COMSOL® Software – Release Highlights History

COMSOL Multiphysics® Software							
Geometry and Mesh	4.2–4	5.0–6	6.0	6.1	6.2	6.3	6.4
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.
*5.0–6 includes 5.0, 5.0.1, 5.1, 5.2, 5.2a, 5.3, 5.3a, 5.4, 5.5, and 5.6 versions.

COMSOL MULTIPHYSICS® COMSOL SERVER™

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					✓	✓	✓
Automated geometry preparation tools for robust mesh generation						✓	✓
New mesh element sizing algorithm for resolving geometric details						✓	✓
Physics-controlled meshing for imported STL files						✓	✓
Extrude and revolve operations for edges and vertices						✓	✓
Selection of components to import from an assembly						✓	✓
Variable radius and constant width fillets						✓	✓
Projection of edges to faces						✓	✓
New virtual operation for merging faces						✓	✓
Easier swept meshing between disconnected surfaces						✓	✓
Import of component outlines and creation of plated vias for PCBs						✓	✓
ECAD export to the OASIS format						✓	✓
Automatic surrounding domain creation							✓
Quad-dominant meshing option							✓
Generalized swept meshing							✓
Mesh-Based Geometry option for editing and repairing imported meshes, including STL files							✓
Preview of CAD assemblies							✓
Preview of PCB layouts, including selection of layers and nets to be imported							✓
User Interface and Modeling Tools	**4.2–4**	**5.0–6**	**6.0**	**6.1**	**6.2**	**6.3**	**6.4**
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					✓	✓	✓
Display user-defined comments in settings windows						✓	✓
New Data Viewer window for easy access to parameters, declarations, and Java variables						✓	✓
Studies and Solvers	**4.2–4**	**5.0–6**	**6.0**	**6.1**	**6.2**	**6.3**	**6.4**
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					✓	✓	✓
GPU acceleration delivering up to 25x faster transient acoustics simulations						✓	✓
Efficient surrogate model creation with GPU-based training support						✓	✓
Nonlinear eigenvalue solver						✓	✓
NVIDIA CUDA® direct sparse solver (cuDSS) for one or more GPUs							✓
Surrogate model data generation on clusters							✓
Export of network parameters for deep neural network (DNN) surrogate models							✓
Results and Visualization	**4.2–4**	**5.0–6**	**6.0**	**6.1**	**6.2**	**6.3**	**6.4**
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					✓	✓	✓
Interactive plot markers for field values						✓	✓
User-defined default units						✓	✓

Spatially varying transparency							✓
Array-based plot layouts							✓
Application Builder	**4.2–4**	**5.0–6**	**6.0**	**6.1**	**6.2**	**6.3**	**6.4**
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					✓	✓	✓
Interactive Java® environment enabling on-the-fly model modifications using the COMSOL API						✓	✓
Optional chatbot tool providing Java® code assistance and answers to general queries						✓	✓
Chatbot tool connects to OpenAI API-compatible LLMs, including GPT-5™, DeepSeek™, Google Gemini™, and Anthropic Claude™							✓
Model Manager	**4.2–4**	**5.0–6**	**6.0**	**6.1**	**6.2**	**6.3**	**6.4**
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					✓	✓	✓
Command-line-driven batch computations with Model Manager databases						✓	✓
Cluster support for models saved in a Model Manager database							✓

COMSOL Multiphysics® Platform and Hardware Support	4.2–4	5.0–6	6.0	6.1	6.2	6.3	6.4
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				✓	✓	✓	✓
NVIDIA® GPU support for acoustics and DNN training						✓	✓
NVIDIA CUDA® direct sparse solver (cuDSS) for one or more GPUs							✓

COMSOL Server™ Product	4.2–4	5.0–6	6.0	6.1	6.2	6.3	6.4
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	5.0–6	6.0	6.1	6.2	6.3	6.4
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	✓	✓	✓	✓	✓	✓	✓
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		✓	✓	✓	✓	✓	✓

ELECTROMAGNETICS	4.2–4	5.0–6	6.0	6.1	6.2	6.3	6.4
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		✓	✓	✓	✓	✓	✓
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			✓	✓	✓	✓	✓

ELECTROMAGNETICS	4.2–4	5.0–6	6.0	6.1	6.2	6.3	6.4
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				✓	✓	✓	✓
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					✓	✓	✓
NEW Product: Electric Discharge Module						✓	✓
Efficient modeling of laminated iron in motors and transformers						✓	✓
Support for DQ excitation in electric motors						✓	✓
Homogenized litz coil conductor modeling						✓	✓
Improved accuracy in electrostatic force calculations for MEMS devices						✓	✓
Simulation of dielectric dispersion in biological tissue						✓	✓
RLGC parameter calculation for multiconductor transmission lines						✓	✓

ELECTROMAGNETICS	4.2–4	5.0–6	6.0	6.1	6.2	6.3	6.4
Time-domain analysis of transmission lines						✓	✓
Automated setup of periodic structures in wave optics						✓	✓
Automatic generation of spot diagrams and geometric modulation transfer function (MTF) plots in ray optics						✓	✓
Accurate calculation of leakage current in semiconductor devices						✓	✓
Dedicated interfaces for simulating nonisothermal plasma flow						✓	✓
Transient induction boundary conditions							✓
Far-field radiation in substrates							✓
Efficient switching arc simulation							✓
Plasma modeling of etching and deposition processes in semiconductor applications							✓
Ray-based light scattering in tissues and humid environments							✓
Simulation of ferroelectric and piezoelectric semiconductors as well as memristors							✓

HEAT TRANSFER	4.2–4	5.0–6	6.0	6.1	6.2	6.3	6.4
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		✓	✓	✓	✓	✓	✓

HEAT TRANSFER	4.2–4	5.0–6	6.0	6.1	6.2	6.3	6.4
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					✓	✓	✓
Radiation in participating media for 2D axisymmetric models					✓	✓	✓
Increased performance and workflow for orbital thermal loads with heat radiation					✓	✓	✓

HEAT TRANSFER	4.2–4	5.0–6	6.0	6.1	6.2	6.3	6.4
Nonisothermal reacting flow in porous media					✓	✓	✓
Modeling of annealing in metal processing					✓	✓	✓
Fast drying simulations with nonequilibrium moisture transport						✓	✓
Repeating unit cell method for heat transfer in composites and porous media						✓	✓
Forward ray shooting for improved external radiation accuracy						✓	✓
Performance boost for surface-to-surface radiation in larger models						✓	✓
Performance improvements for thermal radiation in participating media							✓
Refraction in surface-to-surface radiation							✓
Anisotropic thermal properties for prismatic batteries							✓
Induction hardening for steel parts							✓

STRUCTURAL MECHANICS	4.2–4	5.0–6	6.0	6.1	6.2	6.3	6.4
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		✓	✓	✓	✓	✓	✓

STRUCTURAL MECHANICS	4.2–4	5.0–6	6.0	6.1	6.2	6.3	6.4
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		✓	✓	✓	✓	✓	✓
Response spectrum analysis		✓	✓	✓	✓	✓	✓
Representative volume elements (RVE) for homogenization of periodic materials		✓	✓	✓	✓	✓	✓
Shell interface for axisymmetric analysis		✓	✓	✓	✓	✓	✓

STRUCTURAL MECHANICS	4.2–4	5.0–6	6.0	6.1	6.2	6.3	6.4
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		✓	✓	✓	✓	✓	✓
Embedded reinforcements for anchors, rebars, and wire meshes		✓	✓	✓	✓	✓	✓
Automatic generation of joints for multibody dynamics		✓	✓	✓	✓	✓	✓

STRUCTURAL MECHANICS	4.2–4	5.0–6	6.0	6.1	6.2	6.3	6.4
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				✓	✓	✓	✓
Phase field in solids for damage and fracture modeling					✓	✓	✓
Virtual crack extension method					✓	✓	✓
Automatic stabilization of contact models					✓	✓	✓
Warpage 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					✓	✓	✓

STRUCTURAL MECHANICS	4.2–4	5.0–6	6.0	6.1	6.2	6.3	6.4
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					✓	✓	✓
Electromechanical modeling for shells and membranes						✓	✓
Multiphysics simulation of moisture-induced shrinkage and swelling						✓	✓
Efficient modeling of spot welds and fasteners						✓	✓
Mechanical contact conditions for interior boundaries, removing the need for contact pairs						✓	✓
Viscoelastic time-domain simulation with frequency-dependent material properties						✓	✓
Geometry modeling of random particulate composites						✓	✓
Part Library for lattice geometries						✓	✓
Up to 50% faster plasticity computations						✓	✓
Pressure-dependent plasticity for foams and other materials						✓	✓
Explicit structural dynamics including support for nonlinear materials							✓
Automatic mechanical contact for many objects							✓
Phase-field damage modeling for explicit dynamics							✓
Mode tracking for rotordynamics and other simulation types							✓
Easier modeling of mechanical assemblies connected by joints							✓
Magnetomechanics for shells and membranes							✓

ACOUSTICS	4.2–4	5.0–6	6.0	6.1	6.2	6.3	6.4
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		✓	✓	✓	✓	✓	✓

ACOUSTICS	4.2–4	5.0–6	6.0	6.1	6.2	6.3	6.4
New solvers for large frequency-domain acoustic problems		✓	✓	✓	✓	✓	✓
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					✓	✓	✓

ACOUSTICS	4.2–4	5.0–6	6.0	6.1	6.2	6.3	6.4
Asymptotic waveform evaluation (AWE) method for dense frequency sweeps					✓	✓	✓
Modal analysis for vibroacoustic multiphysics					✓	✓	✓
Waveform Audio File Format (WAV) import					✓	✓	✓
GPU-accelerated computations for time-explicit pressure acoustics						✓	✓
Time-domain simulation with frequency-dependent material properties						✓	✓
Faster thermoviscous acoustics simulation using the sequential linearized Navier–Stokes (SLNS) model						✓	✓
Anisotropic poroacoustics modeling						✓	✓
Support for multi-GPU setups and GPUs on clusters for time-explicit pressure acoustics							✓
Import CFD data in the CGNS file format for use in aeroacoustics							✓
Poroacoustics feature for both transient and time-explicit pressure acoustics							✓
Periodic port boundary condition for automatic handling of multiple diffraction orders							✓

FLUID FLOW	4.2–4	5.0–6	6.0	6.1	6.2	6.3	6.4
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	✓	✓	✓	✓	✓	✓	✓

FLUID FLOW	4.2–4	5.0–6	6.0	6.1	6.2	6.3	6.4
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		✓	✓	✓	✓	✓	✓
Non-Newtonian yield-stress fluids: Bingham-Papanastasiou, Casson-Papanastasiou models, 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)		✓	✓	✓	✓	✓	✓

FLUID FLOW	4.2–4	5.0–6	6.0	6.1	6.2	6.3	6.4
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				✓	✓	✓	✓
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					✓	✓	✓

FLUID FLOW	4.2–4	5.0–6	6.0	6.1	6.2	6.3	6.4
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					✓	✓	✓
Reynolds stress turbulence models for secondary flows in ducts and flows with strong swirl or mean rotation						✓	✓
Enhanced high-Mach-number flow simulations with a new kinetic energy option						✓	✓
Shear-induced migration for particle fractionation and microfiltration						✓	✓
Mixing plane functionality for efficient modeling of pumps, turbines, and rotating machinery in general						✓	✓
Non-Newtonian flow in porous media						✓	✓
NEW Product: Granular Flow Module							✓
Scale-adaptive simulation (SAS) for accurate unsteady turbulence modeling with the SST model							✓
Elliptic Blending R-ε turbulence model							✓
Algebraic turbulence models for high Mach number flow in rotating machinery							✓
Periodic and pressure jump conditions for porous media flow							✓
Pipe flow now supports orifices, valves, and 3D coupling for reversible mass transfer							✓

CHEMICAL AND ELECTROCHEMICAL	4.2–4	5.0–6	6.0	6.1	6.2	6.3	6.4
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		✓	✓	✓	✓	✓	✓

CHEMICAL AND ELECTROCHEMICAL	4.2–4	5.0–6	6.0	6.1	6.2	6.3	6.4
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		✓	✓	✓	✓	✓	✓
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		✓	✓	✓	✓	✓	✓

CHEMICAL AND ELECTROCHEMICAL	4.2–4	5.0–6	6.0	6.1	6.2	6.3	6.4
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				✓	✓	✓	✓
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					✓	✓	✓
New two-electrode lumped model and single-particle electrode options for battery design						✓	✓
Modeling of concentrated electrolytes in electrochemical cells						✓	✓
Precipitation and crystallization simulation for particle nucleation and growth with particle size distribution						✓	✓
Demo app featuring time-dependent surrogate modeling for battery test cycles						✓	✓
Particle aggregation and breakage for crystallization, precipitation, and granulation processes							✓

CHEMICAL AND ELECTROCHEMICAL	4.2–4	5.0–6	6.0	6.1	6.2	6.3	6.4
Moving-bed reactor functionality							✓
Large eddy simulation (LES) with reacting flow							✓
New Aqueous Electrolyte Transport interface for efficient modeling of multicomponent solutions							✓
Built-in variables for power losses in a battery cell							✓
Arbitrary load cycles for batteries							✓
User-friendly heat transfer setup for prismatic battery models							✓

OPTIMIZATION	4.2–4	5.0–6	6.0	6.1	6.2	6.3	6.4
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					✓	✓	✓
Global parameter optimization solver						✓	✓
New optimization options for time-dependent and parametric studies							✓

UNCERTAINTY QUANTIFICATION	4.2–4	5.0–6	6.0	6.1	6.2	6.3	6.4
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					✓	✓	✓
Frequency and time-dependent uncertainty quantification							✓

PARTICLE TRACING	4.2–4	5.0–6	6.0	6.1	6.2	6.3	6.4
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		✓	✓	✓	✓	✓	✓

PARTICLE TRACING	4.2–4	5.0–6	6.0	6.1	6.2	6.3	6.4
Droplet evaporation		✓	✓	✓	✓	✓	✓
Particle-matter interaction with absorbed dose of ions			✓	✓	✓	✓	✓
Heat transfer between particles and surrounding fluid			✓	✓	✓	✓	✓

LIQUID & GAS PROPERTIES	4.2–4	5.0–6	6.0	6.1	6.2	6.3	6.4
NEW Product: Liquid & Gas Properties Module		✓	✓	✓	✓	✓	✓
Realistic fluid and fluid mixture properties		✓	✓	✓	✓	✓	✓

INTERFACING	4.2–4	5.0–6	6.0	6.1	6.2	6.3	6.4
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®		✓	✓	✓	✓	✓	✓