# 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.

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

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

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

| | 4.2-4 | 5.0–5 | 5.6 | 6.0 | 6.1 | 6.2 | 6.3 |
|---|---|---|---|---|---|---|---|
| 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™** | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |

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