

# COMSOL® Software – Release Highlights History

COMSOL Multiphysics® Software							
Geometry and Mesh	4.2-4	5.0-2	5.3	5.4	5.5	5.6	6.0
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							✓

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

\*5.0-2 includes 5.0, 5.0.1, 5.1, 5.2, and 5.2a versions.

\*5.3 includes 5.3 and 5.3a versions.

Modeling Tools	4.2-4	5.0-2	5.3	5.4	5.5	5.6	6.0
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						✓	✓
Studies and Solvers	4.2-4	5.0-2	5.3	5.4	5.5	5.6	6.0
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							✓
<b>Results and Visualization</b>	<b>4.2-4</b>	<b>5.0-2</b>	<b>5.3</b>	<b>5.4</b>	<b>5.5</b>	<b>5.6</b>	<b>6.0</b>
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							✓
<b>Application Builder</b>	<b>4.2-4</b>	<b>5.0-2</b>	<b>5.3</b>	<b>5.4</b>	<b>5.5</b>	<b>5.6</b>	<b>6.0</b>
<b>NEW Workspace: Application Builder</b>		✓	✓	✓	✓	✓	✓
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				✓	✓	✓	✓
<b>NEW Product: COMSOL Compiler™</b>				✓	✓	✓	✓
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							✓
<b>Model Manager</b>	<b>4.2-4</b>	<b>5.0-2</b>	<b>5.3</b>	<b>5.4</b>	<b>5.5</b>	<b>5.6</b>	<b>6.0</b>
<b>NEW Workspace: Model Manager</b>							✓
Organize models and apps, access and version control							✓
Asset management with web browser access							✓

<b>COMSOL Multiphysics® Platform and Hardware Support</b>	<b>4.2-4</b>	<b>5.0-2</b>	<b>5.3</b>	<b>5.4</b>	<b>5.5</b>	<b>5.6</b>	<b>6.0</b>
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 M1 processors							✓

COMSOL Server™ Product	4.2-4	5.0-2	5.3	5.4	5.5	5.6	6.0
<b>NEW Product: COMSOL Server™</b>		✓	✓	✓	✓	✓	✓
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	5.0-2	5.3	5.4	5.5	5.6	6.0
Lumped ports and R,L,C,S parameter matrices	✓	✓	✓	✓	✓	✓	✓
Multiphysics interface for electrostatic-structural interactions	✓	✓	✓	✓	✓	✓	✓
Multiphysics interface for piezoresistivity	✓	✓	✓	✓	✓	✓	✓
Inductively coupled and microwave plasmas	✓	✓	✓	✓	✓	✓	✓
<b>NEW Product: Wave Optics Module</b>	✓	✓	✓	✓	✓	✓	✓
<b>NEW Product: Semiconductor Module</b>	✓	✓	✓	✓	✓	✓	✓
Nonlinear magnetic material library with 160 materials	✓	✓	✓	✓	✓	✓	✓
Multiphysics interface for laser heating	✓	✓	✓	✓	✓	✓	✓
Multiphysics interface for optoelectronics		✓	✓	✓	✓	✓	✓
<b>NEW Product: Ray Optics Module</b>		✓	✓	✓	✓	✓	✓
Coil analysis tools		✓	✓	✓	✓	✓	✓
Optical materials database with over 1400 materials		✓	✓	✓	✓	✓	✓
Multiphysics interface for ray heating		✓	✓	✓	✓	✓	✓
User-defined materials written in C		✓	✓	✓	✓	✓	✓
Smith plots		✓	✓	✓	✓	✓	✓

ELECTROMAGNETICS	4.2-4	5.0-2	5.3	5.4	5.5	5.6	6.0
Magnetic vector hysteresis material model		✓	✓	✓	✓	✓	✓
Optical aberration plots		✓	✓	✓	✓	✓	✓
Electrostatics based on the boundary element method (BEM)			✓	✓	✓	✓	✓
Accelerated computation of capacitance matrix and other lumped matrices			✓	✓	✓	✓	✓
Part Library with waveguides, surface-mount footprints, and SMA connectors			✓	✓	✓	✓	✓
Photometric data file import for ray optics			✓	✓	✓	✓	✓
Schrödinger equation interfaces			✓	✓	✓	✓	✓
Revolutionary new method for capacitively coupled plasma (CCP) simulations			✓	✓	✓	✓	✓
Hybrid boundary-element-finite-element method (BEM-FEM) for magnetic field analysis			✓	✓	✓	✓	✓
Soft magnet material model of permanent magnets			✓	✓	✓	✓	✓
Adaptive frequency sweep for high-frequency electromagnetics			✓	✓	✓	✓	✓
Library of more than 60 RF and microwave substrate materials from Rogers Corporation			✓	✓	✓	✓	✓
Electric currents in layered shells				✓	✓	✓	✓
Part Library for coils and magnetic cores				✓	✓	✓	✓
Far-field analysis for transient models				✓	✓	✓	✓
High-definition Part Library for ray optics				✓	✓	✓	✓
Optical dispersion models for ray optics				✓	✓	✓	✓
New algorithm for computing ray intensity and power				✓	✓	✓	✓
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					✓	✓	✓

<b>ELECTROMAGNETICS</b>	<b>4.2-4</b>	<b>5.0-2</b>	<b>5.3</b>	<b>5.4</b>	<b>5.5</b>	<b>5.6</b>	<b>6.0</b>
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							✓

<b>HEAT TRANSFER</b>	<b>4.2-4</b>	<b>5.0-2</b>	<b>5.3</b>	<b>5.4</b>	<b>5.5</b>	<b>5.6</b>	<b>6.0</b>
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	5.0-2	5.3	5.4	5.5	5.6	6.0
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				✓	✓	✓	✓
<b>NEW Product: Metal Processing Module</b>					✓	✓	✓
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							✓



STRUCTURAL MECHANICS	4.2-4	5.0-2	5.3	5.4	5.5	5.6	6.0
Prestressed analysis	✓	✓	✓	✓	✓	✓	✓
Thin-film damping for MEMS	✓	✓	✓	✓	✓	✓	✓
<b>NEW Product: Geomechanics Module</b>	✓	✓	✓	✓	✓	✓	✓
Multiphysics interface for MEMS thermoelasticity	✓	✓	✓	✓	✓	✓	✓
Load cases	✓	✓	✓	✓	✓	✓	✓
Membranes	✓	✓	✓	✓	✓	✓	✓
Cyclic and Floquet periodicity	✓	✓	✓	✓	✓	✓	✓
<b>NEW Product: Nonlinear Structural Materials Module</b>	✓	✓	✓	✓	✓	✓	✓
<b>NEW Product: Fatigue Module</b>	✓	✓	✓	✓	✓	✓	✓
Bolt pretension	✓	✓	✓	✓	✓	✓	✓
<b>NEW Product: Multibody Dynamics Module</b>	✓	✓	✓	✓	✓	✓	✓
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		✓	✓	✓	✓	✓	✓
<b>NEW Product: Rotordynamics Module</b>		✓	✓	✓	✓	✓	✓
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			✓	✓	✓	✓	✓

STRUCTURAL MECHANICS	4.2-4	5.0-2	5.3	5.4	5.5	5.6	6.0
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			✓	✓	✓	✓	✓
<b>NEW Product: Composite Materials Module</b>				✓	✓	✓	✓
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					✓	✓	✓

STRUCTURAL MECHANICS	4.2-4	5.0-2	5.3	5.4	5.5	5.6	6.0
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)							✓
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							✓

ACOUSTICS	4.2-4	5.0-2	5.3	5.4	5.5	5.6	6.0
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	5.0-2	5.3	5.4	5.5	5.6	6.0
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							✓

FLUID FLOW	4.2-4	5.0-2	5.3	5.4	5.5	5.6	6.0
High Mach number flow	✓	✓	✓	✓	✓	✓	✓
<b>NEW Product: Microfluidics Module</b>	✓	✓	✓	✓	✓	✓	✓
k-omega turbulence model	✓	✓	✓	✓	✓	✓	✓
Euler-Euler two-phase flow	✓	✓	✓	✓	✓	✓	✓
Slip flow	✓	✓	✓	✓	✓	✓	✓
<b>NEW Product: Pipe Flow Module</b>	✓	✓	✓	✓	✓	✓	✓
Automatic boundary layer meshing	✓	✓	✓	✓	✓	✓	✓
Turbulent mixing and reacting flow	✓	✓	✓	✓	✓	✓	✓
SST turbulence	✓	✓	✓	✓	✓	✓	✓
Thin screens	✓	✓	✓	✓	✓	✓	✓
<b>NEW Product: Molecular Flow Module</b>	✓	✓	✓	✓	✓	✓	✓
Wall surface roughness for turbulent flow	✓	✓	✓	✓	✓	✓	✓

FLUID FLOW	4.2-4	5.0-2	5.3	5.4	5.5	5.6	6.0
Anisotropic porous media flow	✓	✓	✓	✓	✓	✓	✓
<b>NEW Product: Mixer Module</b>	✓	✓	✓	✓	✓	✓	✓
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, and Herschel-Bulkley-Papanastasiou				✓	✓	✓	✓
<b>NEW Product: Porous Media Flow Module</b>					✓	✓	✓
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	5.0-2	5.3	5.4	5.5	5.6	6.0
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					✓	✓	✓
<b>NEW Product: Polymer Flow Module</b>						✓	✓
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							✓

CHEMICAL	4.2-4	5.0-2	5.3	5.4	5.5	5.6	6.0
Surface reactions	✓	✓	✓	✓	✓	✓	✓
Reacting flow	✓	✓	✓	✓	✓	✓	✓
AC impedance spectroscopy	✓	✓	✓	✓	✓	✓	✓
<b>NEW Product: Electrodeposition Module</b>	✓	✓	✓	✓	✓	✓	✓
<b>NEW Product: Corrosion Module</b>	✓	✓	✓	✓	✓	✓	✓
<b>NEW Product: Electrochemistry Module</b>	✓	✓	✓	✓	✓	✓	✓
Multiscale simulations for packed bed reactors		✓	✓	✓	✓	✓	✓
Equilibrium reactions		✓	✓	✓	✓	✓	✓
Multiphysics interface for hygroscopic swelling with species transport		✓	✓	✓	✓	✓	✓
Nonspherical catalytic pellet shapes		✓	✓	✓	✓	✓	✓
Thin insulating sheets for corrosion simulations		✓	✓	✓	✓	✓	✓
Nernst-Planck-Poisson equations interface			✓	✓	✓	✓	✓
Electrophoretic transport interface			✓	✓	✓	✓	✓
Primary and secondary current distribution based on the boundary element method (BEM)			✓	✓	✓	✓	✓
A built-in thermodynamic properties library			✓	✓	✓	✓	✓
Link between Reaction Engineering interface and thermodynamic property packages			✓	✓	✓	✓	✓
Electrode reactions on thin electrode surfaces fully immersed in electrolyte			✓	✓	✓	✓	✓
New Lithium-Ion Battery Designer application for optimizing batteries for specific use cases			✓	✓	✓	✓	✓
Updated Thermodynamics interface				✓	✓	✓	✓
Partition condition for prescribing the ratio between concentrations in two adjacent phases				✓	✓	✓	✓
Lumped battery interface				✓	✓	✓	✓
Stress and strain in electrode particles due to lithium intercalation				✓	✓	✓	✓
Equivalent circuit modeling of batteries				✓	✓	✓	✓
Level set interface for corrosion modeling				✓	✓	✓	✓
Generate materials from a thermodynamic system					✓	✓	✓
Generate a Chemistry interface from a thermodynamic system					✓	✓	✓
Diffusivity models for gases and liquids					✓	✓	✓
Water and steam properties					✓	✓	✓



CHEMICAL	4.2-4	5.0-2	5.3	5.4	5.5	5.6	6.0
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					✓	✓	✓
<b>NEW Product: Fuel Cell &amp; Electrolyzer Module</b>						✓	✓
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							✓

OPTIMIZATION	4.2-4	5.0-2	5.3	5.4	5.5	5.6	6.0
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							✓

UNCERTAINTY QUANTIFICATION	4.2-4	5.0-2	5.3	5.4	5.5	5.6	6.0
<b>NEW Product: Uncertainty Quantification Module</b>							✓
Parameter screening							✓
Global sensitivity analysis							✓
Uncertainty propagation							✓
Reliability analysis							✓
Design of experiments							✓

PARTICLE TRACING	4.2-4	5.0-2	5.3	5.4	5.5	5.6	6.0
<b>NEW Product: Particle Tracing Module</b>	✓	✓	✓	✓	✓	✓	✓
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	5.0-2	5.3	5.4	5.5	5.6	6.0
<b>NEW Product: Liquid &amp; Gas Properties Module</b>						✓	✓
Realistic fluid and fluid mixture properties						✓	✓

INTERFACING	4.2-4	5.0-2	5.3	5.4	5.5	5.6	6.0
<b>NEW Product: LiveLink™ for AutoCAD®</b>	✓	✓	✓	✓	✓	✓	✓
LiveLink™ for SOLIDWORKS®: one-window interface	✓	✓	✓	✓	✓	✓	✓
<b>NEW Product: LiveLink™ for PTC® Creo® Parametric™</b>	✓	✓	✓	✓	✓	✓	✓
<b>NEW Product: LiveLink™ for Excel®</b>	✓	✓	✓	✓	✓	✓	✓
<b>NEW Product: ECAD Import Module</b>	✓	✓	✓	✓	✓	✓	✓
<b>NEW Product: LiveLink™ for Solid Edge®</b>	✓	✓	✓	✓	✓	✓	✓
LiveLink™ for Inventor®: one-window interface	✓	✓	✓	✓	✓	✓	✓
<b>NEW Product: LiveLink™ for Revit®</b>	✓	✓	✓	✓	✓	✓	✓
<b>NEW Product: Design Module</b>	✓	✓	✓	✓	✓	✓	✓
<b>NEW Product: LiveLink™ for Simulink®</b>						✓	✓