

COMSOL® Software – Release Highlights History

COMSOL Multiphysics® Software							
Geometry and Mesh	4.2-4	5.0-3	5.4	5.5	5.6	6.0	6.1
Virtual geometry operations	✓	✓	✓	✓	✓	✓	✓
Image import	✓	✓	✓	✓	✓	✓	✓
STL export	✓	✓	✓	✓	✓	✓	✓
NASTRAN® program mesh export	✓	✓	✓	✓	✓	✓	✓
Loft, fillet, chamfer, thickening, and midsurfacing with the Design Module		✓	✓	✓	✓	✓	✓
New tetrahedral mesher		✓	✓	✓	✓	✓	✓
Element quality optimizer		✓	✓	✓	✓	✓	✓
Performance improvements for large models by a factor of 5 or more		✓	✓	✓	✓	✓	✓
Automatic removal of geometric detail for more flexible meshing		✓	✓	✓	✓	✓	✓
Automatic pyramid transitions from hex to tet elements		✓	✓	✓	✓	✓	✓
Parametric models with user-defined functions		✓	✓	✓	✓	✓	✓
Extended mesh adaption and refinement for all element types and imported meshes			✓	✓	✓	✓	✓
New sketching tools for 2D drawings				✓	✓	✓	✓
Dimensions and constraints for new sketch tools with Design Module				✓	✓	✓	✓
Associative geometry import				✓	✓	✓	✓
Direct Meshing of imported surface meshes				✓	✓	✓	✓
Import and export 3MF and PLY file formats				✓	✓	✓	✓
Editing of imported meshes					✓	✓	✓
Organize geometry objects and operations in groups						✓	✓
Construction geometry for easier geometry creation						✓	✓
Offset and thicken for curves in 2D						✓	✓
Union and boundary layer operations for imported meshes						✓	✓
Mesh repair for misaligned CAD models							✓

*4.2-4 includes 4.2, 4.2a, 4.3, 4.3a, 4.3b, and 4.4 versions.

*5.0-3 includes 5.0, 5.0.1, 5.1, 5.2, 5.2a, 5.3, and 5.3a versions.

Modeling Tools	4.2-4	5.0-3	5.4	5.5	5.6	6.0	6.1
Coordinate-based selections	✓	✓	✓	✓	✓	✓	✓
Automatic curvilinear coordinate systems	✓	✓	✓	✓	✓	✓	✓
New COMSOL Desktop® environment	✓	✓	✓	✓	✓	✓	✓
Material sweeps		✓	✓	✓	✓	✓	✓
Open and inspect MPH-files without add-on licenses		✓	✓	✓	✓	✓	✓
Autocomplete for parameters, variables, and equations		✓	✓	✓	✓	✓	✓
Model methods for programming Model Builder tasks		✓	✓	✓	✓	✓	✓
PDE modeling with the boundary element method (BEM)		✓	✓	✓	✓	✓	✓
Copy-paste physics interfaces or model components		✓	✓	✓	✓	✓	✓
Model methods in the model tree with input arguments		✓	✓	✓	✓	✓	✓
Colored selections for geometry and physics			✓	✓	✓	✓	✓
Multiple Parameter nodes and Parameter Cases			✓	✓	✓	✓	✓
Node groups for organizing the model tree			✓	✓	✓	✓	✓
Custom settings windows			✓	✓	✓	✓	✓
Clip planes for easier selection inside complex CAD models					✓	✓	✓
Context menus in the graphics window					✓	✓	✓
New Find and Replace tool							✓
Studies and Solvers	4.2-4	5.0-3	5.4	5.5	5.6	6.0	6.1
Time-dependent adaptive meshing	✓	✓	✓	✓	✓	✓	✓
Automatic remeshing	✓	✓	✓	✓	✓	✓	✓
Cluster sweeps and cloud computing	✓	✓	✓	✓	✓	✓	✓
Multiparameter sweeps	✓	✓	✓	✓	✓	✓	✓
Smoothed AMG solver		✓	✓	✓	✓	✓	✓
Optimized domain decomposition solver		✓	✓	✓	✓	✓	✓
Model reduction based on modal analysis and asymptotic waveform evaluation (AWE)		✓	✓	✓	✓	✓	✓
Algebraic multigrid (AMG) solver for CFD		✓	✓	✓	✓	✓	✓
Combine two solutions into one		✓	✓	✓	✓	✓	✓
Direct and iterative solver suggestions		✓	✓	✓	✓	✓	✓

Several times faster solving in the Windows® operating system			✓	✓	✓	✓	✓
Parameter sweeps over Parameter Cases				✓	✓	✓	✓
Optimization for parametric sweeps with derivative-free methods				✓	✓	✓	✓
Distributed solution data storage on clusters				✓	✓	✓	✓
Multigrid performance improvements on clusters				✓	✓	✓	✓
New IPOPT optimization solver					✓	✓	✓
Craig-Bampton method for model reduction						✓	✓
Results and Visualization	4.2-4	5.0-3	5.4	5.5	5.6	6.0	6.1
Report Generator	✓	✓	✓	✓	✓	✓	✓
Interactive slice and isosurface plots	✓	✓	✓	✓	✓	✓	✓
Reports on Microsoft® Word® program format	✓	✓	✓	✓	✓	✓	✓
2D and 3D annotations		✓	✓	✓	✓	✓	✓
1D annotations		✓	✓	✓	✓	✓	✓
Annotations with LaTeX formatting		✓	✓	✓	✓	✓	✓
VTK format export		✓	✓	✓	✓	✓	✓
6 new color tables		✓	✓	✓	✓	✓	✓
Selections for plotting a subset of the geometry		✓	✓	✓	✓	✓	✓
1D plots with two different quantities on y-axes		✓	✓	✓	✓	✓	✓
Step between solutions using toolbar buttons		✓	✓	✓	✓	✓	✓
3Dconnexion® SpaceMouse® device support		✓	✓	✓	✓	✓	✓
Cividis color table for people with color vision deficiency		✓	✓	✓	✓	✓	✓
Save plots in models for faster rendering		✓	✓	✓	✓	✓	✓
Export animations in the WebM video format		✓	✓	✓	✓	✓	✓
Arrows on streamlines			✓	✓	✓	✓	✓
Evaluation groups			✓	✓	✓	✓	✓
glTF™ file export			✓	✓	✓	✓	✓
Report templates			✓	✓	✓	✓	✓
Animated spheres and arrows on Streamline plots				✓	✓	✓	✓
Link from PowerPoint® to import COMSOL® model images				✓	✓	✓	✓

PLY and 3MF export of plots				✓	✓	✓	✓
Realistic material rendering of plastics, metals, and organic materials					✓	✓	✓
Partial transparency in visualizations					✓	✓	✓
New and improved color tables, including logarithmic scale						✓	✓
Ambient occlusion and transparency with Fresnel transmittance						✓	✓
Generate reports as Microsoft® PowerPoint® presentations						✓	✓
Direct shadows visual effect							✓
Interface for Microsoft® Word							✓
Application Builder	4.2-4	5.0-3	5.4	5.5	5.6	6.0	6.1
NEW Workspace: Application Builder		✓	✓	✓	✓	✓	✓
Send email from applications		✓	✓	✓	✓	✓	✓
50+ demo applications in the Application Libraries		✓	✓	✓	✓	✓	✓
Interactive data picking in graphics		✓	✓	✓	✓	✓	✓
OS command line arguments			✓	✓	✓	✓	✓
Local declarations and methods in forms			✓	✓	✓	✓	✓
NEW Product: COMSOL Compiler™			✓	✓	✓	✓	✓
Add-ins to COMSOL Multiphysics				✓	✓	✓	✓
Templates for standardized layouts for desktops, tablets, and smartphones					✓	✓	✓
Control knob form object					✓	✓	✓
Interactive design of menus and ribbon toolbars						✓	✓
Resizable and detachable subwindows							✓
Model Manager	4.2-4	5.0-3	5.4	5.5	5.6	6.0	6.1
NEW Workspace: Model Manager						✓	✓
Organize models and apps, access and version control						✓	✓
Asset management with web browser access						✓	✓
Version control of reports and CAD assemblies							✓

COMSOL Multiphysics® Platform and Hardware Support	4.2-4	5.0-3	5.4	5.5	5.6	6.0	6.1
General Windows®, macOS, and Linux® operating system support	✓	✓	✓	✓	✓	✓	✓
Run apps on all major web browsers		✓	✓	✓	✓	✓	✓
Windows® 10 operating system support		✓	✓	✓	✓	✓	✓
3Dconnexion® SpaceMouse® device support		✓	✓	✓	✓	✓	✓
Windows® 11 operating system support						✓	✓
macOS operating system support on M-series processors						✓	✓
Linux operating system support on ARMv8 processors							✓

COMSOL Server™ Product	4.2-4	5.0-3	5.4	5.5	5.6	6.0	6.1
NEW Product: COMSOL Server™		✓	✓	✓	✓	✓	✓
Run apps with COMSOL Client for Windows® operating system or web browsers		✓	✓	✓	✓	✓	✓
Allow coworkers and customers worldwide to run COMSOL applications		✓	✓	✓	✓	✓	✓
Custom COMSOL Server™ themes for branding		✓	✓	✓	✓	✓	✓
Centralized cluster settings		✓	✓	✓	✓	✓	✓
Usage log text file		✓	✓	✓	✓	✓	✓
Automatic login to COMSOL Server™		✓	✓	✓	✓	✓	✓
Live search in the Application Library page			✓	✓	✓	✓	✓
Send notifications to users as email			✓	✓	✓	✓	✓
Updated appearance with new colors				✓	✓	✓	✓
Automatically release licenses when software is idle				✓	✓	✓	✓

ELECTROMAGNETICS	4.2-4	5.0-3	5.4	5.5	5.6	6.0	6.1
Lumped ports and R,L,C,S parameter matrices	✓	✓	✓	✓	✓	✓	✓
Multiphysics interface for electrostatic-structural interactions	✓	✓	✓	✓	✓	✓	✓
Multiphysics interface for piezoresistivity	✓	✓	✓	✓	✓	✓	✓
Inductively coupled and microwave plasmas	✓	✓	✓	✓	✓	✓	✓
NEW Product: Wave Optics Module	✓	✓	✓	✓	✓	✓	✓

ELECTROMAGNETICS	4.2-4	5.0-3	5.4	5.5	5.6	6.0	6.1
NEW Product: Semiconductor Module	✓	✓	✓	✓	✓	✓	✓
Nonlinear magnetic material library with 160 materials	✓	✓	✓	✓	✓	✓	✓
Multiphysics interface for laser heating	✓	✓	✓	✓	✓	✓	✓
Multiphysics interface for optoelectronics		✓	✓	✓	✓	✓	✓
NEW Product: Ray Optics Module		✓	✓	✓	✓	✓	✓
Coil analysis tools		✓	✓	✓	✓	✓	✓
Optical materials database with over 1400 materials		✓	✓	✓	✓	✓	✓
Multiphysics interface for ray heating		✓	✓	✓	✓	✓	✓
User-defined materials written in C		✓	✓	✓	✓	✓	✓
Smith plots		✓	✓	✓	✓	✓	✓
Magnetic vector hysteresis material model		✓	✓	✓	✓	✓	✓
Optical aberration plots		✓	✓	✓	✓	✓	✓
Electrostatics based on the boundary element method (BEM)		✓	✓	✓	✓	✓	✓
Accelerated computation of capacitance matrix and other lumped matrices		✓	✓	✓	✓	✓	✓
Part Library with waveguides, surface-mount footprints, and SMA connectors		✓	✓	✓	✓	✓	✓
Photometric data file import for ray optics		✓	✓	✓	✓	✓	✓
Schrödinger equation interfaces		✓	✓	✓	✓	✓	✓
Revolutionary new method for capacitively coupled plasma (CCP) simulations		✓	✓	✓	✓	✓	✓
Hybrid boundary-element-finite-element method (BEM-FEM) for magnetic field analysis		✓	✓	✓	✓	✓	✓
Soft magnet material model of permanent magnets		✓	✓	✓	✓	✓	✓
Adaptive frequency sweep for high-frequency electromagnetics		✓	✓	✓	✓	✓	✓
Library of more than 60 RF and microwave substrate materials from Rogers Corporation		✓	✓	✓	✓	✓	✓
Electric currents in layered shells			✓	✓	✓	✓	✓
Part Library for coils and magnetic cores			✓	✓	✓	✓	✓
Far-field analysis for transient models			✓	✓	✓	✓	✓
High-definition Part Library for ray optics			✓	✓	✓	✓	✓
Optical dispersion models for ray optics			✓	✓	✓	✓	✓
New algorithm for computing ray intensity and power			✓	✓	✓	✓	✓

ELECTROMAGNETICS	4.2-4	5.0-3	5.4	5.5	5.6	6.0	6.1
Wavelength distributions at ray releases for polychromatic light			✓	✓	✓	✓	✓
Multiphysics interface for Schrödinger-Poisson Equation			✓	✓	✓	✓	✓
Lorentz coupling multiphysics for electroacoustic transducers				✓	✓	✓	✓
Hard magnetic materials library for permanent magnets				✓	✓	✓	✓
Full-wave and ray optics simulation coupling				✓	✓	✓	✓
Mixed-mode S-parameters				✓	✓	✓	✓
Spot Diagram plot				✓	✓	✓	✓
New interface for detecting electrical breakdown				✓	✓	✓	✓
New tools for corona discharge in electrostatic precipitators				✓	✓	✓	✓
Density-gradient formulation for semiconductor device simulations				✓	✓	✓	✓
Parasitic inductance computations with L-matrix extraction					✓	✓	✓
Material models for laminated iron cores used in motors and transformers					✓	✓	✓
Ferroelectric material model for electrostatics					✓	✓	✓
Faster ray tracing, scattering in domains and from surfaces for ray optics					✓	✓	✓
Computation of frequency-dependent resistance and inductance matrices for PCBs						✓	✓
Adaptive and physics-controlled meshing for microwave and mmWave circuits on PCBs						✓	✓
Hybrid boundary-element-finite-element method (BEM-FEM) for antennas and electromagnetic wave propagation						✓	✓
Composite electromagnetic shielding materials						✓	✓
Nonlinear magnetic materials for RF and microwave components						✓	✓
New tools for electric motors including a Part Library and efficient torque calculations						✓	✓
Magnetomechanics analysis for strongly coupled structural and magnetic multiphysics simulations						✓	✓
Optical material library with glasses from leading manufacturers						✓	✓
Electric circuit extraction							✓
Motor winding layouts and magnet arrays							✓
Multiphysics interface for magnetohydrodynamics simulations							✓
Liquid metal material library for magnetohydrodynamics							✓
Electric discharge simulations							✓

ELECTROMAGNETICS	4.2-4	5.0-3	5.4	5.5	5.6	6.0	6.1
Efficient modeling of periodic structures for electromagnetic waves							✓
Fluence rate calculations for ray optics							✓
Combined inductively and capacitively coupled plasmas (RF bias)							✓

HEAT TRANSFER	4.2-4	5.0-3	5.4	5.5	5.6	6.0	6.1
Multilayered shells	✓	✓	✓	✓	✓	✓	✓
Fans and grilles	✓	✓	✓	✓	✓	✓	✓
Solar irradiation	✓	✓	✓	✓	✓	✓	✓
Moist air and condensation	✓	✓	✓	✓	✓	✓	✓
Multiwavelength radiation	✓	✓	✓	✓	✓	✓	✓
Phase change	✓	✓	✓	✓	✓	✓	✓
Thermal contact with surface roughness	✓	✓	✓	✓	✓	✓	✓
Multiphysics interface for the thermoelectric effect	✓	✓	✓	✓	✓	✓	✓
Bioheating with damage integral analysis	✓	✓	✓	✓	✓	✓	✓
Nonisothermal flow in porous media		✓	✓	✓	✓	✓	✓
Algebraic turbulence models		✓	✓	✓	✓	✓	✓
Multiphysics interface for the Marangoni effect		✓	✓	✓	✓	✓	✓
Meteorological database for ambient conditions		✓	✓	✓	✓	✓	✓
Multiphysics interface for heat and moisture transport		✓	✓	✓	✓	✓	✓
Surface-to-surface radiation symmetry for perpendicular planes		✓	✓	✓	✓	✓	✓
Irreversible transformations in solids		✓	✓	✓	✓	✓	✓
New Moisture Flow multiphysics coupling		✓	✓	✓	✓	✓	✓
New inflow boundary condition based on known upstream conditions		✓	✓	✓	✓	✓	✓
Beer-Lambert law for absorption of light in weakly absorbing media		✓	✓	✓	✓	✓	✓
Mixed diffuse-specular reflections and semitransparent surfaces			✓	✓	✓	✓	✓
Heat transfer in thin, layered structures			✓	✓	✓	✓	✓
Arbitrary number of spectral bands for surface-to-surface radiation			✓	✓	✓	✓	✓

HEAT TRANSFER	4.2-4	5.0-3	5.4	5.5	5.6	6.0	6.1
Light-diffusion equation interface			✓	✓	✓	✓	✓
Thermal insulation for interior boundaries			✓	✓	✓	✓	✓
Ambient Thermal Properties tool			✓	✓	✓	✓	✓
Dedicated plots for temperature discontinuities			✓	✓	✓	✓	✓
NEW Product: Metal Processing Module				✓	✓	✓	✓
Lumped Thermal System interface				✓	✓	✓	✓
Multiple spectral bands for radiation in participating media				✓	✓	✓	✓
Surface-to-Surface radiation with ray shooting method				✓	✓	✓	✓
Multiphysics coupling for heat transfer in thin structures				✓	✓	✓	✓
Directional surface properties for heat radiation					✓	✓	✓
Phase change interfaces					✓	✓	✓
10x increased efficiency in solving surface-to-surface radiation						✓	✓
Multiscale modeling of heat transfer in pellet beds						✓	✓
Radiative loads on satellites in orbit							✓
Easier coupling of shells and solids in heat transfer models							✓

STRUCTURAL MECHANICS	4.2-4	5.0-3	5.4	5.5	5.6	6.0	6.1
Prestressed analysis	✓	✓	✓	✓	✓	✓	✓
Thin-film damping for MEMS	✓	✓	✓	✓	✓	✓	✓
NEW Product: Geomechanics Module	✓	✓	✓	✓	✓	✓	✓
Multiphysics interface for MEMS thermoelasticity	✓	✓	✓	✓	✓	✓	✓
Load cases	✓	✓	✓	✓	✓	✓	✓
Membranes	✓	✓	✓	✓	✓	✓	✓
Cyclic and Floquet periodicity	✓	✓	✓	✓	✓	✓	✓
NEW Product: Nonlinear Structural Materials Module	✓	✓	✓	✓	✓	✓	✓
NEW Product: Fatigue Module	✓	✓	✓	✓	✓	✓	✓
Bolt pretension	✓	✓	✓	✓	✓	✓	✓
NEW Product: Multibody Dynamics Module	✓	✓	✓	✓	✓	✓	✓

STRUCTURAL MECHANICS	4.2-4	5.0-3	5.4	5.5	5.6	6.0	6.1
Rotordynamic forces	✓	✓	✓	✓	✓	✓	✓
Multiphysics interface for hygroscopic swelling		✓	✓	✓	✓	✓	✓
Nonlinear elastic materials		✓	✓	✓	✓	✓	✓
Orthotropic, anisotropic, and hyperelastic membranes		✓	✓	✓	✓	✓	✓
Multiphysics interfaces for multibody dynamics with heat transfer and acoustics		✓	✓	✓	✓	✓	✓
NEW Product: Rotordynamics Module		✓	✓	✓	✓	✓	✓
Multiphysics interface for thermoelastic damping in MEMS		✓	✓	✓	✓	✓	✓
User-defined materials written in C		✓	✓	✓	✓	✓	✓
Adhesion and decohesion for mechanical contact		✓	✓	✓	✓	✓	✓
Multiphysics interface for magnetostriction		✓	✓	✓	✓	✓	✓
New plasticity material models		✓	✓	✓	✓	✓	✓
Stress linearization evaluation of membrane, bending, and peak stress		✓	✓	✓	✓	✓	✓
Automatic suppression of rigid body motion		✓	✓	✓	✓	✓	✓
Computation of safety factors for 12 safety criteria		✓	✓	✓	✓	✓	✓
Frequency response of mechanical contact models		✓	✓	✓	✓	✓	✓
Material models for porous plasticity		✓	✓	✓	✓	✓	✓
Vibration fatigue analysis		✓	✓	✓	✓	✓	✓
Rotor bearing system simulator application		✓	✓	✓	✓	✓	✓
Shape memory alloy (SMA) material models		✓	✓	✓	✓	✓	✓
Generalized multiphysics interface for fluid-structure interaction (FSI)		✓	✓	✓	✓	✓	✓
Bolt thread contact modeling		✓	✓	✓	✓	✓	✓
Solid-beam connection in 3D models		✓	✓	✓	✓	✓	✓
Generalized plane strain formulation		✓	✓	✓	✓	✓	✓
Cam-Follower condition for multibody dynamics		✓	✓	✓	✓	✓	✓
Lumped Mechanical System interface		✓	✓	✓	✓	✓	✓
Ball and roller bearings for rotordynamics simulations		✓	✓	✓	✓	✓	✓
NEW Product: Composite Materials Module			✓	✓	✓	✓	✓
Composite material analysis based on layerwise and equivalent single layer theory			✓	✓	✓	✓	✓

STRUCTURAL MECHANICS	4.2-4	5.0-3	5.4	5.5	5.6	6.0	6.1
Response spectrum analysis			✓	✓	✓	✓	✓
Representative volume elements (RVE) for homogenization of periodic materials			✓	✓	✓	✓	✓
Shell interface for axisymmetric analysis			✓	✓	✓	✓	✓
Multiphysics interface for fluid-structure interaction with shells , membranes, and composite materials			✓	✓	✓	✓	✓
Multiphysics interface for fluid-structure interaction with structural assemblies and multibody dynamics			✓	✓	✓	✓	✓
Multiphysics interface for acoustic-structure interaction for composite materials			✓	✓	✓	✓	✓
Multiphysics interface for thermal expansion in composite materials			✓	✓	✓	✓	✓
Multiphysics interface for Joule heating in composite materials			✓	✓	✓	✓	✓
Multiphysics interface for thermoelectric effect in composite materials			✓	✓	✓	✓	✓
Activation of material for additive manufacturing			✓	✓	✓	✓	✓
Flexible formulation for rigid connectors and attachments			✓	✓	✓	✓	✓
Mullins effect for hyperelastic materials			✓	✓	✓	✓	✓
Continuum-based damage model for brittle materials			✓	✓	✓	✓	✓
New modeling options for hyperelastic materials with low compressibility			✓	✓	✓	✓	✓
Mean stress correction for fatigue analysis based on the Goodman, Gerber, and Soderberg methods			✓	✓	✓	✓	✓
Multiphysics interface for electromechanics with structural FEM and electrostatics BEM			✓	✓	✓	✓	✓
Contact modeling extended to Shell, Layered Shell, and Membrane interfaces				✓	✓	✓	✓
Random vibration analysis				✓	✓	✓	✓
Nonlinear materials in Shell and Layered Shell interfaces				✓	✓	✓	✓
Multiphysics interface for FSI with heat transfer				✓	✓	✓	✓
FSI for two-phase flow				✓	✓	✓	✓
Mechanical analysis of pipes				✓	✓	✓	✓
Piezoelectric material in layered shells				✓	✓	✓	✓
Roller chain sprocket modeling				✓	✓	✓	✓
Automatic setup of rigid domains and gears				✓	✓	✓	✓
Mechanical contact: transient contact and wear modeling					✓	✓	✓
Crack modeling and phase-field-based damage simulation					✓	✓	✓
Poroelasticity in composite shells					✓	✓	✓

STRUCTURAL MECHANICS	4.2-4	5.0-3	5.4	5.5	5.6	6.0	6.1
Embedded reinforcements for anchors, rebars, and wire meshes					✓	✓	✓
Automatic generation of joints for multibody dynamics					✓	✓	✓
Rigid body contact					✓	✓	✓
Active magnetic bearings for rotordynamics					✓	✓	✓
Ferroelectric elasticity					✓	✓	✓
Nonlinear piezoelectricity with hysteresis					✓	✓	✓
10x faster solving for creep and faster solving for nonlinear structural materials						✓	✓
Easier modeling of mechanical contact with automated generation of pairs and contact conditions						✓	✓
Reduced-order modeling with component mode synthesis (CMS)						✓	✓
Improved modeling of shells in imported CAD assemblies						✓	✓
Fatigue evaluation for random vibrations						✓	✓
Contact with friction in crack modeling						✓	✓
Fiber-reinforced linear elastic materials						✓	✓
Wrinkling in membranes						✓	✓
Faster and more robust contact for solids, shells, and membranes, including full support for self-contact							✓
Nonlinear materials in thin layers for the analysis of gaskets and adhesive layers							✓
Weld evaluation for joined structural shells							✓
Numerical testing of material models							✓
Analysis of cable or wire systems							✓
Wear analysis for shells and membranes							✓
Shear force and moment diagrams for beams							✓
Modeling of pyroelectricity							✓

ACOUSTICS	4.2-4	5.0-3	5.4	5.5	5.6	6.0	6.1
Multiphysics interface for acoustic-piezo interactions	✓	✓	✓	✓	✓	✓	✓
Multiphysics interface for acoustic-shell interactions	✓	✓	✓	✓	✓	✓	✓
Multiphysics interface for poroelastic waves	✓	✓	✓	✓	✓	✓	✓
Multiphysics interface for thermoviscous acoustic-solid interactions	✓	✓	✓	✓	✓	✓	✓
Multiphysics interface for pipe acoustics	✓	✓	✓	✓	✓	✓	✓
Multiphysics interface for membrane-acoustic interactions	✓	✓	✓	✓	✓	✓	✓
Multiphysics interface for thermoviscous acoustic-shell interactions	✓	✓	✓	✓	✓	✓	✓
Aeroacoustics with linearized Euler equations	✓	✓	✓	✓	✓	✓	✓
Ray acoustics		✓	✓	✓	✓	✓	✓
Aeroacoustics with linearized Navier-Stokes equations		✓	✓	✓	✓	✓	✓
Octave plots		✓	✓	✓	✓	✓	✓
Discontinuous Galerkin method for ultrasound with background flow		✓	✓	✓	✓	✓	✓
Directivity plots		✓	✓	✓	✓	✓	✓
Perfectly matched layers (PMLs) for pressure acoustics in the time domain		✓	✓	✓	✓	✓	✓
Beam width calculations for far-field plots		✓	✓	✓	✓	✓	✓
Thermoviscous acoustics in the time domain		✓	✓	✓	✓	✓	✓
Hybrid BEM-FEM for acoustics and acoustic-structure interactions		✓	✓	✓	✓	✓	✓
Impulse response analysis for ray acoustics		✓	✓	✓	✓	✓	✓
Port boundary conditions for pressure acoustics			✓	✓	✓	✓	✓
Nonlinear acoustics Westervelt model for high sound pressure levels			✓	✓	✓	✓	✓
Atmosphere and ocean attenuation material models			✓	✓	✓	✓	✓
Multiphysics BEM-FEM coupling to thermoviscous acoustics and poroelastic waves			✓	✓	✓	✓	✓
Multiphysics BEM-FEM coupling to poroelastic waves			✓	✓	✓	✓	✓
New Elastic Waves, Time Explicit interface				✓	✓	✓	✓
Acoustic-structure interaction for time explicit interfaces				✓	✓	✓	✓
Ports for thermoviscous acoustics				✓	✓	✓	✓
Background fluid flow coupling and mapping study for aeroacoustics				✓	✓	✓	✓
New solvers for large frequency-domain acoustic problems				✓	✓	✓	✓

ACOUSTICS	4.2-4	5.0-3	5.4	5.5	5.6	6.0	6.1
Acoustic-Pipe Acoustic Connection multiphysics coupling				✓	✓	✓	✓
Nonlinear acoustics for high-intensity ultrasound					✓	✓	✓
Sound distortion in mobile device loudspeakers due to nonlinear thermoviscous effects					✓	✓	✓
Mechanical port conditions for analyzing vibration paths and mechanical feedback					✓	✓	✓
New boundary element method (BEM) formulation for large scattering models, including sonar applications					✓	✓	✓
Room acoustics metrics including reverberation time, definition, and clarity using ray acoustics					✓	✓	✓
Faster impulse response for ray acoustics					✓	✓	✓
Waveform Audio File Format (.wav) export					✓	✓	✓
Multiphysics interface for piezoelectric waves using a time-explicit method						✓	✓
Flow-induced noise with large eddy simulation (LES) CFD						✓	✓
Physics-controlled mesh functionality for pressure acoustics						✓	✓
High-frequency pressure acoustics interfaces for scattering and radiation						✓	✓
Easy-to-use perfectly matched boundary radiation condition						✓	✓
Mode analysis on cross sections for aeroacoustics						✓	✓
Up to 40% faster solver for elastic-acoustic waves and more than 2 billion degrees of freedom							✓
Acoustic streaming for acoustically driven fluid flow							✓
Lumped boundary and port features for thermoviscous acoustics in microtransducers							✓
Thermoviscous acoustic damping of MEMS devices							✓
Explicit solvers for combining piezoelectricity, structural mechanics, acoustics, and fluid flow							✓
Fracture boundary condition for elastic waves							✓

FLUID FLOW	4.2-4	5.0-3	5.4	5.5	5.6	6.0	6.1
High Mach number flow	✓	✓	✓	✓	✓	✓	✓
NEW Product: Microfluidics Module	✓	✓	✓	✓	✓	✓	✓
k-omega turbulence model	✓	✓	✓	✓	✓	✓	✓
Euler-Euler two-phase flow	✓	✓	✓	✓	✓	✓	✓
Slip flow	✓	✓	✓	✓	✓	✓	✓
NEW Product: Pipe Flow Module	✓	✓	✓	✓	✓	✓	✓

FLUID FLOW	4.2-4	5.0-3	5.4	5.5	5.6	6.0	6.1
Automatic boundary layer meshing	✓	✓	✓	✓	✓	✓	✓
Turbulent mixing and reacting flow	✓	✓	✓	✓	✓	✓	✓
SST turbulence	✓	✓	✓	✓	✓	✓	✓
Thin screens	✓	✓	✓	✓	✓	✓	✓
NEW Product: Molecular Flow Module	✓	✓	✓	✓	✓	✓	✓
Wall surface roughness for turbulent flow	✓	✓	✓	✓	✓	✓	✓
Anisotropic porous media flow	✓	✓	✓	✓	✓	✓	✓
NEW Product: Mixer Module	✓	✓	✓	✓	✓	✓	✓
Algebraic turbulence models		✓	✓	✓	✓	✓	✓
Turbulence with grilles and fans		✓	✓	✓	✓	✓	✓
Cavitation for thin film flow		✓	✓	✓	✓	✓	✓
3D laminar flow to 1D pipe flow connection		✓	✓	✓	✓	✓	✓
Coupled porous media and turbulent flow		✓	✓	✓	✓	✓	✓
Three-phase laminar flow		✓	✓	✓	✓	✓	✓
Easy definition of gravity and buoyancy effects		✓	✓	✓	✓	✓	✓
v2-f turbulence model		✓	✓	✓	✓	✓	✓
Automatic wall treatment for turbulent flow		✓	✓	✓	✓	✓	✓
Algebraic multigrid (AMG) solver for CFD		✓	✓	✓	✓	✓	✓
Transport of diluted species in porous media and fractures		✓	✓	✓	✓	✓	✓
Generalized multiphysics interface for fluid-structure interaction (FSI)		✓	✓	✓	✓	✓	✓
Inlet boundary conditions for fully developed turbulent flow		✓	✓	✓	✓	✓	✓
Realizable k-ε turbulence model		✓	✓	✓	✓	✓	✓
Buoyancy-driven turbulence		✓	✓	✓	✓	✓	✓
All turbulence models made available for multiphase flow		✓	✓	✓	✓	✓	✓
Rotating machinery interfaces made available for all flow interfaces		✓	✓	✓	✓	✓	✓
Large eddy simulation (LES) for single-phase flow			✓	✓	✓	✓	✓
Phase transport in free and porous media			✓	✓	✓	✓	✓
Fully developed flow at inlets and outlets for turbulent flow			✓	✓	✓	✓	✓

FLUID FLOW	4.2-4	5.0-3	5.4	5.5	5.6	6.0	6.1
Non-Newtonian yield-stress fluids: Bingham-Papanastasiou, Casson-Papanastasiou models, and Herschel-Bulkley-Papanastasiou			✓	✓	✓	✓	✓
NEW Product: Porous Media Flow Module				✓	✓	✓	✓
Viscoelastic flow				✓	✓	✓	✓
Compressible Euler equations				✓	✓	✓	✓
Phase transport mixture model for arbitrary number of dispersed phases				✓	✓	✓	✓
Nonisothermal large eddy simulation (LES)				✓	✓	✓	✓
Continuity and Initial Interface pair features				✓	✓	✓	✓
Inelastic non-Newtonian constitutive relations				✓	✓	✓	✓
Interior Slip Wall feature				✓	✓	✓	✓
Reacting flow in porous media				✓	✓	✓	✓
Heat transfer in fractures				✓	✓	✓	✓
Non-Darcian flow				✓	✓	✓	✓
Mechanical analysis of pipes				✓	✓	✓	✓
NEW Product: Polymer Flow Module					✓	✓	✓
Combined separated and dispersed multiphase flow					✓	✓	✓
Compressible dispersed multiphase flow					✓	✓	✓
Nonisothermal multiphase mixture model					✓	✓	✓
Shallow water equations interface					✓	✓	✓
Droplet evaporation for particle tracing					✓	✓	✓
Improved LES with automatic wall treatment and thermal wall functions						✓	✓
High-Mach-number-flow analysis for rotating machinery						✓	✓
Curing of thermosetting resins						✓	✓
Phase separation in rotating machinery with multiple dispersed phases						✓	✓
Two-phase flow in porous media for the Brinkman equations with level sets						✓	✓
Multiphysics interface for nonisothermal flow in porous media						✓	✓
CFD with detached eddy simulation (DES)							✓
Turbulent flow in porous media coupled with flow in open media							✓
High Mach number reacting flow							✓

CHEMICAL	4.2-4	5.0-3	5.4	5.5	5.6	6.0	6.1
Surface reactions	✓	✓	✓	✓	✓	✓	✓
Reacting flow	✓	✓	✓	✓	✓	✓	✓
AC impedance spectroscopy	✓	✓	✓	✓	✓	✓	✓
NEW Product: Electrodeposition Module	✓	✓	✓	✓	✓	✓	✓
NEW Product: Corrosion Module	✓	✓	✓	✓	✓	✓	✓
NEW Product: Electrochemistry Module	✓	✓	✓	✓	✓	✓	✓
Multiscale simulations for packed bed reactors		✓	✓	✓	✓	✓	✓
Equilibrium reactions		✓	✓	✓	✓	✓	✓
Multiphysics interface for hygroscopic swelling with species transport		✓	✓	✓	✓	✓	✓
Nonspherical catalytic pellet shapes		✓	✓	✓	✓	✓	✓
Thin insulating sheets for corrosion simulations		✓	✓	✓	✓	✓	✓
Nernst-Planck-Poisson equations interface		✓	✓	✓	✓	✓	✓
Electrophoretic transport interface		✓	✓	✓	✓	✓	✓
Primary and secondary current distribution based on the boundary element method (BEM)		✓	✓	✓	✓	✓	✓
A built-in thermodynamic properties library		✓	✓	✓	✓	✓	✓
Link between Reaction Engineering interface and thermodynamic property packages		✓	✓	✓	✓	✓	✓
Electrode reactions on thin electrode surfaces fully immersed in electrolyte		✓	✓	✓	✓	✓	✓
New Lithium-Ion Battery Designer application for optimizing batteries for specific use cases		✓	✓	✓	✓	✓	✓
Updated Thermodynamics interface			✓	✓	✓	✓	✓
Partition condition for prescribing the ratio between concentrations in two adjacent phases			✓	✓	✓	✓	✓
Lumped battery interface			✓	✓	✓	✓	✓
Stress and strain in electrode particles due to lithium intercalation			✓	✓	✓	✓	✓
Equivalent circuit modeling of batteries			✓	✓	✓	✓	✓
Level set interface for corrosion modeling			✓	✓	✓	✓	✓
Generate materials from a thermodynamic system				✓	✓	✓	✓
Generate a Chemistry interface from a thermodynamic system				✓	✓	✓	✓
Diffusivity models for gases and liquids				✓	✓	✓	✓
Water and steam properties				✓	✓	✓	✓

CHEMICAL	4.2-4	5.0-3	5.4	5.5	5.6	6.0	6.1
Single-ion conductor charge balance for solid-state batteries				✓	✓	✓	✓
Lumped Battery interface improvements				✓	✓	✓	✓
Equilibrium potential calculation using the Nernst Equation				✓	✓	✓	✓
Concentration-dependent Butler-Volmer kinetics				✓	✓	✓	✓
Electrode reactions for Batteries & Fuel Cells				✓	✓	✓	✓
Current Distribution, Pipe interface				✓	✓	✓	✓
NEW Product: Fuel Cell & Electrolyzer Module					✓	✓	✓
Material library for corrosion					✓	✓	✓
Realistic fluid models for dry air, moist air, and water–steam mixtures					✓	✓	✓
Automatic reaction balancing					✓	✓	✓
Reactive pellet beds for concentrated solutions					✓	✓	✓
Multiphysics interface for nonisothermal reacting flow						✓	✓
Porous catalyst feature for heterogeneous reactions and adsorption						✓	✓
Turbulent reacting flow with diluted species						✓	✓
Stresses and strains due to lithium intercalation in lithium-ion batteries						✓	✓
Event sequences for easier modeling of multistep charge/discharge cycles						✓	✓
New material library for fuel cells and electrolyzers						✓	✓
Transport of species across fuel cell and electrolyzer membranes						✓	✓
New interface for cathodic protection						✓	✓
Dispersed multiphase flow with chemical species transport and reactions							✓
Shrinking core feature for heterogeneous reactions in porous media							✓
New interface for modeling battery packs with several hundred cells							✓
Thermal analysis and thermal runaway in 3D models							✓
Functionality for modeling impurities from sulfuric compounds, heavy hydrocarbons, and ammonia in fuel cells							✓

OPTIMIZATION	4.2-4	5.0-3	5.4	5.5	5.6	6.0	6.1
Parameter optimization	✓	✓	✓	✓	✓	✓	✓
Design optimization	✓	✓	✓	✓	✓	✓	✓
Gradient-based and derivative-free optimization study	✓	✓	✓	✓	✓	✓	✓
Multianalysis optimization		✓	✓	✓	✓	✓	✓
New least square fitting method		✓	✓	✓	✓	✓	✓
Combined parametric sweeps with derivative-free optimization			✓	✓	✓	✓	✓
Easier shape optimization setup				✓	✓	✓	✓
Filter dataset for creating smooth topology optimization mesh				✓	✓	✓	✓
Compute confidence intervals for parameter estimation				✓	✓	✓	✓
Built-in shape optimization tools					✓	✓	✓
Built-in topology optimization tools					✓	✓	✓
New interface for parameter estimation						✓	✓
Manufacturing constraints for milling for topology optimization							✓

UNCERTAINTY QUANTIFICATION	4.2-4	5.0-3	5.4	5.5	5.6	6.0	6.1
NEW Product: Uncertainty Quantification Module						✓	✓
Parameter screening						✓	✓
Global sensitivity analysis						✓	✓
Uncertainty propagation						✓	✓
Reliability analysis						✓	✓
Design of experiments						✓	✓
Inverse uncertainty quantification							✓
Multidimensional interpolation using Gaussian process regression							✓

PARTICLE TRACING	4.2-4	5.0-3	5.4	5.5	5.6	6.0	6.1
NEW Product: Particle Tracing Module	✓	✓	✓	✓	✓	✓	✓
Secondary emission	✓	✓	✓	✓	✓	✓	✓
Particle-particle interactions	✓	✓	✓	✓	✓	✓	✓
Particle-field and fluid-particle interactions	✓	✓	✓	✓	✓	✓	✓
Space-charge limited emission		✓	✓	✓	✓	✓	✓
Particle-matter interactions		✓	✓	✓	✓	✓	✓
Periodic boundary condition for particle tracing		✓	✓	✓	✓	✓	✓
Rotating frames for particle tracing		✓	✓	✓	✓	✓	✓
Symmetry boundary condition for particle tracing		✓	✓	✓	✓	✓	✓
Accumulators for velocity reinitialization to compute, for example, spatial density of collisions			✓	✓	✓	✓	✓
Faster particle tracing with coupled fields				✓	✓	✓	✓
Virtual mass and pressure gradient forces				✓	✓	✓	✓
Particle size distributions				✓	✓	✓	✓
Particle charging for fluid flow				✓	✓	✓	✓
New tools for corona discharge in electrostatic precipitators				✓	✓	✓	✓
Droplet evaporation					✓	✓	✓
Particle-matter interaction with absorbed dose of ions						✓	✓
Heat transfer between particles and surrounding fluid						✓	✓

LIQUID & GAS PROPERTIES	4.2-4	5.0-3	5.4	5.5	5.6	6.0	6.1
NEW Product: Liquid & Gas Properties Module					✓	✓	✓
Realistic fluid and fluid mixture properties					✓	✓	✓

INTERFACING	4.2-4	5.0-3	5.4	5.5	5.6	6.0	6.1
NEW Product: LiveLink™ for AutoCAD®	✓	✓	✓	✓	✓	✓	✓
NEW Product: LiveLink™ for PTC® Creo® Parametric™	✓	✓	✓	✓	✓	✓	✓
NEW Product: LiveLink™ for Excel®	✓	✓	✓	✓	✓	✓	✓
NEW Product: ECAD Import Module	✓	✓	✓	✓	✓	✓	✓
NEW Product: LiveLink™ for Solid Edge®	✓	✓	✓	✓	✓	✓	✓
LiveLink™ for Inventor®: one-window interface	✓	✓	✓	✓	✓	✓	✓
NEW Product: LiveLink™ for Revit®	✓	✓	✓	✓	✓	✓	✓
NEW Product: Design Module	✓	✓	✓	✓	✓	✓	✓
NEW Product: LiveLink™ for Simulink®					✓	✓	✓