COMSOL® Software – Release Highlights History

COMSOL Multiphysics® Software							
Geometry and Mesh	4.2-4	5.0–5	5.6	6.0	6.1	6.2	6.3
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.
*5.0–5 includes 5.0, 5.0.1, 5.1, 5.2, 5.2a, 5.3, 5.3a, 5.4 and 5.5 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						✓	✓
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							✓
User Interface and Modeling Tools	**4.2-4**	**5.0–5**	**5.6**	**6.0**	**6.1**	**6.2**	**6.3**
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**	**5.0–5**	**5.6**	**6.0**	**6.1**	**6.2**	**6.3**
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							✓
Results and Visualization	**4.2-4**	**5.0–5**	**5.6**	**6.0**	**6.1**	**6.2**	**6.3**
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							✓
Application Builder	**4.2-4**	**5.0–5**	**5.6**	**6.0**	**6.1**	**6.2**	**6.3**
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							✓
Model Manager	**4.2-4**	**5.0–5**	**5.6**	**6.0**	**6.1**	**6.2**	**6.3**
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							✓

COMSOL Multiphysics® Platform and Hardware Support	4.2-4	5.0-5	5.6	6.0	6.1	6.2	6.3
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							✓

COMSOL Server™ Product	4.2-4	5.0-5	5.6	6.0	6.1	6.2	6.3
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	5.0–5	5.6	6.0	6.1	6.2	6.3
Lumped ports and R,L,C,S parameter matrices	✓	✓	✓	✓	✓	✓	✓
Multiphysics interface for electrostatic-structural interactions	✓	✓	✓	✓	✓	✓	✓
Multiphysics interface for piezoresistivity	✓	✓	✓	✓	✓	✓	✓
Inductively coupled and microwave plasmas	✓	✓	✓	✓	✓	✓	✓

ELECTROMAGNETICS	4.2-4	5.0–5	5.6	6.0	6.1	6.2	6.3
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		✓	✓	✓	✓	✓	✓
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		✓	✓	✓	✓	✓	✓

ELECTROMAGNETICS	4.2-4	5.0–5	5.6	6.0	6.1	6.2	6.3
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				✓	✓	✓	✓
Optical material library with glasses from leading manufacturers				✓	✓	✓	✓
Electric circuit extraction					✓	✓	✓
Motor winding layouts and magnet arrays					✓	✓	✓
Multiphysics interface for magnetohydrodynamics simulations					✓	✓	✓

ELECTROMAGNETICS	4.2-4	5.0–5	5.6	6.0	6.1	6.2	6.3
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							✓
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							✓

HEAT TRANSFER	4.2-4	5.0–5	5.6	6.0	6.1	6.2	6.3
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		✓	✓	✓	✓	✓	✓
Light-diffusion equation interface		✓	✓	✓	✓	✓	✓
Thermal insulation for interior boundaries		✓	✓	✓	✓	✓	✓
Ambient Thermal Properties tool		✓	✓	✓	✓	✓	✓
Dedicated plots for temperature discontinuities		✓	✓	✓	✓	✓	✓
NEW Product: Metal Processing Module		✓	✓	✓	✓	✓	✓

HEAT TRANSFER	4.2-4	5.0–5	5.6	6.0	6.1	6.2	6.3
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						✓	✓
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							✓

STRUCTURAL MECHANICS	4.2-4	5.0–5	5.6	6.0	6.1	6.2	6.3
Prestressed analysis	✓	✓	✓	✓	✓	✓	✓
Thin-film damping for MEMS	✓	✓	✓	✓	✓	✓	✓
NEW Product: Geomechanics Module	✓	✓	✓	✓	✓	✓	✓
Multiphysics interface for MEMS thermoelasticity	✓	✓	✓	✓	✓	✓	✓
Load cases	✓	✓	✓	✓	✓	✓	✓

STRUCTURAL MECHANICS	4.2-4	5.0–5	5.6	6.0	6.1	6.2	6.3
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		✓	✓	✓	✓	✓	✓
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		✓	✓	✓	✓	✓	✓

STRUCTURAL MECHANICS	4.2-4	5.0–5	5.6	6.0	6.1	6.2	6.3
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		✓	✓	✓	✓	✓	✓
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		✓	✓	✓	✓	✓	✓

STRUCTURAL MECHANICS	4.2-4	5.0–5	5.6	6.0	6.1	6.2	6.3
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)				✓	✓	✓	✓
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					✓	✓	✓

STRUCTURAL MECHANICS	4.2-4	5.0–5	5.6	6.0	6.1	6.2	6.3
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						✓	✓
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							✓

ACOUSTICS	4.2-4	5.0–5	5.6	6.0	6.1	6.2	6.3
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	5.0–5	5.6	6.0	6.1	6.2	6.3
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	5.0–5	5.6	6.0	6.1	6.2	6.3
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							✓

FLUID FLOW	4.2-4	5.0–5	5.6	6.0	6.1	6.2	6.3
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		✓	✓	✓	✓	✓	✓

FLUID FLOW	4.2-4	5.0–5	5.6	6.0	6.1	6.2	6.3
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, amd 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		✓	✓	✓	✓	✓	✓

FLUID FLOW	4.2-4	5.0–5	5.6	6.0	6.1	6.2	6.3
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						✓	✓
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							✓

FLUID FLOW	4.2-4	5.0–5	5.6	6.0	6.1	6.2	6.3
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							✓

CHEMICAL AND ELECTROCHEMICAL	4.2-4	5.0–5	5.6	6.0	6.1	6.2	6.3
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		✓	✓	✓	✓	✓	✓

CHEMICAL AND ELECTROCHEMICAL	4.2-4	5.0–5	5.6	6.0	6.1	6.2	6.3
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			✓	✓	✓	✓	✓
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					✓	✓	✓

CHEMICAL AND ELECTROCHEMICAL	4.2-4	5.0–5	5.6	6.0	6.1	6.2	6.3
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							✓

OPTIMIZATION	4.2-4	5.0–5	5.6	6.0	6.1	6.2	6.3
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							✓

UNCERTAINTY QUANTIFICATION	4.2-4	5.0–5	5.6	6.0	6.1	6.2	6.3
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	5.0–5	5.6	6.0	6.1	6.2	6.3
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	5.0–5	5.6	6.0	6.1	6.2	6.3
NEW Product: Liquid & Gas Properties Module			✓	✓	✓	✓	✓
Realistic fluid and fluid mixture properties			✓	✓	✓	✓	✓

INTERFACING	4.2-4	5.0–5	5.6	6.0	6.1	6.2	6.3
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®			✓	✓	✓	✓	✓