



Realize Your Product Promise®

# 2019 R1

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# STRUCTURES

	MECHANICAL ENTERPRISE	MECHANICAL PREMIUM	MECHANICAL PRO	AUTODYN	LS-DYNA	AIM		
<b>Geometric Idealization</b>								
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	•							
<b>Modeling Capabilities</b>								
Contact - Linear	•	•	•	•	•	•		
Contact - Nonlinear	•	•	•	•	•	•		
Joints	•	•	•	•	•	•		
Spot Welds	•	•	•	•	•			
Element Birth and Death	•	•						
Gasket Elements	•							
Rezoning and Adaptive Remeshing	•			•	•			

# STRUCTURES

	MECHANICAL ENTERPRISE	MECHANICAL PREMIUM	MECHANICAL PRO	AUTODYN	LS-DYNA	AIM		
<b>Materials</b>								
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	•							
<b>Composite Materials</b>								
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	◻							

# STRUCTURES

	MECHANICAL ENTERPRISE	MECHANICAL PREMIUM	MECHANICAL PRO	AUTODYN	LS-DYNA	AIM		
<b>Structural Solver Capabilities</b>								
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	•							
<b>Topology Optimization</b>								
Structural optimization	•	•	•			•		
Modal optimization	•	•	•			•		
Thermal Loads	•	•	•					
Inertial Loads	•	•	•					
Optimized Design Validation	•	•	•			•		
Manufacturing Constraints	•	•	•			▲		
Stress Constraints	•	•	•			•		
Symmetry	•	•	•			•		
Lattice Optimization	□							
Overhang/Additive constraints	□							
<b>Multi Analysis</b>								
Submodeling	•	•	•					
Data Mapping	•	•	•			•		
Multiphysics Data Mapping	•	•						
Initial State	•	•		•	•			
Advanced Multi-Stage 2D to 3D Analysis	•	•						

# STRUCTURES

	MECHANICAL ENTERPRISE	MECHANICAL PREMIUM	MECHANICAL PRO	AUTODYN	LS-DYNA	AIM		
<b>Vibrations</b>								
Modal	•	•	•			•		
Modal - Pre-Stressed	•	•	•			•		
Modal - Damped/Unsymmetric	•	•						
Transient - Mode-Superposition	•	•						
Harmonic - Mode-Superposition	•	•						
Harmonic - Full	•	•						
Spectrum	•	•						
Random Vibration	•	•				•		
Mistuning	•	•						
Rotordynamics	•	•						
Modal Acoustic	•							
Harmonic Acoustic	•							
<b>Nonlinear Transient Dynamics</b>								
Rigid Body Mechanisms	•	•						
Rigid Body Dynamics with CMS I Components for Flexible Bodies	•							
Full Transient	•	•		•	•			
CMS with Substructuring	•							

# STRUCTURES

	MECHANICAL ENTERPRISE	MECHANICAL PREMIUM	MECHANICAL PRO	AUTODYN	LS-DYNA	AIM		
<b>Explicit Dynamics</b>								
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				•				
<b>Durability</b>								
Stress-Life (SN)	•	•	•			•		
Strain-Life (EN)	•	•	•			•		
Dang Van	□ <sup>1</sup>	□ <sup>1</sup>	□ <sup>1</sup>					
Safety Factor	•	•	•			•		
Adhesive Bond	□ <sup>1</sup>	□ <sup>1</sup>	□ <sup>1</sup>					
Crack Growth Linear Fracture Mechanics	□ <sup>1</sup>	□ <sup>1</sup>	□ <sup>1</sup>					
Seam Weld	□ <sup>1</sup>	□ <sup>1</sup>	□ <sup>1</sup>					
Spot Weld	□ <sup>1</sup>	□ <sup>1</sup>	□ <sup>1</sup>					
Thermo-Mechanical Fatigue	□ <sup>1</sup>	□ <sup>1</sup>	□ <sup>1</sup>					
Vibration Fatigue	□ <sup>1</sup>	□ <sup>1</sup>	□ <sup>1</sup>					
Virtual Strain Gauge Correlation	□ <sup>1</sup>	□ <sup>1</sup>	□ <sup>1</sup>					
Python Scripting Customization	□ <sup>1</sup>	□ <sup>1</sup>	□ <sup>1</sup>					

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

# STRUCTURES

	MECHANICAL ENTERPRISE	MECHANICAL PREMIUM	MECHANICAL PRO	AUTODYN	LS-DYNA	AIM		
<b>Wave Hydrodynamics</b>								
Diffraction and Radiation	•							
Frequency & Time Domain Motions Analysis	•							
Moorings, Joints & Tethers	•							
Load Transfer to Structural Analysis	•							
<b>Thermal</b>								
Steady State Thermal	•	•	•			•		
Transient Thermal	•	•	•			•		
Conduction	•	•	•	•	•	•		
Convection	•	•	•			•		
Radiation to Space	•	•	•			•		
Radiation - Surface to Surface	•	•	•					
Phase Change	•	•	•	•	•			
Thermal Analysis of Layered Shells and Solids	•	•						
<b>Additional Physics</b>								
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	◻							



# STRUCTURES

	MECHANICAL ENTERPRISE	MECHANICAL PREMIUM	MECHANICAL PRO	AUTODYN	LS-DYNA	AIM		
<b>Optimization</b>								
DesignXplorer Included	•	•	•	□	□	•		
Parameters	•	•	•	•	•	•		
Design Point Studies	•	•	•	•	•	•		
Correlation Analysis	•	•	•	•		•		
Design of Experiments	•	•	•	•		•		
Sensitivity Analysis	•	•	•	•		•		
Goal Driven Optimization	•	•	•	•		•		
Six Sigma Analysis	•	•	•	•		•		
<b>Miscellaneous and Usability</b>								
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	•	•			•			
<b>HPC - Structures</b>								
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	□ <sup>6</sup> MAPDL - Yes Explicit - No RBD - No Aqwa - No	□ <sup>6</sup>	□ <sup>6</sup>					
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

# FLUIDS

	FLUENT	CFX	POLYFLOW	FORTE	FENSAP-ICE	AIM	CHEMKIN ENTERPRISE
<b>General Solver Capabilities</b>							
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	•						
<b>Single Phase, Non-Reacting Flows</b>							
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)	•	▲					

# FLUIDS

	FLUENT	CFX	POLYFLOW	FORTE	FENSAP-ICE	AIM	CHEMKIN ENTERPRISE
<b>Heat Transfer</b>							
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	•						
<b>Particles Flows (Multiphase)</b>							
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	•	•					
<b>Free Surface Flows (Multiphase)</b>							
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	•						

# FLUIDS

	FLUENT	CFX	POLYFLOW	FORTE	FENSAP-ICE	AIM	CHEMKIN ENTERPRISE
<b>Dispersed Multiphase Flows (Multiphase)</b>							
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)	•	•					
<b>Reacting Flows</b>							
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							•

# FLUIDS

	FLUENT	CFX	POLYFLOW	FORTE	FENSAP-ICE	AIM	CHEMKIN ENTERPRISE
<b>Turbomachinery</b>							
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		•					
<b>In-Flight Icing</b>							
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)					•		

# FLUIDS

	FLUENT	CFX	POLYFLOW	FORTE	FENSAP-ICE	AIM	CHEMKIN ENTERPRISE
<b>Optimization</b>							
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)	◻						
<b>High Rheology Material</b>							
Viscoelasticity			•				
Specialty Extrusion Models			•			▲	
Specialty Blow Molding Models			•			▲	
Specialty Fiber Spinning Models	•						
<b>HPC – Fluids</b>							
Parallel Solving on Local PC Option	•	•	•	•	•	•	•
Parallel Solving Over Network Option	•	•	•	•	•	•	
Parallel Solving Over Cloud Launched from Desktop	•						
GPU Support	•		•				
<b>Pre and Post Processing</b>							
Photo Realistic Rendering	•	•	•	•	•		•
SpaceClaim Direct Modeler	•	•	•	•	•	•	•
Compare Multiple Runs, Datasets, Physics, Graphs in a Single Window	•	•	•	•	•		•

# FLUIDS

	FLUENT	CFX	POLYFLOW	FORTE	FENSAP-ICE	AIM	CHEMKIN ENTERPRISE
<b>Multiphysics</b>							
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	•	•			•		
<b>Fluid-Structure Interaction</b>							
Force Induced Motion/Deformation	□	□	•			•	
Fluid Thermal Deformation	□	□				•	
<b>Electro-Thermal Interaction</b>							
Convection Cooled Electronics	•	•					
Conduction Cooled Electronics	•	•					
High Frequency Thermal Management	•	•					
Electromechanical Thermal Management	•	•					
<b>Other Coupled Interactions</b>							
Aero-Vibro Acoustics	•						
Acoustics-Structural	•	•					
Fluid Magnetohydrodynamics	•	•					
<b>Ease of Use and Productivity</b>							
Support ACT Extensions	•						
Mosaic-Enabled Meshing Technology	•						
Task-Based Workflow - Watertight Geometries	•						
Task-Based Workflow - Fault Tolerant (Beta)	•						
Directly Enter Expressions	•	•				•	

# ELECTRONICS

	MAXWELL	HFSS	SIwave	Q3D EXTRACTOR	ICEPAK	AIM		
<b>Low Frequency Electromagnetics</b>								
Electrostatics	•					•		
AC Conduction	•					•		
DC Conduction	•					•		
Magnetostatics	•					•		
Adaptive Field Mesh	•	•	•	•		•		
AC Harmonic Magnetic	•					•		
Electric Transient	•							
<b>Magnetic Transient</b>								
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	•							
<b>Advanced Magnetic Modeling</b>								
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 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	•							



# ELECTRONICS

	MAXWELL	HFSS	SIwave	Q3D EXTRACTOR	ICEPAK	AIM		
<b>High Frequency Electromagnetics</b>								
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		•						
<b>Continued on next page</b>								

# ELECTRONICS

	MAXWELL	HFSS	SIwave	Q3D EXTRACTOR	ICEPAK	AIM		
<b>High Frequency Electromagnetics (continued)</b>								
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 Controlled Parametrics		•						
3D Component with Encryption Creation		•						
3D Component with Encryption Utilization		•						

# ELECTRONICS

	MAXWELL	HFSS	SIwave	Q3D EXTRACTOR	ICEPAK	AIM		
<b>Power and Signal Integrity Board Simulation Capabilities</b>								
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)   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		•	•					

# ELECTRONICS

	MAXWELL	HFSS	SIwave	Q3D EXTRACTOR	ICEPAK	AIM		
<b>RLCG Parasitic Extraction</b>								
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				•				
<b>Electronics Cooling</b>								
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					•			

## ELECTRONICS

	MAXWELL	HFSS	SIwave	Q3D EXTRACTOR	ICEPAK	AIM		
<b>HPC for Electronics</b>								
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	•	•		•	•			
<b>SYSTEMS MODELING - ELECTRONIC PRODUCTS</b>								
<b>System Modeling for Power Electronics</b>								
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	•	•	•	•	•			
<b>System Modeling for RF/Microwave</b>								
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		□						

## ELECTRONICS

	MAXWELL	HFSS	SIwave	Q3D EXTRACTOR	ICEPAK	AIM		
<b>System Modeling for SI/PI</b>								
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		□	•					
<b>MULTIPHYSICS</b>								
<b>Platform Technologies</b>								
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	•	•		•	•			
<b>Electro-Thermal Interaction</b>								
Convection Cooled Electronics		•			•			
Conduction Cooled Electronics		•			•			
High Frequency Thermal Management		•		•	•			
Electromechanical Thermal Management	•			•	•			
<b>Miscellaneous</b>								
Integrated Windows HPC Support	•	•	•	•	•			
Integrated IBM Spectrum LSF Support	•	•	•	•	•			
Customizable 3rd Party Scheduler Support	•	•	•	•	•			
Support ACT Extensions	▲	▲	▲	▲	▲	▲		

# SYSTEMS & EMBEDDED SOFTWARE

	TWIN BUILDER	medini ANALYZE	ARCHITECT	SCADE SUITE	SCADE DISPLAY	VRXPERIENCE		
<b>System Simulation, Validation and Digital Twins</b>								
Integrated Graphical Modeling Environment	•							
Standard Modeling Languages and Exchange Formats	•							
Multi-Domain Systems Modeler	•							
Extensive OD 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	•							
<b>Functional Safety Analysis</b>								
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		•						

# SYSTEMS & EMBEDDED SOFTWARE

	TWIN BUILDER	medini ANALYZE	ARCHITECT	SCADE SUITE	SCADE DISPLAY	VRXPERIENCE		
<b>Model-based Systems Engineering</b>								
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			•	•				
<b>Embedded Control Software Development</b>								
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				•				



# SYSTEMS & EMBEDDED SOFTWARE

	TWIN BUILDER	medini ANALYZE	ARCHITECT	SCADE SUITE	SCADE DISPLAY	VRXPERIENCE		
<b>Man-Machine Interface Software</b>								
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					•			
<b>VRXPERIENCE</b>								
<b>Photometry</b>								
Illuminance						•		
Luminance						•		
3D Illuminance						•		
<b>Human Vision</b>								
Glare Simulation						•		
<b>Optical Sensors</b>								
Ground-Truth sensor						•		
Camera Sensor						•		
LiDAR Sensor						▲		
Sensor Fusion						◻		
<b>Head-up Display</b>								
HUD Visualisation						•		

# SYSTEMS & EMBEDDED SOFTWARE

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

# SYSTEMS & EMBEDDED SOFTWARE

	TWIN BUILDER	medini ANALYZE	ARCHITECT	SCADE SUITE	SCADE DISPLAY	VRXPERIENCE		
<b>Experience</b>								
Trigger & Animation						•		
Physics Engine - Collision & Kinematics						•		
Hard & Soft Switches Interaction						•		
<b>Engine / Solver Embedded or Interface</b>								
Variation Engine (Aesthetica)						•		
System Co-Simulation						□		
Sensor Data Fusion Co-Simulation Display Content Co-Simulation						□		
<b>Acoustics Sounds</b>								
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)						•		

## 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		•						

## DESIGN TOOLS

	DISCOVERY ESSENTIALS	DISCOVERY STANDARD	DISCOVERY ULTIMATE					
<b>Structural</b>								
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 Analysis			•					
Basic Plasticity			•					
Large Deformation			•					
Fatigue Analysis			•					
Topology Optimization		•	•					
<b>Fluid</b>								
Steady-State Flow		•	•					
Transient Flow		•	•					
Time-dependent Fluid Conditions			•					
Incompressible Flow			•					
Compressible Flow <sup>1</sup>		▲	•					
Non-Newtonian Fluids			•					
Periodic Domains			•					
Porous Media			•					
Particle Flow			•					
<b>Thermal</b>								
Steady State Thermal		•	•					
Transient Thermal		•	•					
Time Dependent Thermal Conditions			•					
Conduction		•	•					
Convection		•	•					
Radiation to Space			•					

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

## DESIGN TOOLS

	DISCOVERY ESSENTIALS	DISCOVERY STANDARD	DISCOVERY ULTIMATE					
<b>3-D Printing<sup>2</sup></b>								
Import, Repair, Edit Faceted Data	•	•	•					
Shelling and Infills	•	•	•					
Thickness Eetection	•	•	•					
<b>Reverse Engineering</b>								
Autosurface of Scanned Data	•	•	•					
Build Solid/Surfaces on Scanned Data	•	•	•					
<b>Interfaces and Add-ons</b>								
Algorx Momentum <sup>3</sup>	•	•	•					
Keyshot Rendering <sup>3</sup>	•	•	•					
(1) Discovery Live supports mildly compressible fluid flow up to ~Mach 0.3								
(2) Included with Discovery Standard and Ultimate								
(3) Add-on Module"								

<b>ADDITIVE SOLUTIONS</b>	<b>ADDITIVE PRINT</b>	<b>ADDITIVE SUITE*</b>	<b>MECHANICAL ENTERPRISE</b>					
<b>Topology and Lattice Optimization</b>								
Structural Optimization			•					
Modal Optimization			•					
Thermal Loads			•					
Inertial Loads			•					
Optimized Design Validation			•					
Manufacturing Constraints			•					
Stress Constraints			•					
Symmetry			•					
Lattice Optimization		•	□					
Overhang/Additive Constraints		•	□					
<b>Geometry and STL File Handling</b>								
SpaceClaim Direct Modeler	•	•	•					
<b>Workbench Additive</b>								
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		•						



ADDITIVE SOLUTIONS	ADDITIVE PRINT	ADDITIVE SUITE*	MECHANICAL ENTERPRISE					
<b>Additive Print</b>								
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	•	•						
<b>Additive Science</b>								
Nonlinear and Temperature Dependent Material Properties		•						
Meltpool Dimensions		•						
Detailed Thermal History		▲						
% Porosity		•						
Sensor Measurement Predictions		▲						
* Additive Suite requires a Mechanical Enterprise license								

# OPTICAL

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

# OPTICAL

SPEOS								
<b>Head-up Display</b>								
HUD Optical Analysis	•							
HUD Optical Design	•							
HUD Visualisation	•							
<b>Manufacturing Variation</b>								
Target Specification	•							
Tolerance Study	•							
<b>Solver</b>								
Multi-Threading	•							
Highly Scalable HPC	•							
<b>Add-on Features</b>								
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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