion | • | | | | | | | |

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# OPTICAL

| | SPEOS | | | | | | | |
|---|:---:|---|---|---|---|---|---|---|
| **Head-up Display** | | | | | | | | |
| HUD Optical Analysis | • | | | | | | | |
| HUD Optical Design | • | | | | | | | |
| HUD Visualisation | • | | | | | | | |
| | | | | | | | | |
| **Manufacturing Variation** | | | | | | | | |
| Target Specification | • | | | | | | | |
| Tolerance Study | • | | | | | | | |
| | | | | | | | | |
| **Solver** | | | | | | | | |
| Multi-Threading | • | | | | | | | |
| Highly Scalable HPC | • | | | | | | | |
| | | | | | | | | |
| **Add-on Features** | | | | | | | | |
| Optimizer | • | | | | | | | |
| Design of Experiment | • | | | | | | | |
| Regulation Check | • | | | | | | | |
| Colorimetry | • | | | | | | | |
| Light Expert | • | | | | | | | |
| 3D Textures | • | | | | | | | |
| 3D Energy Density | • | | | | | | | |
| Polarization | • | | | | | | | |
| Fluorescence | • | | | | | | | |
| 360° view | • | | | | | | | |
| Sky | • | | | | | | | |
| Visibility & Legibility | • | | | | | | | |
| Stray Light Analysis | • | | | | | | | |
| High Dynamic Range Screen support | • | | | | | | | |
| Virtual BSDF Bench | • | | | | | | | |
| Thermic Source | • | | | | | | | |
| MODTRAN Interface | ▲ | | | | | | | |
| Night Vision Goggle | • | | | | | | | |

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