Powerful User-Driven Features and Scalable Deployment of Apps Bring Multiphysics to Everyone with the Latest Release of COMSOL Multiphysics® and COMSOL Server™

The latest release of the COMSOL Multiphysics® and COMSOL Server™ products provide numerical simulation specialists with the leading integrated CAE software environment for creating multiphysics models and building simulation apps that can be easily deployed to collaborators and customers worldwide.
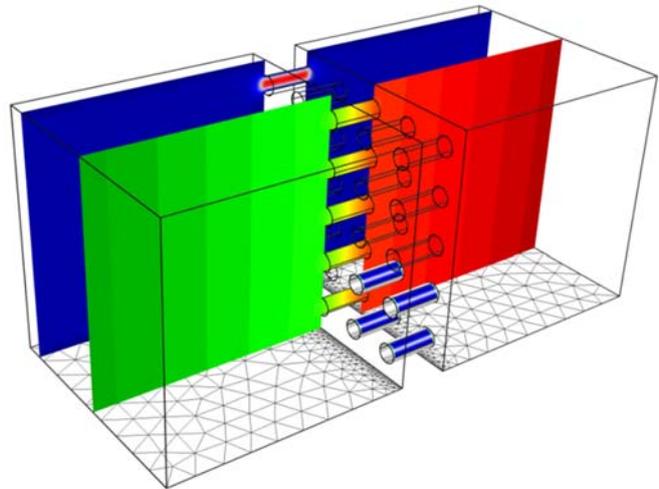
BURLINGTON, MA (June 17, 2016) — COMSOL, Inc. the leading provider of multiphysics modeling, simulation, and application design software, today announced the latest release of the **COMSOL Multiphysics® and COMSOL Server™ simulation software environment**. Hundreds of user-driven features and enhancements to COMSOL Multiphysics®, COMSOL Server™, and add-on products have been implemented with an emphasis on accuracy, usability, and productivity. From new solvers and methods, to application design and deployment tools, COMSOL® software version 5.2a expands the electrical, mechanical, fluid, and chemical design and optimization capabilities.

Powerful New Tools for Multiphysics Simulation

In COMSOL Multiphysics 5.2a, three new solvers deliver faster and more memory efficient computations. The smoothed aggregation algebraic multigrid (SA-AMG) solver has proven to be particularly efficient for linear elastic analysis, but is also applicable to many other types of analyses. This solver is very memory conservative, making it possible to run structural assemblies with millions of degrees of freedom on a standard desktop or laptop computer.

Thermoviscous acoustics simulation solved with the domain decomposition solver. Local acceleration, total acoustic pressure, and total thermo-viscous power dissipation density are shown. This COMSOL® model is used to design microphones and speakers used in consumer products, such as, smartphones, tablets, and laptops. It consists of 2.5 million degrees of freedom and required 14 GB of RAM to solve. Previously 120 GB were needed using a direct solver.

The domain decomposition solver has been optimized for handling large multiphysics models. "The domain decomposition solver provides simulation specialists with a robust and flexible technology to more efficiently compute strongly-coupled multiphysics applications which previously required a memory-hungry direct solver," says Jacob Ystrom, Technical Manager of the numerical analysis department at COMSOL. "Using this solver, customers will benefit from improved efficiency when running on single computers, clusters, as well as when combined with other solvers such as the aggregation algebraic multigrid solver."

A new explicit solver based on the discontinuous Galerkin (DG) method for acoustics in the time-domain is now available. "Combing the discontinuous Galerkin method with the new absorbing layers in the time-domain,

results in a level of memory efficiency that will allow our customers to perform more realistic simulations than ever possible before, for a given memory size" says Mads Jensen, Technical Product Manager, Acoustics.
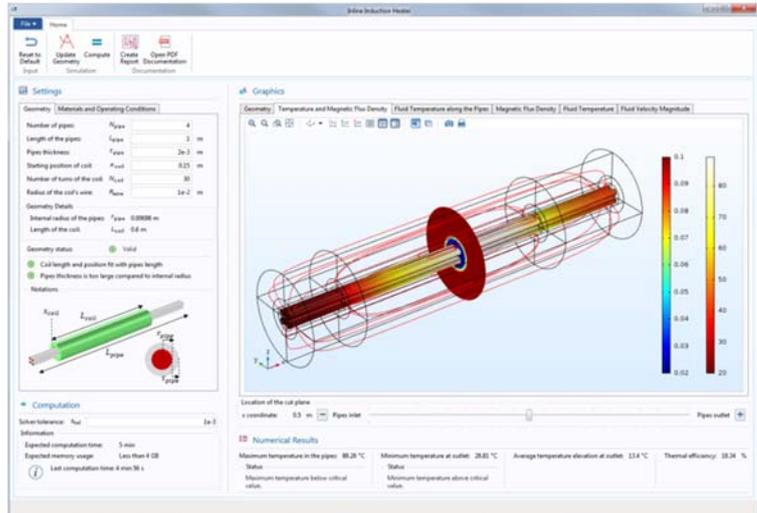
Building and Deploying Apps: Easy and Scalable for Global Use
The complete suite of computational tools provided by COMSOL Multiphysics® software and its Application Builder allows simulation specialists to design and optimize their products and create apps for the benefit of colleagues and customers. Simulation apps allow users without any previous experience using simulation software to run the apps for their specific purpose. With version 5.2a, app designers can build even more dynamic apps where the appearance of the user interface can change during run time, centralize unit handling to better serve teams working across different countries, and include hyperlinks and videos.
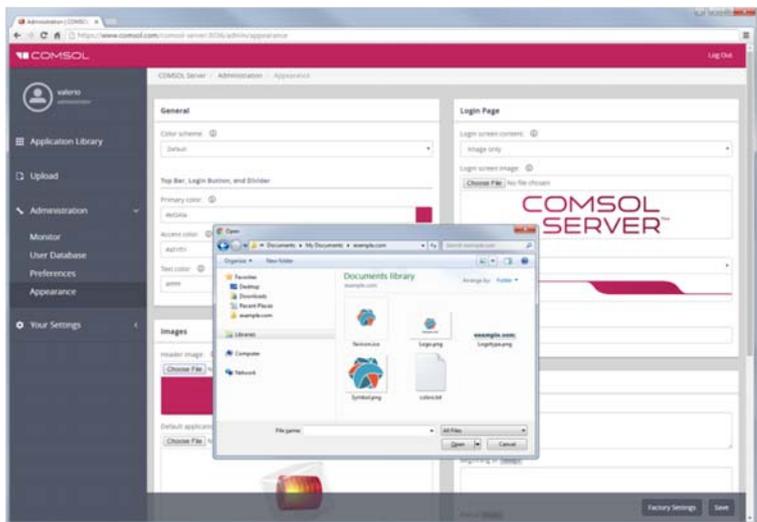
Apps can be deployed throughout organizations using the COMSOL Client for Windows® or web browser by connecting to a COMSOL Server™ installation. This provides a cost-effective solution for managing how apps are used, either by

COMSOL Multiphysics® and COMSOL Server™, can be used for the design of a magnetic induction device used for food processing.

users within an organization or to an organization's clients and customers worldwide. In this latest version, administrators can customize the visual appearance and style of COMSOL Server™ software for branding purposes, and set the number of prelaunched applications for high-usage cases.

"By providing our customers with the flexibility to customize the visual appearance and style of their COMSOL Server installation, they will be able to provide a cohesive brand experience that their colleagues and customers will be able to easily recognize and adopt into their existing processes," says Svante Littmarck, President and CEO, COMSOL Inc.

"The Application Builder allowed us to give other departments access to our analysis app without them needing to learn finite element theory," commented Romain Haettel, Principal Engineer of ABB Corporate Research Center (ABB CRC). "We have also been using the COMSOL Server license to distribute our app to colleagues

Administrators can customize the visual theme of the COMSOL Server™ web interface. Colors, logos, and log in screen can be customized and HTML code added for branding purposes.

worldwide for testing. With this new version we can hopefully bring an even better user experience through quick launch from our own styled version of the COMSOL Server software." ABB is a global leader in manufacturing of power transformers and innovator in creating and deploying simulation apps for worldwide use.

"Our customers have come to trust the exceptional robustness and user-friendliness of our multiphysics solutions for app creation and deployment. They're reaping the benefits of such technology by implementing more efficient workflows and processes," concludes Littmarck.
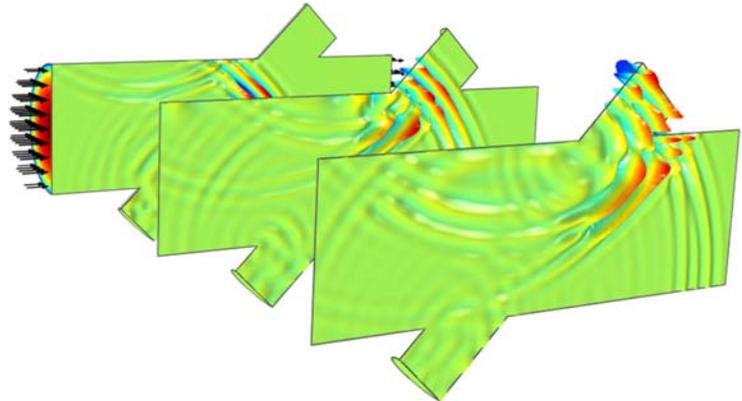
Hundreds of User-Driven Features and Enhancements to COMSOL Multiphysics®, COMSOL Server™, and Add-On Products

Version 5.2a delivers user-driven, new and enhanced functionality from core technology to specialized boundary conditions and material libraries. For example, the tetrahedral meshing algorithm with an included state-of-the-art quality optimization algorithm has made it easier than ever to create coarse meshes used for the preliminary study of complicated CAD geometries that feature many thin parts. Visualizations now include annotations with LaTeX formatting, improved table surface plots, VTK export, and new color tables.

Magnetic vector hysteresis for the modeling of transformers and ferromagnetic material is introduced. Domain terminal boundary conditions for easier simulation of touchscreens and MEMS devices are now available. Ray tracing simulations can combine graded index and constant index materials in meshed and unmeshed domains. The new Optical Aberration plot type is dedicated to measuring monochromatic aberrations. Two-port-networks, fast-frequency sweeps, and nonlinear frequency-mixing are available for high-frequency electromagnetics analysis.

Design and manufacturing engineers working across all industries will benefit from the new adhesion and decohesion feature as they analyze various processes involving mechanical contact with parts sticking together and pulling apart. A new physics interface for modeling linear and nonlinear magnetostriction is also available. Heat transfer users can now access a meteorological database from 6000 weather stations and model fluid, solid, or porous media thin structures.

COMSOL® numerical simulation of a wetted transient time-of-flight ultrasound flow meter. Ultrasound signal propagating in the device is shown at different time steps. The steady-state background flow in the flow meter is computed first. The Convected Wave Equation, Time Explicit physics interface is then used to model the ultrasound signal propagating in the device. The interface is based on the discontinuous Galerkin method (DG).

Users modeling fluid flow with buoyancy will appreciate the new gravity property for density variations, which simplifies the set up of natural convection applications where density may vary depending on temperature, salinity, or other variables. Pipe flow simulations can now benefit from the advanced pump curves.

For chemical simulations, surface reaction in reactive pellet beds and a new reacting flow multiphysics interface are available. Battery manufacturers and designers can now model complex 3D assemblies in battery packs using the new single particle battery interface. Discharge and recharge behaviors are supplied by the single particle model at every point in the geometry. This makes it possible to estimate the geometrical current density distribution and the local state of charge in the battery pack.

Highlights of New Features and Tools Available in Version 5.2a
- **COMSOL Multiphysics®, Application Builder, and COMSOL Server™:** The appearance of the user interface of simulation apps can change during run time. Centralized unit handling to better serve teams working across different countries is supported. Hyperlinks and videos can now be included. A new *Add Multiphysics* window makes it easier for users to create multiphysics models incrementally by providing

a list of available predefined multiphysics couplings for the selected physics interfaces. Autocomplete has been expanded to many fields including the equation view fields.

- **Geometry and Mesh:** The enhanced tetrahedral meshing algorithm can now easily create coarse meshes for complicated CAD geometries that feature many thin parts. A new optimization algorithm built into the mesher is available for improving element quality, which may improve the accuracy of a solution and make it faster to converge. Interactive drawing for 2D geometries now features better coordinate display and snapping points.

- **Mathematical Modeling Tools, Studies, and Visualization:** Three new solvers are introduced: the smoothed aggregation algebraic multigrid method (SA-AMG), the domain decomposition solver, and the discontinuous Galerkin (DG) method. Users can now save data and plots added to the Export node under Results in VTK format, making it possible to import COMSOL simulation results and meshes to 3rd party software.

- **Electrical:** The AC/DC Module now features a material model for magnetic hysteresis built-in called Jiles-Atherton. The new lumped two-port network coupling is introduced in the RF Module, allowing for lumped modeling to represent parts of a microwave circuit in a simplified way without having to model the details.

- **Mechanical:** The Structural Mechanics Module includes the new adhesion and decohesion features, available as a subnode under the Contact feature. A Magnetostriction physics interface that supports both linear and nonlinear magnetostriction is now available. The nonlinear material modeling capabilities have been expanded with new plasticity models, mixed isotropic and kinematic hardening, and large-strain viscoelasticity.

- **Fluid:** The CFD Module and Heat Transfer Module now include a feature that adds a gravity force and concurrently compensates for the hydrostatic pressure on boundaries. A new linearized density option in Non-Isothermal Flow, a common simplification for natural convection flows, is now available.

- **Chemical:** Battery manufacturers and designers can now model complex 3D assemblies in battery packs using the Single Particle Battery physic interface available in the Batteries & Fuel Cells Module. Additionally, a new Reacting Flow Multiphysics physics interface is now available.

Using COMSOL Multiphysics®, Application Builder, and COMSOL Server™, simulation specialists have access to a fully integrated software environment to create applications that will best serve their specific industry in a dynamic, easy to use, quick to implement format that can be scaled for global benefit.

Availability

To watch the release highlights video and download COMSOL Multiphysics® and COMSOL Server™ software version 5.2a now, visit www.comsol.com/release/5.2a

About COMSOL

COMSOL is a global provider of simulation software for product design and research to technical enterprises, research labs, and universities. Its COMSOL Multiphysics® product is an integrated software environment for creating physics-based models and simulation apps. A particular strength is its ability to account for coupled or multiphysics phenomena. Add-on products expand the simulation platform for electrical, mechanical, fluid flow, and chemical applications. Interfacing tools enable the integration of COMSOL Multiphysics® simulations with all major technical computing and CAD tools on the CAE market. Simulation experts rely on the COMSOL Server™ product to deploy apps to their design teams, manufacturing departments, test laboratories, and customers throughout the world. Founded in 1986, COMSOL employs more than 400 people in 22 offices worldwide and extends its reach with a network of distributors.

~