COMSOL® Software – Release Highlights History

COMSOL Multiphysics® software						
Geometry and Mesh	**4.2**	**4.3**	**4.4**	**5.0**	**5.1**	**5.2**
Virtual geometry operations	✓	✓	✓	✓	✓	✓
Image import	✓	✓	✓	✓	✓	✓
STL export		✓	✓	✓	✓	✓
NASTRAN® program mesh export			✓	✓	✓	✓
Loft, fillet, chamfer, thickening and midsurfacing with the Design Module				✓	✓	✓
New tetrahedral mesher						✓
Modeling Tools	**4.2**	**4.3**	**4.4**	**5.0**	**5.1**	**5.2**
Coordinate-based selections	✓	✓	✓	✓	✓	✓
Automatic curvilinear coordinate systems		✓	✓	✓	✓	✓
New COMSOL Desktop® environment			✓	✓	✓	✓
Material sweeps				✓	✓	✓
Open and inspect MPH files without add-on licenses					✓	✓
Studies and Solvers	**4.2**	**4.3**	**4.4**	**5.0**	**5.1**	**5.2**
Time-dependent adaptive meshing	✓	✓	✓	✓	✓	✓
Automatic remeshing	✓	✓	✓	✓	✓	✓
Cluster sweeps and cloud computing		✓	✓	✓	✓	✓
Multiparameter sweeps		✓	✓	✓	✓	✓
Results and Visualization	**4.2**	**4.3**	**4.4**	**5.0**	**5.1**	**5.2**
Report Generator	✓	✓	✓	✓	✓	✓
Interactive slice and isosurface plots	✓	✓	✓	✓	✓	✓
Reports on Microsoft® Word program format		✓	✓	✓	✓	✓
2D and 3D annotations						✓
Application Builder	**4.2**	**4.3**	**4.4**	**5.0**	**5.1**	**5.2**
Application Builder for converting models to apps				✓	✓	✓
Send email from applications					✓	✓
60 example applications in the Application Libraries						✓

COMSOL Server™ product	**4.2**	**4.3**	**4.4**	**5.0**	**5.1**	**5.2**
NEW Product: COMSOL Server™				✓	✓	✓
Run apps with COMSOL Client for Windows® operating system or web browsers				✓	✓	✓
Allow coworkers and customers worldwide to run COMSOL® applications				✓	✓	✓

*4.2 includes 4.2 and 4.2a versions.
*4.3 includes 4.3, 4.3a, and 4.3b versions.
*5.0 includes 5.0 and 5.0.1 versions.

COMSOL MULTIPHYSICS®   COMSOL SERVER™

ELECTRICAL	4.2	4.3	4.4	5.0	5.1	5.2
Lumped ports and R,L,C,S parameter matrices	✓	✓	✓	✓	✓	✓
Multiphysics interface for electrostatic-structural interactions	✓	✓	✓	✓	✓	✓
Multiphysics interface for piezoresistivity		✓	✓	✓	✓	✓
Inductively coupled and microwave plasmas		✓	✓	✓	✓	✓
NEW Product: Wave Optics Module		✓	✓	✓	✓	✓
NEW Product: Semiconductor Module		✓	✓	✓	✓	✓
Nonlinear magnetic material library with over 160 materials			✓	✓	✓	✓
Multiphysics interface for laser heating			✓	✓	✓	✓
Multiphysics interface for optoelectronics				✓	✓	✓
NEW Product: Ray Optics Module				✓	✓	✓
Coil analysis tools					✓	✓
Optical material library with over 1400 materials					✓	✓
Multiphysics interface for ray heating					✓	✓
User-defined materials written in C						✓
Smith plots						✓

HEAT TRANSFER	4.2	4.3	4.4	5.0	5.1	5.2
Multilayered shells	✓	✓	✓	✓	✓	✓
Fans and grilles	✓	✓	✓	✓	✓	✓
Solar irradiation		✓	✓	✓	✓	✓
Moist air and condensation		✓	✓	✓	✓	✓
Multi-wavelength radiation		✓	✓	✓	✓	✓
Phase change		✓	✓	✓	✓	✓
Thermal contact with surface roughness		✓	✓	✓	✓	✓
Multiphysics interface for the thermoelectric effect			✓	✓	✓	✓
Bioheating with damage integral analysis			✓	✓	✓	✓
Non-isothermal flow in porous media					✓	✓
Algebraic turbulence models					✓	✓
Multiphysics interface for the Marangoni effect					✓	✓

STRUCTURAL MECHANICS	4.2	4.3	4.4	5.0	5.1	5.2
Prestressed analysis	✓	✓	✓	✓	✓	✓
Thin-film damping for MEMS	✓	✓	✓	✓	✓	✓
NEW Product: Geomechanics Module	✓	✓	✓	✓	✓	✓
Multiphysics interface for MEMS thermoelasticity		✓	✓	✓	✓	✓
Load cases		✓	✓	✓	✓	✓
Membranes		✓	✓	✓	✓	✓
Cyclic and Floquet periodicity		✓	✓	✓	✓	✓
NEW Product: Nonlinear Structural Materials Module		✓	✓	✓	✓	✓
NEW Product: Fatigue Module		✓	✓	✓	✓	✓
Bolt pretension		✓	✓	✓	✓	✓
NEW Product: Multibody Dynamics Module		✓	✓	✓	✓	✓
Rotordynamic forces			✓	✓	✓	✓
Multiphysics interface for hygroscopic swelling				✓	✓	✓
Nonlinear elastic materials				✓	✓	✓
Orthotropic, anisotropic, and hyperelastic membranes				✓	✓	✓
Nonlinear elastic materials				✓	✓	✓
Multiphysics interfaces for multibody dynamics with heat transfer and acoustics				✓	✓	✓
Multiphysics interface for thermoelastic damping in MEMS						✓
User-defined materials written in C						✓

ACOUSTICS	4.2	4.3	4.4	5.0	5.1	5.2
Multiphysics interface for acoustic-piezo interactions	✓	✓	✓	✓	✓	✓
Multiphysics interface for acoustic-shell interactions	✓	✓	✓	✓	✓	✓
Multiphysics interface for poroelastic waves	✓	✓	✓	✓	✓	✓
Multiphysics interface for thermoviscous acoustic-solid interactions	✓	✓	✓	✓	✓	✓
Multiphysics interface for pipe acoustics		✓	✓	✓	✓	✓
Multiphysics interface for membrane-acoustic interactions		✓	✓	✓	✓	✓
Multiphysics interface for thermoviscous acoustic-shell interactions		✓	✓	✓	✓	✓
Aeroacoustics with linearized Euler equations			✓	✓	✓	✓
Ray acoustics				✓	✓	✓
Aeroacoustics with linearized Navier-Stokes equations				✓	✓	✓
Octave plots						✓

FLUID FLOW	4.2	4.3	4.4	5.0	5.1	5.2
High-mach number flow	✓	✓	✓	✓	✓	✓
NEW Product: Microfluidics Module	✓	✓	✓	✓	✓	✓
k-omega turbulence model	✓	✓	✓	✓	✓	✓
Euler-Euler two-phase flow	✓	✓	✓	✓	✓	✓
Slip-flow	✓	✓	✓	✓	✓	✓
NEW Product: Pipe Flow Module		✓	✓	✓	✓	✓
Automatic boundary-layer meshing		✓	✓	✓	✓	✓
Turbulent mixing and reacting flow		✓	✓	✓	✓	✓
SST turbulence		✓	✓	✓	✓	✓
Thin screens		✓	✓	✓	✓	✓
NEW Product: Molecular Flow Module		✓	✓	✓	✓	✓
Wall surface roughness for turbulent flow			✓	✓	✓	✓
Anisotropic porous media flow			✓	✓	✓	✓
NEW Product: Mixer Module			✓	✓	✓	✓
Algebraic turbulence models				✓	✓	✓
Turbulence with grilles and fans				✓	✓	✓
Cavitation for thin film flow				✓	✓	✓
3D laminar flow to 1D pipe flow connection				✓	✓	✓
Coupled porous media and turbulent flow					✓	✓
Three-phase laminar flow						✓

CHEMICAL	4.2	4.3	4.4	5.0	5.1	5.2
Surface reactions	✓	✓	✓	✓	✓	✓
Reacting flow	✓	✓	✓	✓	✓	✓
AC impedance spectroscopy	✓	✓	✓	✓	✓	✓
NEW Product: Electrodeposition Module	✓	✓	✓	✓	✓	✓
NEW Product: Corrosion Module		✓	✓	✓	✓	✓
NEW Product: Electrochemistry Module		✓	✓	✓	✓	✓
Multiscale simulations for packed bed reactors				✓	✓	✓
Equilibrium reactions				✓	✓	✓
Multiphysics interface for hygroscopic swelling with species transport					✓	✓
Nonspherical catalytic pellet shapes						✓
Thin insulating sheets for corrosion simulations						✓

OPTIMIZATION	4.2	4.3	4.4	5.0	5.1	5.2
Parameter optimization		✓	✓	✓	✓	✓
Design optimization		✓	✓	✓	✓	✓
Gradient-based and derivative-free optimization study		✓	✓	✓	✓	✓
Multianalysis optimization				✓	✓	✓
New least square fitting method						✓

PARTICLE TRACING	4.2	4.3	4.4	5.0	5.1	5.2
NEW Product: Particle Tracing Module	✓	✓	✓	✓	✓	✓
Secondary emission		✓	✓	✓	✓	✓
Particle-particle interactions		✓	✓	✓	✓	✓
Particle-field and fluid-particle Interactions			✓	✓	✓	✓
Space-charge limited emission					✓	✓
Particle-matter interactions						✓

INTERFACING	4.2	4.3	4.4	5.0	5.1	5.2
NEW Product: LiveLink™ for AutoCAD®	✓	✓	✓	✓	✓	✓
LiveLink™ for SOLIDWORKS®: one-window interface	✓	✓	✓	✓	✓	✓
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			✓	✓	✓	✓

COMSOL® Software – Release Details History

COMSOL MULTIPHYSICS® PLATFORM SUPPORT	4.2	4.3	4.4	5.0	5.1	5.2
General Windows®, OS X, and Linux® operating system support	✓	✓	✓	✓	✓	✓
Windows® 8.1 support			✓	✓	✓	✓
Run apps on all major web browsers				✓	✓	✓
OS X 10.11 El Capitan support					✓	✓
Windows® 10 operating system support					✓	✓

COMSOL MULTIPHYSICS® MESH AND GEOMETRY	4.2	4.3	4.4	5.0	5.1	5.2
Virtual geometry operations	✓	✓	✓	✓	✓	✓
Parametric surfaces	✓	✓	✓	✓	✓	✓
Digital elevation model import	✓	✓	✓	✓	✓	✓
Image import	✓	✓	✓	✓	✓	✓
Interpolation curves	✓	✓	✓	✓	✓	✓
STL export		✓	✓	✓	✓	✓
3D cross-section work planes		✓	✓	✓	✓	✓
Automatic curvilinear coordinate systems		✓	✓	✓	✓	✓
Boolean operations on surfaces		✓	✓	✓	✓	✓
2D NASTRAN® program import		✓	✓	✓	✓	✓
NASTRAN® program mesh export			✓	✓	✓	✓
Solid operations on imported meshes				✓	✓	✓
Loft, fillet, chamfer, thickening, and midsurfacing with the new Design Module				✓	✓	✓
Geometry Parts					✓	✓
New tetrahedral mesher						✓
Mesh Parts						✓

COMSOL MULTIPHYSICS® MODELING TOOLS	4.2	4.3	4.4	5.0	5.1	5.2
Coordinate-based selections	✓	✓	✓	✓	✓	✓
Boundary PDEs and distributed ODEs	✓	✓	✓	✓	✓	✓
New COMSOL Desktop®				✓	✓	✓	✓
Multiphysics node				✓	✓	✓	✓
Hover-and-click selections				✓	✓	✓	✓
Global materials				✓	✓	✓
Material sweeps				✓	✓	✓
Open and inspect MPH files without add-on licenses					✓	✓
Search tool for models and apps					✓	✓
Table sort					✓	✓
Save MPH file if license server connection is lost						✓
Release licenses dynamically						✓

COMSOL MULTIPHYSICS® STUDIES AND SOLVERS	4.2	4.3	4.4	5.0	5.1	5.2
Time-dependent adaptive meshing	✓	✓	✓	✓	✓	✓
Automatic remeshing	✓	✓	✓	✓	✓	✓
Double-dogleg nonlinear solver		✓	✓	✓	✓	✓
Cluster Sweep and Batch Sweep		✓	✓	✓	✓	✓
Multiparameter sweeps		✓	✓	✓	✓	✓
Cloud computing with Amazon EC2™		✓	✓	✓	✓	✓
Sensitivity study		✓	✓	✓	✓	✓
CAD assembly multiphysics simulations				✓	✓	✓
Eigenfrequency interval search				✓	✓	✓
Selections for solution data						✓

COMSOL MULTIPHYSICS® RESULTS AND VISUALIZATION	4.2	4.3	4.4	5.0	5.1	5.2
Report Generator	✓	✓	✓	✓	✓	✓
Interactive slice and isosurface plots	✓	✓	✓	✓	✓	✓
Join data sets	✓	✓	✓	✓	✓	✓
Reports on Microsoft® Word program format		✓	✓	✓	✓	✓
Comet tail plots		✓	✓	✓	✓	✓
STL export of isosurfaces		✓	✓	✓	✓	✓
Text-based search for variables in results			✓	✓	✓	✓
Spectrum color table				✓	✓	✓
Contour tube plot				✓	✓	✓
Visualize on grid outside computational mesh					✓	✓
Point trajectories plot					✓	✓
Array visualization for periodic solutions					✓	✓
2D and 3D annotations						✓

COMSOL MULTIPHYSICS® APPLICATION BUILDER	4.2	4.3	4.4	5.0	5.1	5.2
Application Builder				✓	✓	✓
Convert model to app				✓	✓	✓
20 example applications in Application Libraries					✓	✓
Send email from applications					✓	✓
Support for apps using LiveLink™ *for* Excel®					✓	✓
Enabling disabling of form objects from methods					✓	✓
60 example applications in Application Libraries						✓
Editor Tools						✓
Dynamic graphics updates						✓

COMSOL SERVER™	4.2	4.3	4.4	5.0	5.1	5.2
NEW Product: COMSOL Server™				✓	✓	✓
Run apps with COMSOL Client for Windows®				✓	✓	✓
Run apps with any major web browser				✓	✓	✓
Allow coworkers and customers to run COMSOL applications				✓	✓	✓
Fast launch of apps, app prelaunching				✓	✓	✓
Configure for one app						✓
Reconnect to app for lost connections						✓

ELECTRICAL	4.2	4.3	4.4	5.0	5.1	5.2
Lumped ports and matrices for AC/DC	✓	✓	✓	✓	✓	✓
Far fields in dielectric media	✓	✓	✓	✓	✓	✓
S-parameter matrices for high-frequency electromagnetics	✓	✓	✓	✓	✓	✓
Differential inductance	✓	✓	✓	✓	✓	✓
Multiphysics interface electrostatic-structural interactions	✓	✓	✓	✓	✓	✓
Coil excitation tools		✓	✓	✓	✓	✓
Porous media material models		✓	✓	✓	✓	✓
Electrical motors and generator tools		✓	✓	✓	✓	✓
Dispersive media		✓	✓	✓	✓	✓
Multiphysics interface for piezoresistivity		✓	✓	✓	✓	✓
S-parameter matrices for low-frequency electromagnetics		✓	✓	✓	✓	✓
Inductively coupled plasmas		✓	✓	✓	✓	✓
Periodic ports with Floquet periodicity		✓	✓	✓	✓	✓
Lumped RLC elements		✓	✓	✓	✓	✓
NEW Product: Wave Optics Module		✓	✓	✓	✓	✓
New E-J formulation for superconductive materials		✓	✓	✓	✓	✓
Vectorized floating potentials		✓	✓	✓	✓	✓
Electrical contact with surface roughness		✓	✓	✓	✓	✓
NEW Product: Semiconductor Module			✓	✓	✓	✓
Nonlinear magnetic material library with over 160 materials			✓	✓	✓	✓
Improved multiphysics interface for induction heating			✓	✓	✓	✓
Interior ports			✓	✓	✓	✓
Transition boundary condition for thin conductive films			✓	✓	✓	✓
Deposited microwave power boundary condition			✓	✓	✓	✓
Gaussian background field			✓	✓	✓	✓
Improved multiphysics interface for microwave heating			✓	✓	✓	✓
Multiphysics interface for laser heating			✓	✓	✓	✓
Improved multiphysics interface for Joule heating			✓	✓	✓	✓
Thermal diffusion of electrons in plasmas			✓	✓	✓	✓

ELECTRICAL	4.2	4.3	4.4	5.0	5.1	5.2
Heterojunctions, impact ionization, and field-dependent mobility			✓	✓	✓	✓
Small-signal analysis and incomplete ionization for semiconductors			✓	✓	✓	✓
Automated meshing for infinite elements and perfectly matched layers				✓	✓	✓
Automatic mesh adaption based on material properties				✓	✓	✓
Numeric TEM ports for transmission lines				✓	✓	✓
Multiphysics interface for optoelectronics				✓	✓	✓
Linearly polarized wave as background field				✓	✓	✓
NEW Product: Ray Optics Module				✓	✓	✓
Equilibrium discharges for plasmas				✓	✓	✓
Doping models for semiconductors				✓	✓	✓
Automatic meshing for dopant concentration gradients				✓	✓	✓
Spontaneous emission				✓	✓	✓
Light absorption and stimulated emission				✓	✓	✓
Tunnel currents				✓	✓	✓
Modeling of traps				✓	✓	✓
Band-Gap narrowing models				✓	✓	✓
Transmission line calculator app					✓	✓
Coil geometry analysis tool					✓	✓
SPICE export					✓	✓
SPICE Components: PNP BJT, p-channel MOSFET, Mutual inductance, Transformer					✓	✓
Loss tangent, loss angle, and dissipation factor					✓	✓
Surface roughness on lossy conductive surfaces					✓	✓
Time-domain modeling of dispersive Drude-Lorentz media					✓	✓
Wavelength-domain study					✓	✓
Hexagonal periodic structures					✓	✓
Beam envelope method for ring resonators					✓	✓
Optical material library with over 1400 materials					✓	✓
Optical components part library					✓	✓
Polarization ellipses plot					✓	✓
Multiphysics interface for ray heating					✓	✓
Ray release based on text file					✓	✓
Ray intensity computation in graded media					✓	✓
Material models from externally programmed libraries written in C						✓
Effective nonlinear magnetic curves calculator						✓
Smith plots						✓
Optical fiber simulation app						✓
Multiphysics interface for thermoelastic damping in MEMS						✓
	4.2	4.3	4.4	5.0	5.1	5.2

HEAT TRANSFER	4.2	4.3	4.4	5.0	5.1	5.2
Multilayered shells	✓	✓	✓	✓	✓	✓
Fans and grilles	✓	✓	✓	✓	✓	✓
External radiation sources	✓	✓	✓	✓	✓	✓
Solar irradiation		✓	✓	✓	✓	✓
Total power heat sources		✓	✓	✓	✓	✓
Moist air and condensation		✓	✓	✓	✓	✓
Load cases		✓	✓	✓	✓	✓
Multi-wavelength radiation		✓	✓	✓	✓	✓
Phase change with apparent heat capacity method		✓	✓	✓	✓	✓
Thermal contact with surface roughness		✓	✓	✓	✓	✓
Fast methods for radiation in participating media			✓	✓	✓	✓
Multiphysics interface for thermoelectric effect			✓	✓	✓	✓
Bioheating damage integral analysis			✓	✓	✓	✓
Easy verification of global heat and energy balances			✓	✓	✓	✓
Mixed low- and high-conductive multilayered shells				✓	✓	✓
Heat transfer in fractures				✓	✓	✓
Heat transfer in highly conductive rods				✓	✓	✓
Cryogenic damage integral analysis				✓	✓	✓
Fans and grilles for turbulent flow				✓	✓	✓
Viscous dissipation				✓	✓	✓
Isothermal domains				✓	✓	✓
List of solar positions for cities				✓	✓	✓
New multiphysics interface for non-isothermal flow				✓	✓	✓
Algebraic turbulence models					✓	✓
Multiphysics interface for local thermal non-equilibrium					✓	✓
Coupled porous media and turbulent flow					✓	✓
Non-isothermal flow in porous media					✓	✓
Deposited beam power tool					✓	✓
Multiphysics interface for the Marangoni effect					✓	✓
Blackbody intensity and emissive power functions					✓	✓
5 times faster bioheating					✓	✓
Symmetry plane for surface-to-surface radiation						✓

STRUCTURAL MECHANICS	4.2	4.3	4.4	5.0	5.1	5.2
PMLs for piezoelectric materials	✓	✓	✓	✓	✓	✓
Infinite elements for solid mechanics	✓	✓	✓	✓	✓	✓
Prestressed analysis	✓	✓	✓	✓	✓	✓
NEW Product: Geomechanics Module	✓	✓	✓	✓	✓	✓
Voigt notation for anisotropic materials	✓	✓	✓	✓	✓	✓
Specify elastic materials using 9 different property combinations	✓	✓	✓	✓	✓	✓
Thin-film damping for MEMS	✓	✓	✓	✓	✓	✓
New contact solver based on double dogleg method		✓	✓	✓	✓	✓
Load cases		✓	✓	✓	✓	✓
Membranes		✓	✓	✓	✓	✓
Cyclic and Floquet periodicity		✓	✓	✓	✓	✓
Rigid connectors		✓	✓	✓	✓	✓
Low-reflecting boundary conditions for transient elastic waves		✓	✓	✓	✓	✓
Buckling for trusses		✓	✓	✓	✓	✓
NEW Product: Nonlinear Structural Materials Module		✓	✓	✓	✓	✓
Yeoh, Varga, and Blatz-Ko hyperelasticity		✓	✓	✓	✓	✓
Dilation angle for soil		✓	✓	✓	✓	✓
NEW Product: Fatigue Module		✓	✓	✓	✓	✓
Bolt pretension		✓	✓	✓	✓	✓
Beam cross-section user interface		✓	✓	✓	✓	✓
Gent, Gao, and Storakers hyperelasticity		✓	✓	✓	✓	✓
Rainflow fatigue analysis		✓	✓	✓	✓	✓
NEW Product: Multibody Dynamics Module		✓	✓	✓	✓	✓
Multiphysics interface for MEMS thermoelasticity		✓	✓	✓	✓	✓
Thermal expansion for piezomaterials		✓	✓	✓	✓	✓
Rotordynamic forces				✓	✓	✓
Contact penalty method				✓	✓	✓
Solid-shell and shell-beam connections				✓	✓	✓
Rigid domains				✓	✓	✓
Timoshenko beams				✓	✓	✓
New thermal stress multiphysics interface				✓	✓	✓
Fatigue in nonlinear materials and thermal fatigue				✓	✓	✓
Fixed joint, distance joint, universal joint, and friction in joints				✓	✓	✓
Improved multiphysics interface for thermal stress				✓	✓	✓
Geometrically nonlinear beams					✓	✓
Improved fluid-structure interaction for fixed and flexible geometry					✓	✓
Spring and damper matrices					✓	✓
Multiphysics interface for hygroscopic swelling				✓	✓	✓

STRUCTURAL MECHANICS	4.2	4.3	4.4	5.0	5.1	5.2
Easy couplings between shells and beams				✓	✓	✓
Nonlinear elastic materials				✓	✓	✓
Orthotropic, anisotropic, and hyperelastic membranes				✓	✓	✓
Nonlinear elastic materials				✓	✓	✓
Stress-life and strain-life fatigue models				✓	✓	✓
Elastic joints and base motion for multibody dynamics				✓	✓	✓
Multiphysics interfaces for multibody dynamics with heat transfer				✓	✓	✓
Multiphysics interfaces for multibody dynamics with pressure acoustics				✓	✓	✓
Improved multiphysics interface for the piezoelectric effect				✓	✓	✓
Dielectric loss in piezoelectric materials				✓	✓	✓
Built-in quartz material properties				✓	✓	✓
Part library for mechanical components					✓	✓
External stress interface					✓	✓
Viscous damping					✓	✓
Nonlinear elasticity, viscoelasticity, creep, and viscoplasticity for membranes					✓	✓
Plasticity in trusses					✓	✓
Point trajectory plots for multibody dynamics					✓	✓
Perforations in thin-film flow for MEMS					✓	✓
Material models from externally programmed libraries written in C						✓
Optimized contact for small displacements						✓

ACOUSTICS	4.2	4.3	4.4	5.0	5.1	5.2
Multiphysics interface for acoustic-piezo interactions	✓	✓	✓	✓	✓	✓
Multiphysics interface for acoustic-shell interactions	✓	✓	✓	✓	✓	✓
Multiphysics interface for poroelastic waves	✓	✓	✓	✓	✓	✓
Multiphysics interface for thermoviscous acoustics	✓	✓	✓	✓	✓	✓
Multiphysics interface for thermoviscous acoustic-solid interactions	✓	✓	✓	✓	✓	✓
Multiphysics interface for time-domain pipe acoustics		✓	✓	✓	✓	✓
Multiphysics interface for membrane-acoustic interactions		✓	✓	✓	✓	✓
Multiphysics interface for thermoviscous acoustic-shell interactions		✓	✓	✓	✓	✓
Thermoviscous acoustic boundary condition approximation		✓	✓	✓	✓	✓
Multiphysics interface for frequency-domain pipe acoustics		✓	✓	✓	✓	✓
Aeroacoustics with linearized Euler equations				✓	✓	✓
Ray acoustics				✓	✓	✓
Acoustic diffusion				✓	✓	✓
Improved multiphysics interface for the piezoelectric effect				✓	✓	✓
Aeroacoustics with linearized Navier-Stokes equations				✓	✓	✓
Predefined impedance boundary conditions					✓	✓

ACOUSTICS	4.2	4.3	4.4	5.0	5.1	5.2
Expanded poroacoustic fluid models					✓	✓
Dipole and quadrupole sources					✓	✓
Visualize far fields on grid outside computational mesh					✓	✓
Octave plots						✓
New multiphysics interface for poroelastic waves						✓

FLUID FLOW	4.2	4.3	4.4	5.0	5.1	5.2
High-Mach number flow	✓	✓	✓	✓	✓	✓
NEW Product: Microfluidics Module	✓	✓	✓	✓	✓	✓
k-omega turbulence model	✓	✓	✓	✓	✓	✓
Euler-Euler two-phase flow	✓	✓	✓	✓	✓	✓
Slip-flow	✓	✓	✓	✓	✓	✓
Turbulent mixing		✓	✓	✓	✓	✓
NEW Product: Pipe Flow Module		✓	✓	✓	✓	✓
Automatic boundary-layer meshing		✓	✓	✓	✓	✓
Turbulent reacting flow		✓	✓	✓	✓	✓
SCCM inflow		✓	✓	✓		✓
Frozen rotor method		✓	✓	✓	✓	✓
SST turbulence		✓	✓	✓	✓	✓
Thin screens		✓	✓	✓	✓	✓
Heat transfer with phase change		✓	✓	✓	✓	✓
Two-phase flow in pipes		✓	✓	✓	✓	✓
Multiphysics interface for frequency-domain pipe acoustics		✓	✓	✓	✓	✓
NEW Product: Molecular Flow Module		✓	✓	✓	✓	✓
Wall surface roughness for turbulent flow			✓	✓	✓	✓
Anisotropic porous media flow with Brinkman equations			✓	✓	✓	✓
NEW Product: Mixer Module			✓	✓	✓	✓
Algebraic turbulence models				✓	✓	✓
Turbulence with grilles and fans				✓	✓	✓
New multiphysics interface for non-isothermal flow				✓	✓	✓
SST turbulence model for reacting flow				✓	✓	✓
Cavitation for thin film flow				✓	✓	✓
Rotating machinery with multiphase flow				✓	✓	✓
Multiphysics interface for transport of diluted species in porous media				✓	✓	✓
Partially saturated porous media				✓	✓	✓
3D laminar flow to 1D pipe flow connection				✓	✓	✓
Euler-Euler two-phase flow for turbulent flow					✓	✓
Coupled porous media and turbulent flow					✓	✓

FLUID FLOW	4.2	4.3	4.4	5.0	5.1	5.2
Capillary pressure in two-phase porous media flow					✓	✓
Perforations for thin-film flow					✓	✓
Infinite elements for porous media					✓	✓
Part library with mixer equipment components					✓	✓
Part library with microfluidic channels					✓	✓
New y-junctions and n-way junctions for pipe flow					✓	✓
Parallelized molecular flow computations					✓	✓
Molecular flow with multiple species					✓	✓
Three-phase laminar flow						✓
Algebraic turbulence for rotating machinery						✓
Stationary free surface flow computation						✓
Algebraic turbulence for mixing						✓
Compressible flow in 1D pipes						✓

CHEMICAL	4.2	4.3	4.4	5.0	5.1	5.2
Surface reactions	✓	✓	✓	✓	✓	✓
Infinite elements for diffusion	✓	✓	✓	✓	✓	✓
Parameter estimation with the Optimization Module	✓	✓	✓	✓	✓	✓
Reacting flow	✓	✓	✓	✓	✓	✓
AC impedance spectroscopy	✓	✓	✓	✓	✓	✓
NEW Product: Electrodeposition Module	✓	✓	✓	✓	✓	✓
Infinite elements for electrochemical currents	✓	✓	✓	✓	✓	✓
Shell electrodes		✓	✓	✓	✓	✓
Potentiostatic control		✓	✓	✓	✓	✓
NEW Product: Corrosion Module		✓	✓	✓	✓	✓
Film resistance		✓	✓	✓	✓	✓
Thin impermeable barrier		✓	✓	✓	✓	✓
Edge electrodes		✓	✓	✓	✓	✓
Infinite electrolytes		✓	✓	✓	✓	✓
NEW Product: Electrochemistry Module		✓	✓	✓	✓	✓
Multicomponent flash calculations			✓	✓	✓	✓

CHEMICAL	4.2	4.3	4.4	5.0	5.1	5.2
Multiscale simulations for packed bed reactors				✓	✓	✓
New Chemistry interface				✓	✓	✓
Multiphysics interface for transport of diluted species in porous media				✓	✓	✓
Mass-based concentrations				✓	✓	✓
Partially saturated porous media				✓	✓	✓
Equilibrium reactions				✓	✓	✓
Current distribution on edges with the boundary element method (BEM)				✓	✓	✓
Counter electrodes for electroanalysis				✓	✓	✓
New gas mixture viscosity correlation for reaction engineering					✓	✓
Film resistance for reactive pellets					✓	✓
Multiphysics interface for hygroscopic swelling with species transport					✓	✓
Dusty gas model					✓	✓
Mass-based concentration variables					✓	✓
Nonspherical catalytic pellet shapes						✓
Volumetric effects from edge elements						✓
Thin insulating sheets for corrosion simulations						✓

OPTIMIZATION	4.2	4.3	4.4	5.0	5.1	5.2
Time-dependent sensitivity and optimization		✓	✓	✓	✓	✓
Parameter optimization		✓	✓	✓	✓	✓
Design optimization		✓	✓	✓	✓	✓
Gradient-based and derivative-free optimization study		✓	✓	✓	✓	✓
New derivative-free optimization solver: BOBYQA			✓	✓	✓	✓
New gradient-based optimization solver: MMA			✓	✓	✓	✓
Multianalysis optimization				✓	✓	✓
New parameter estimation study				✓	✓	✓
Optimization solver stop and continue				✓	✓	✓
New derivative-free method: COBYLA				✓	✓	✓
New least square fitting method						✓

PARTICLE TRACING	4.2	4.3	4.4	5.0	5.1	5.2
NEW Product: Particle Tracing		✓	✓	✓	✓	✓
Particle forces: electric, magnetic, collisional, drag, gravity, acoustophoretic, dielectrophoretic, user-defined		✓	✓	✓	✓	✓
New forces: Brownian, Schiller-Naumann, magnetophoretic, thermophoretic		✓	✓	✓	✓	✓
Secondary emission		✓	✓	✓	✓	✓
Particle-particle interactions		✓	✓	✓	✓	✓
Diffuse and general reflection		✓	✓	✓	✓	✓
Velocity reinitialization		✓	✓	✓	✓	✓
Monte Carlo elastic collisions		✓	✓	✓	✓	✓
Changing auxiliary variables		✓	✓	✓	✓	✓
Particle-field and fluid-particle Interactions			✓	✓	✓	✓
Release of particles in a cone			✓	✓	✓	✓
Max, min, average over particles			✓	✓	✓	✓
New accumulator tools enabling multiphysics couplings for erosion, etching, mass deposition, boundary load, mass flux, current density, heat source.				✓	✓	✓
Particle 1D plots				✓	✓	✓
Multiphysics interface for electric-particle field interaction					✓	✓
Multiphysics interface for magnetic-particle field interaction					✓	✓
New multiphysics interface for fluid-particle interaction					✓	✓
Inelastic collisions					✓	✓
Particle beams with beam emittance and Twiss parameters					✓	✓
Space-charge limited emission					✓	✓
Charge-exchange collisions						✓
Release from edges and points						✓
Improved density-based release						✓
Particle counters						✓
Particle-matter interactions						✓

INTERFACING	4.2	4.3	4.4	5.0	5.1	5.2
NEW Product: LiveLink™ *for* AutoCAD®	✓	✓	✓	✓	✓	✓
NEW Product: LiveLink™ *for* PTC® Creo® Parametric™	✓	✓	✓	✓	✓	✓
NEW Product: LiveLink™ *for* Excel®		✓	✓	✓	✓	✓
NEW Product: ECAD Import Module		✓	✓	✓	✓	✓
NEW Product: LiveLink™ *for* Solid Edge®		✓	✓	✓	✓	✓
NEW Product: LiveLink™ *for* Revit®			✓	✓	✓	✓
NEW Product: Design Module			✓	✓	✓	✓
Synchronize selections for materials with LiveLink™ *for* PTC® Pro/ENGINEER®					✓	✓
Synchronize selections for materials with LiveLink™ *for* PTC® Creo® Parametric™					✓	✓
Synchronize selections for materials with LiveLink™ *for* Solid Edge®					✓	✓

NEW IMPORT FORMATS	4.2	4.3	4.4	5.0	5.1	5.2
PTC® Creo® Parametric™ 1.0 software		✓	✓	✓	✓	✓
ACIS® (SAT®) R22 software		✓	✓	✓	✓	✓
CATIA® V5 R21 software		✓	✓	✓	✓	✓
Autodesk® Inventor® 2012 software		✓	✓	✓	✓	✓
Parasolid® R23, R24 software		✓	✓	✓	✓	✓
SOLIDWORKS® 2012 software		✓	✓	✓	✓	✓
Catia® V5 R 22 software		✓	✓	✓	✓	✓
Parasolid® V 25 software		✓	✓	✓	✓	✓
SOLIDWORKS® 2013 software		✓	✓	✓	✓	✓
Autodesk® Inventor® 2013 software		✓	✓	✓	✓	✓
PTC® Creo® Parametric™ 2.0 software		✓	✓	✓	✓	✓
NX™ (.prt) software				✓	✓	✓
Autodesk® AutoCAD® (.dwg, .dxf) software				✓	✓	✓
SOLIDWORKS® 2014 software				✓	✓	✓
Autodesk® Inventor® 2015 software				✓	✓	✓

LIVELINK™ for SOLIDWORKS®	4.2	4.3	4.4	5.0	5.1	5.2
One-window interface	✓	✓	✓	✓	✓	✓
Parameter linking		✓	✓	✓	✓	✓
Sync material names		✓	✓	✓	✓	✓
Sync user-defined selections			✓	✓	✓	✓
Run apps using LiveLink™ for SOLIDWORKS®					✓	✓

LIVELINK™ for INVENTOR®	4.2	4.3	4.4	5.0	5.1	5.2
Parameter linking		✓	✓	✓	✓	✓
One-window interface		✓	✓	✓	✓	✓
Sync material names and selections			✓	✓	✓	✓

ECAD IMPORT MODULE	4.2	4.3	4.4	5.0	5.1	5.2
ODB++ import			✓	✓	✓	✓
Layer renaming					✓	✓
Selections for layers						✓

LIVELINK™ *for* MATLAB®	4.2	4.3	4.4	5.0	5.1	5.2
Improved performance and memory handling	✓	✓	✓	✓	✓	✓
Model navigator	✓	✓	✓	✓	✓	✓
New functions*		✓	✓	✓	✓	✓
Updates to: mphnavigator , mpheval, mphint, mphinterp , mphplot, mphsolutioninfo, mphtable		✓	✓	✓	✓	✓
New client/server functionality			✓	✓	✓	✓
Updates to: mphplot		✓	✓	✓	✓	✓
New functions: mphevaluate, mphinterpolationfile, mphwritestl, mphreadstl, mphsurf				✓	✓	✓
Updates to: mphxmeshinfo, mphmean, mphmax, mphmin, mphint2				✓	✓	✓
New mphnavigator, mphopen, and mphload tools					✓	✓
Updates to: mphplot and mphgeom					✓	✓
Updates to: mphplot, mphgetexpressions					✓	✓

*mphimage2geom, mphevalpoint, mphmean, mphmin, mphmax, mphevalglobalmatrix , mphsearch, mphinputmatrix, mphsolution, mphtable, and mphparticle.

LIVELINK™ *for* EXCEL®	4.2	4.3	4.4	5.0	5.1	5.2
Multiple files		✓	✓	✓	✓	✓
Interpolation functions		✓	✓	✓	✓	✓
Material export		✓	✓	✓	✓	✓
Connect to remote server			✓	✓	✓	✓
Export of field-dependent material properties			✓	✓	✓	✓
Parametric sweeps in worksheet			✓	✓	✓	✓
Create macros with Visual Basic® for Applications (VBA) development system				✓	✓	✓
Localized language support				✓	✓	✓
LiveLink™ *for* Excel® for class kit licenses				✓	✓	✓
Save model files for VBA					✓	✓
Save and load spreadsheet files					✓	✓