

COMSOL® Software – Release Highlights History

COMSOL Multiphysics® Software							
Geometry and Mesh	4.2-4	5.0-4	5.5	5.6	6.0	6.1	6.2
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						✓	✓
New distance measurement and centroid measurement features							✓

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

*5.0-4 includes 5.0, 5.0.1, 5.1, 5.2, 5.2a, 5.3, 5.3a, and 5.4 versions.

Detailed control of twisting along a sweep path							✓
Logical expressions for selections							✓
More broadly applicable swept mesh feature							✓
Easy generation of meshes for periodic boundaries							✓
New surface remeshing method for imported STL and topology-optimized meshes							✓
Automatic handling of interior copper layer positions for ECAD import							✓
User Interface and Modeling Tools	4.2-4	5.0-4	5.5	5.6	6.0	6.1	6.2
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						✓	✓
Syntax highlighting for expressions							✓
Node filtering for the Model Builder tree							✓
Compare with Saved button for viewing all changes of a model since last saved							✓
General continuous tangent selections							✓
Surrogate model functions including deep neural network models							✓

Studies and Solvers	4.2-4	5.0-4	5.5	5.6	6.0	6.1	6.2
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					✓	✓	✓
More efficient handling of nonlocal constraints							✓
Solver for combining time-periodic and a transient simulations							✓
Up to 7 times faster boundary element method							✓
Store solver log on file							✓
Surrogate Model Training study with design of experiments sampling							✓
Results and Visualization	4.2-4	5.0-4	5.5	5.6	6.0	6.1	6.2
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						✓	✓
Visualization with floor shadows							✓
Streamline plots on curved surfaces							✓
Centralized configurations for plot parameters							✓

Application Builder	4.2-4	5.0-4	5.5	5.6	6.0	6.1	6.2
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						✓	✓
Surrogate models for fast app execution							✓
Timer events for using apps as digital twins							✓
Add-ins for creating custom ribbon tabs with menus and buttons							✓
Model Manager	4.2-4	5.0-4	5.5	5.6	6.0	6.1	6.2
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						✓	✓
Improved search and maintenance operations for the Model Manager							✓
Application program interface (API) for Model Manager databases							✓

COMSOL Multiphysics® Platform and Hardware Support	4.2-4	5.0-4	5.5	5.6	6.0	6.1	6.2
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	5.0-4	5.5	5.6	6.0	6.1	6.2
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	5.0-4	5.5	5.6	6.0	6.1	6.2
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	5.0-4	5.5	5.6	6.0	6.1	6.2
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		✓	✓	✓	✓	✓	✓

ELECTROMAGNETICS	4.2-4	5.0-4	5.5	5.6	6.0	6.1	6.2
New algorithm for computing ray intensity and power		✓	✓	✓	✓	✓	✓
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						✓	✓

ELECTROMAGNETICS	4.2-4	5.0-4	5.5	5.6	6.0	6.1	6.2
Electric discharge simulations						✓	✓
Efficient modeling of periodic structures for electromagnetic waves						✓	✓
Fluence rate calculations for ray optics						✓	✓
Combined inductively and capacitively coupled plasmas (RF bias)						✓	✓
Faster nonlinear motor and transformer simulations with time-dimension periodicity							✓
New options for acoustic, structural, multibody, heat transfer, and optimization analysis of electric motors							✓
Dispersive material models for tissue and dielectrics							✓
Modeling of stranded conductors, such as litz wires							✓
Automatic free space stabilization of magnetic field simulations							✓
Faster high-frequency analysis based on the boundary element method (BEM)							✓
More efficient handling of chemical reactions in plasmas							✓
Preview of semiconductor doping profiles before solving							✓
Easy-to-use specific absorption computations for RF tissue simulations							✓
Modeling of light wave propagation through liquid crystals							✓

HEAT TRANSFER	4.2-4	5.0-4	5.5	5.6	6.0	6.1	6.2
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		✓	✓	✓	✓	✓	✓

HEAT TRANSFER	4.2-4	5.0-4	5.5	5.6	6.0	6.1	6.2
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		✓	✓	✓	✓	✓	✓
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						✓	✓
ASHRAE weather data from GPS position							✓
Thermal resistance connection between distant surfaces							✓

HEAT TRANSFER	4.2-4	5.0-4	5.5	5.6	6.0	6.1	6.2
Radiation in participating media for 2D axisymmetric models							✓
Increased performance and workflow for orbital thermal loads with heat radiation							✓
Nonisothermal reacting flow in porous media							✓
Modeling of annealing in metal processing							✓

STRUCTURAL MECHANICS	4.2-4	5.0-4	5.5	5.6	5.7	6.1	6.2
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	✓	✓	✓	✓	✓	✓	✓
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		✓	✓	✓	✓	✓	✓

STRUCTURAL MECHANICS	4.2-4	5.0-4	5.5	5.6	5.7	6.1	6.2
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		✓	✓	✓	✓	✓	✓
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		✓	✓	✓	✓	✓	✓

STRUCTURAL MECHANICS	4.2-4	5.0-4	5.5	5.6	5.7	6.1	6.2
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				✓	✓	✓	✓
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)					✓	✓	✓

STRUCTURAL MECHANICS	4.2-4	5.0-4	5.5	5.6	5.7	6.1	6.2
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						✓	✓
Phase field in solids for damage and fracture modeling							✓
Virtual crack extension method							✓
Automatic stabilization of contact models							✓
Warping computation for circuit boards							✓
Magnetic-structure multiphysics analysis for electric motors							✓
Transport in solids for electromigration, hydrogen embrittlement, and other phenomena							✓
Strongly coupled moisture transport with structural deformations							✓
Inertia relief analysis for unconstrained structures accelerated by external loads							✓
New viscoplastic material model specialized for lithium in battery applications							✓
New material models for polymer viscoplasticity							✓
More powerful fiber modeling							✓
Multiple enhancements to shape memory alloys							✓
Parameter estimation functionality now included in the Nonlinear Structural Materials Module							✓
New part library for unit cells and representative volume elements							✓
Piezoresistivity multiphysics with layered shells							✓

ACOUSTICS	4.2-4	5.0-4	5.5	5.6	5.7	6.1	6.2
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	5.0-4	5.5	5.6	5.7	6.1	6.2
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						✓	✓
Order-of-magnitude faster impulse response calculations for room and cabin acoustics							✓
Realistic absorption modeling with frequency-dependent boundary impedance for time-domain analysis							✓
Anisotropic materials for poroelastic waves							✓
New port condition for aeroacoustics analysis of structures such as turbojet engine intakes							✓
Slip walls and surface tension for thermoviscous acoustics modeling							✓
Faster boundary element method (BEM) for acoustics							✓
Asymptotic waveform evaluation (AWE) method for dense frequency sweeps							✓
Modal analysis for vibroacoustic multiphysics							✓
Waveform Audio File Format (WAV) import							✓

FLUID FLOW	4.2-4	5.0-4	5.5	5.6	6.0	6.1	6.2
High Mach number flow	✓	✓	✓	✓	✓	✓	✓
NEW Product: Microfluidics Module	✓	✓	✓	✓	✓	✓	✓
k-omega turbulence model	✓	✓	✓	✓	✓	✓	✓
Euler-Euler two-phase flow	✓	✓	✓	✓	✓	✓	✓
Slip flow	✓	✓	✓	✓	✓	✓	✓
NEW Product: Pipe Flow Module	✓	✓	✓	✓	✓	✓	✓
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		✓	✓	✓	✓	✓	✓

FLUID FLOW	4.2-4	5.0-4	5.5	5.6	6.0	6.1	6.2
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		✓	✓	✓	✓	✓	✓
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					✓	✓	✓

FLUID FLOW	4.2-4	5.0-4	5.5	5.6	6.0	6.1	6.2
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						✓	✓
Up to 40% faster computations for turbulent flow							✓
7 new RANS turbulence models for high-Mach-number flow							✓
Large eddy simulation (LES) for compressible flow							✓
Potential flow for initialization							✓
Mixing plane approach for rotating machinery							✓
Conformation formulation for viscoelastic flow							✓
Nonisothermal reacting flow in porous media							✓
New option to couple Darcy's law flow in porous media with nonporous domains							✓
Parameter estimation functionality now included in the Polymer Flow Module							✓

CHEMICAL	4.2-4	5.0-4	5.5	5.6	6.0	6.1	6.2
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		✓	✓	✓	✓	✓	✓

CHEMICAL	4.2-4	5.0-4	5.5	5.6	6.0	6.1	6.2
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			✓	✓	✓	✓	✓
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				✓	✓	✓	✓

CHEMICAL	4.2-4	5.0-4	5.5	5.6	6.0	6.1	6.2
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						✓	✓
Gas-liquid equilibrium modeling for multiphase flows							✓
Contact resistance boundaries for electrochemistry and corrosion							✓
Pore-wall interaction (Knudsen diffusion) model for accurate gas diffusion electrode descriptions							✓
Automatic state-of-charge and state-of-health variable definitions for battery modeling							✓
New framework for initial charge distribution for the initial state of charge, cell voltage, and electrode voltages							✓
Enhanced functionality for the modeling of impressed cathodic protection of pipelines							✓
Parameter estimation functionality now included in the Chemical Reaction Engineering Module							✓

OPTIMIZATION	4.2-4	5.0-4	5.5	5.6	6.0	6.1	6.2
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						✓	✓
Eigenfrequency-based topology and shape optimization							✓
Correlation matrix output for parameter estimation							✓

UNCERTAINTY QUANTIFICATION	4.2-4	5.0-4	5.5	5.6	6.0	6.1	6.2
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						✓	✓
Correlated input parameters							✓

PARTICLE TRACING	4.2-4	5.0-4	5.5	5.6	6.0	6.1	6.2
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	5.0-4	5.5	5.6	6.0	6.1	6.2
NEW Product: Liquid & Gas Properties Module				✓	✓	✓	✓
Realistic fluid and fluid mixture properties				✓	✓	✓	✓

INTERFACING	4.2-4	5.0-4	5.5	5.6	5.0	6.1	6.2
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®				✓	✓	✓	✓