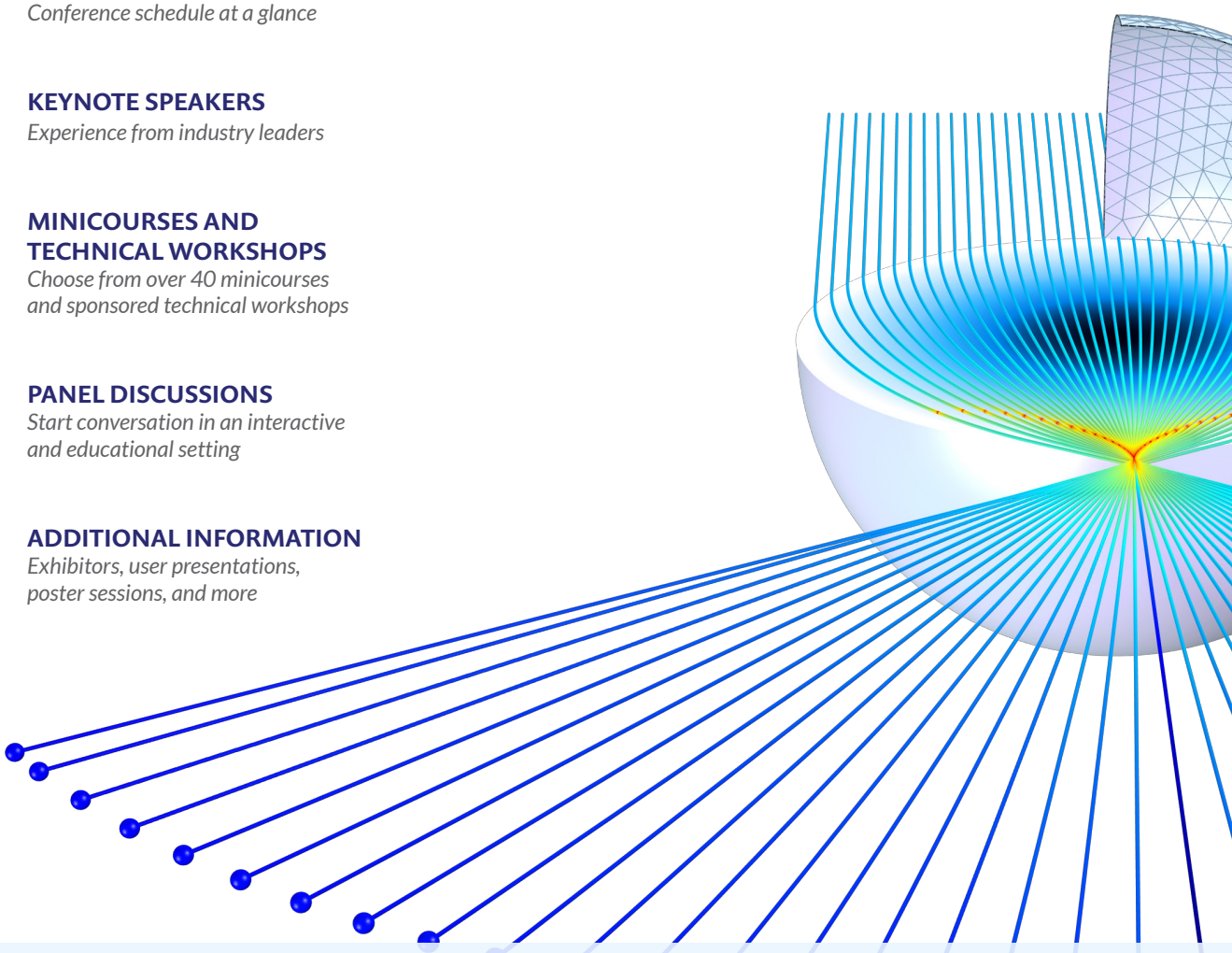
COMSOL CONFERENCE
2018 BOSTON

Connect. Learn. Innovate.

Welcome to the
COMSOL Conference 2018

Join us October 3–5 at the Boston Marriott Newton.
Over the course of three days, expand your skills in numerical simulation. Through a better understanding of multiphysics modeling and simulation applications, you will be better equipped and inspired to tackle your next design challenge.

Learn more about the COMSOL Conference and register today!
▸ comsol.com/conference/registration/boston



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WEDNESDAY OCTOBER 3

TIME	EVENT
8:00AM	Registration Opens
9:00AM	Welcome to the COMSOL Conference
9:30AM	Minicourses and Workshop

COMSOL Multiphysics® for New Users
Conduction and Convection
Geometry Modeling and CAD Import
Laminar and Microfluidic Flow
Resistive and Capacitive Devices
Sponsored Workshop: Modeling Mechanical Behavior of Rubbers and Thermoplastics in COMSOL Multiphysics®

10:30AM	Coffee Break
11:00AM	Keynote Session

Svante Littmarck, *COMSOL, Inc.*

12:00PM	Lunch
1:00PM	Demo Stations, Exhibition, and Poster Sessions Open
1:00PM	Minicourses and Panel Discussion

Magnets, Coils, and Motors
Meshing
Radiation and Ambient Conditions Modeling
Turbulent and High Mach Number Flow
Understanding the Stationary Solvers
Panel Discussion: Materials Processing and Additive Manufacturing

2:00PM	Coffee Break
2:30PM	Minicourses, Workshop, and Panel Discussion

Introduction to the Application Builder
RF and Microwave Modeling
Structural Mechanics and Multiphysics
Understanding the Time-Depenent Solvers
Sponsored Workshop: Synopsys Simpleware™: From 3D Images to Models
Panel Discussion: Batteries and Fuel Cells

3:30PM	Coffee Break
4:00PM	Minicourses

Moisture Transport and Heat Transfer with Phase Change
Optimization
Postprocessing
Structural Dynamics Modeling
Wave Optics Modeling

5:00PM	Tech Briefs Cocktail Reception
6:15PM	Explore Boston

THURSDAY OCTOBER 4

TIME	EVENT
8:00AM	Registration and Breakfast
9:00AM	Minicourses and Panel Discussion

Automating Model Building Using Methods and the Application Builder
Update Training: CAD and Meshing
Update Training: Fluid and Chemical
Update Training: Electrical
Panel Discussion: Modeling Strategies for Acoustics Simulations

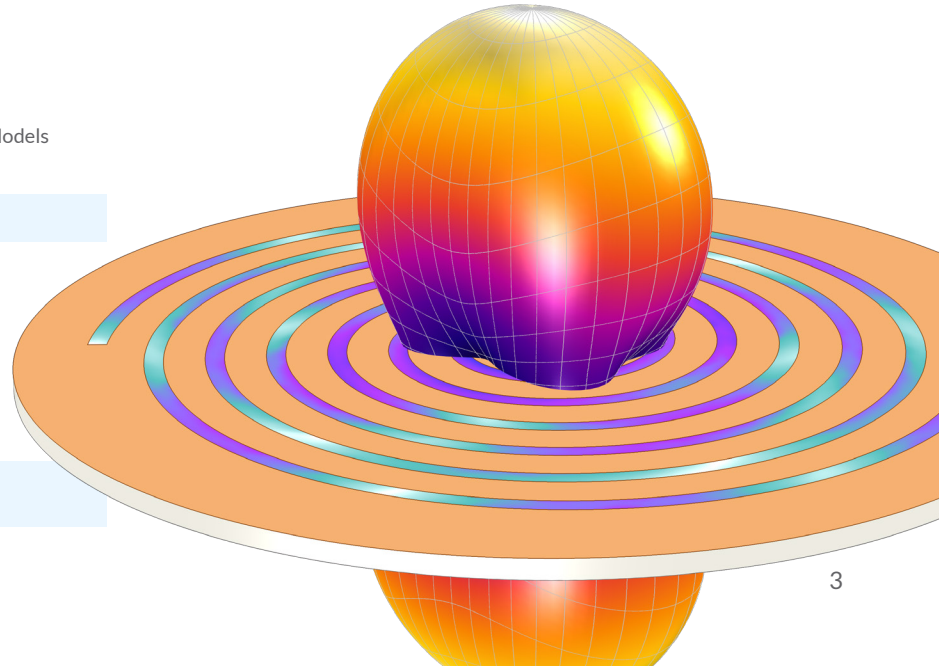
10:00AM	Coffee Break
10:30AM	User Presentations
12:00PM	Lunch
1:00PM	User Presentations
2:30PM	Coffee Break
3:00PM	Keynote Session

Freddy Hansen, *Abbott Laboratories*
Justin McKennon, *NTS Lightning Technologies*
Ivana Milanovic, *University of Hartford*

4:30PM	Coffee Break
5:00PM	Minicourses and Workshop

Deploying Apps Using COMSOL Server™
Update Training: Thermal
Update Training: Structural and Acoustics
Sponsored Workshop: Best Practices for Using COMSOL Multiphysics®: Interpreting Software Feedback

6:00PM	Poster Session
7:00PM	Gala Dinner



FRIDAY OCTOBER 5

TIME	EVENT
7:30AM	Registration and Breakfast
8:00AM	Minicourses

Charged Particle Tracing
Chemical Reaction Engineering
Equation-Based Modeling
Modeling Speakers, Microphones, and Other Transducers
Semiconductor Modeling

9:00AM	Coffee Break
9:30AM	Minicourses

Electrodeposition and Corrosion
Modeling Acoustic Propagation in Small and Large Fluid Domains
Particle Tracing in Fluids
Plasma Modeling
Solving Larger Models

10:30AM	Coffee Break
11:00AM	Keynote Session and Awards Ceremony

Eric Gebhard, *Signal Microwave*
Nicholas Goldring, *Radiasoft*
Steve Doggett, *Built Environments*

12:30PM	Lunch
1:30PM	Minicourses

Battery Modeling
Introduction to the Application Builder
Material Models in Structural Mechanics
Porous Media Flow
Ray Optics Modeling
Selecting Hardware

2:30PM	Conference Ends

COMMUNITY EVENTS

EXPLORE BOSTON
Wednesday, 6:15PM - 10:45PM
Boston

Enjoy a 1-hour walking tour of the Freedom Trail, in Boston, MA. Extra time following the tour will be allotted for independent exploration.

TECH BRIEFS COCKTAIL RECEPTION
Wednesday, 5:00PM - 6:00PM
Salon A-D

Meet fellow COMSOL® software users.

EXHIBITION
Wednesday, 1:00PM - Friday 1:00PM
Salon A-D

Learn about exhibitors' products and services.

LUNCH
Wednesday, 12:00PM - 1:00PM
Thursday, 12:00PM - 1:00PM
Friday, 12:30PM - 1:30PM
Riverside Lawn

Have lunch by the Charles River surrounded by New England's beautiful fall foliage.

POSTER SESSION
Thursday, 6:00PM - 7:00PM
Salon A-D

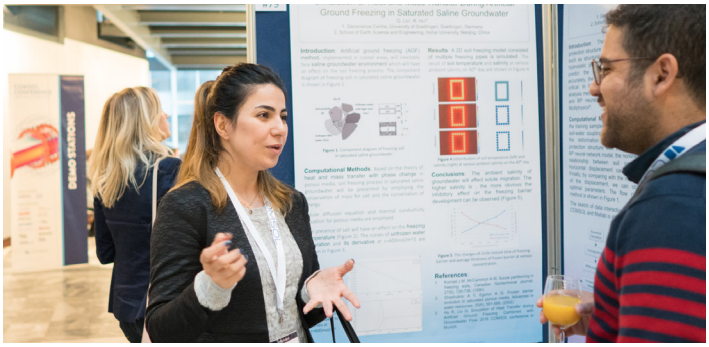
View the posters and meet the authors.

GALA DINNER
Thursday, 7:00PM - 8:30PM
Salon E-H

Try different foods at this relaxed, buffet-style dinner.

AWARDS CEREMONY
Friday, 11:00AM - 12:30PM
Salon E-H

Celebrate the winners of the Best Poster and Best Paper awards.



FLOOR PLAN

CRE Charles River East
CRW Charles River West
CB Commonwealth Ballroom

SVANTE LITTMARCK
COMSOL, Inc.

Wednesday, October 3

Svante Littmarck is the president and CEO of COMSOL, Inc. He cofounded the COMSOL Group in 1986. In 2004, Littmarck received an honorary doctoral degree from the Royal Institute of Technology (KTH) in Stockholm, Sweden, for the development and international reach of high-quality software for scientific computations through his company COMSOL.

FREDDY HANSEN
Abbott Laboratories

Building a Better Pump for Heart Failure Patients
Thursday, October 4

Abbott's Mechanical Circulatory Support group build implants that help people suffering from heart failure, a deadly and increasingly common disease. We combine computational fluid dynamics and particle tracing simulations to optimize the designs of implantable blood pumps that replace the left heart function. In an example, we will showcase HeartMate 3™, a blood pump with a magnetically levitated rotor and arguably the most complex machine ever implanted into a human being.

JUSTIN MCKENNON
NTS Lightning Technologies

The Role of Multiphysics Modeling in Lightning Protection Design and Certification
Thursday, October 4

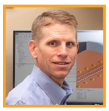
In the aerospace and wind turbine fields, implementing a suitable lightning protection design is paramount. Lightning, and other electromagnetic effects (precipitation static, radiated fields, etc.), can seriously degrade performance, damage, or even destroy objects without an acceptable protection design. In the past, to determine the threat that lightning poses, several iterations of engineering testing were required to obtain data, which drives the protection features an object must have to survive. This is a high-risk path and can result in tremendous program costs and setbacks. Multiphysics modeling allows for the effects of lightning to be understood without having to perform dozens of test iterations and frequently results in large time and cost savings for programs that use it. In this talk, the role of multiphysics in the development of lightning protection designs and the certification of these designs is discussed as well as the benefits of this approach.

IVANA MILANOVIC
University of Hartford

Simulation-Based Approach to STEM Challenges
Thursday, October 4

A new pedagogical approach to STEM challenges is currently implemented in the mechanical engineering program at the University of Hartford. This approach combines problem- and inquiry-based learning, simulations and apps with the COMSOL Multiphysics® software, and emphasizes the importance of outside-of-class learning supported by effective reference materials and faculty mentoring.

A two-course sequence was modified to contain scaffolded and contextualized simulations with application building that develop technical competency in modeling, a deeper understanding of thermofluids concepts by solving realistic technological problems, and writing skills by generating technical reports for each simulation. Apps involve creating a simplified interface that contains the full efficacy of the underlying model but not exposing the end user to its complexity.



ERIC GEBHARD
Signal Microwave

COMSOL® Used as Core Technology for Development of RF/Microwave and High-Speed Digital Connectors
Friday, October 5

Signal Microwave designs and builds coaxial connectors for microwave and high-speed digital applications. This includes wireless systems, radar, 5G, optical systems, test equipment, back planes, etc. The COMSOL® software is one of our core technologies and is used to design virtually every product we make. This presentation will show how COMSOL Multiphysics® is integrated into our design process and allows us to develop excellent products with a faster design cycle time. A pair of examples will be given, showing how COMSOL Multiphysics® allowed us to minimize the development time, troubleshoot machined material, and meet our customers' requirements.

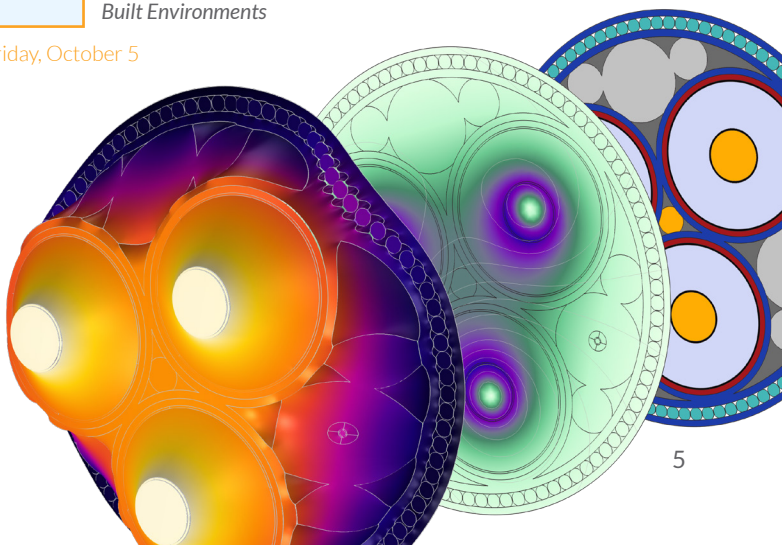
NICHOLAS GOLDRING
Radiasoft

Use of the COMSOL Server™ License to Simulate Next-Generation Synchrotron Light Sources
Friday, October 5

Next-generation synchrotron light sources are creating orders-of-magnitude brighter X-rays by reducing horizontal emittance. This requires the bending magnet pole tips to be closer to the electron beam axis, which in turn requires smaller vacuum chambers. The resultant design challenges are dictated by complex and coupled physical phenomena, including high thermal stresses, photon-stimulated desorption, and electromagnetic wakefields. The Application Builder in the COMSOL Multiphysics® software enables the creation of browser-based graphical user interfaces (GUIs), which enable scientists and engineers to study this complicated problem domain without becoming an expert user of the COMSOL® software. With a relatively inexpensive COMSOL Server™ product license, these GUIs can be run on a cloud-based server, with many processors and all of the required RAM for complex simulations. This approach extends the power of COMSOL Multiphysics® to collaborators, customers, students, etc. We present two such GUIs: 1) the emission of synchrotron radiation and resultant thermal stress on vacuum chamber walls that are downstream of dipole bending sections, and 2) accurate thermal analysis and optimized mechanical bending correction for high-heat-load beamline mirrors. The various challenges of creating the underlying FEA models and the methods used to overcome them will be discussed. Both examples are relevant to the Advanced Photon Source upgrade (APS-U) under construction at Argonne National Laboratory.

STEVE DOGGETT
Built Environments

Friday, October 5



CORE USAGE & THEORY

COMSOL MULTIPHYSICS® FOR NEW USERS

Wednesday, October 3, 9:30AM

This minicourse is for those who are just starting out with COMSOL Multiphysics® or want a refresher on the graphical user interface (GUI) and modeling workflow. During this session, the fundamentals of using the COMSOL® software will be demonstrated.

GEOMETRY MODELING AND CAD IMPORT

Wednesday, October 3, 9:30AM

Whether you choose to construct a geometry in the COMSOL Desktop® or import it from a CAD file, this minicourse will demonstrate some useful tools. Did you know that COMSOL Multiphysics® can automatically generate the cross section of a solid object and you can use it for a 2D simulation? Or that you can directly import topographic data to create 3D objects? Generating a geometry is also about preparing selections for physics settings. By using the right selection tools, you can easily automate the modeling workflow, even when this involves simulations on widely different versions of a geometry. Attend this minicourse to see a demonstration of these techniques and more.

MESHING

Wednesday, October 3, 1:00PM

In this minicourse, we will walk you through the meshing techniques that are available to you in the COMSOL Multiphysics® software. We will introduce you to basic meshing concepts, such as how to tweak the meshing parameters for unstructured meshes. More advanced topics include working with swept meshes and creating mesh plots. You will also learn a useful technique for meshing imported CAD designs: How to hide small geometry features from the mesher.

UNDERSTANDING THE STATIONARY SOLVERS

Wednesday, October 3, 1:00PM

COMSOL Multiphysics® gives you precise control over the way in which your multiphysics models are solved. In this minicourse, we will cover the fundamental numerical techniques and underlying algorithms used for steady-state models and explain the reasons behind the default solver settings. Building upon this knowledge, you will learn various techniques for achieving or accelerating convergence of nonlinear multiphysics models.

INTRODUCTION TO THE APPLICATION BUILDER

Wednesday, October 3, 2:30PM
Friday, October 5, 2:30PM

The Application Builder, included in the COMSOL Multiphysics® software, allows you to wrap your COMSOL Multiphysics® models in user-friendly interfaces. This minicourse will cover the two main components of the Application Builder: the Form Editor and the Method Editor. You will learn how to use the Form Editor to add buttons, sliders, input and output objects, and more. You will also learn how to use the Method Editor and other tools to efficiently write methods to extend the functionality of your apps.

UNDERSTANDING THE TIME-DEPENDENT SOLVERS

Wednesday, October 3, 2:30PM

COMSOL Multiphysics® includes a set of powerful implicit time-stepping algorithms for fast and accurate solutions to transient models. In this minicourse, you will learn how to pick a solver based on the problem at hand, measure and control computational error, as well as check convergence and other salient issues in time-dependent analyses using the finite element method.

OPTIMIZATION

Wednesday, October 3, 4:00PM

The Optimization Module will take you beyond traditional engineering analysis and into the design process. In this minicourse, you will learn to use gradient-based optimization techniques and constraint equations to define and solve problems in shape, parameter, and topology optimization, as well as inverse modeling. The techniques shown in this minicourse are applicable for almost all types of models.

POSTPROCESSING

Wednesday, October 3, 4:00PM

When presenting your results, the quality of the postprocessing will determine the impact of your presentation. This minicourse will thoroughly explore the many tools in the Results node designed to make your data look its best, including mirroring, revolving symmetric data, cut planes, cut lines, exporting data, joining or comparing multiple data sets, as well as animations.

AUTOMATING MODEL BUILDING USING METHODS AND THE APPLICATION BUILDER

Thursday, October 4, 9:00AM

Learn how to use the Application Builder and the Method Editor to automate your model building, including setting up the geometry, material properties, loads, and boundary conditions; meshing; solving; and extracting data. You will learn how the Application Builder can be a powerful tool in your modeling process.

DEPLOYING APPS USING THE COMSOL SERVER™

Thursday, October 4, 5:00PM

Learn how to use COMSOL Server™ to deploy apps created with COMSOL Multiphysics® and spread the use of simulation. This minicourse will introduce you to working with the administration web page, managing user accounts and privileges, uploading and managing apps, monitoring usage, and configuring system-level settings.

EQUATION-BASED MODELING

Friday, October 5, 8:00AM

Partial differential equations (PDEs) constitute the mathematical foundation to describe the laws of nature. This minicourse will introduce you to the techniques for constructing your own linear or nonlinear PDE systems. You will also learn how to add ordinary differential equations (ODEs) and algebraic equations to your model.

SOLVING LARGER MODELS

Friday, October 5, 9:30AM

Solving large and complex finite element models can take significant time and computational resources. In this minicourse, we will address the modeling techniques that you should be aware of and then go into the choice of solvers for large models. We will cover the differences between the various solvers in the COMSOL Multiphysics® software in terms of their time and memory usage.

SELECTING HARDWARE

Friday, October 5, 1:30PM

This course builds upon the Solving Larger Models minicourse and addresses how to select hardware for computationally challenging multiphysics models. Solver performance is inextricably linked to computer architecture and this course will cover how factors such as memory bandwidth, processor speed, and architecture address solution times.

ELECTROMAGNETICS

RESISTIVE AND CAPACITIVE DEVICES

Wednesday, October 3, 9:30AM

In this minicourse, we will address the modeling of resistive and capacitive devices with the AC/DC Module. We will also cover the calculation of electric fields under steady-state, transient, and frequency-domain conditions, as well as the extraction of lumped parameters such as capacitance matrices. Applications include the modeling of resistive heating and sensor design.

MAGNETS, COILS, AND MOTORS

Wednesday, October 3, 1:00PM

Magnetic fields arise due to magnets and the flow of current. In this minicourse, you will learn about using the AC/DC Module to model static, transient, and frequency-domain magnetic fields that arise around magnets and coils. We will introduce various ways of modeling magnetically permeable materials, motors, and generators.

RF AND MICROWAVE MODELING

Wednesday, October 3, 2:30PM

In this minicourse, we will cover the use of the RF Module for simulating Maxwell's equations in the high-frequency electromagnetic wave regime. We will discuss applications in resonant cavity analysis, antenna modeling, transmission lines and waveguides, and scattering. Then, we will address the coupling of electromagnetic wave simulations to heat transfer, such as in RF heating.

WAVE OPTICS MODELING

Wednesday, October 3, 4:00PM

The Wave Optics Module offers both full-wave modeling of Maxwell's equations and the beam envelope method. The beam envelope method is particularly useful for modeling optical waveguiding structures, where the field envelope varies slowly along the direction of propagation. This minicourse introduces the use of the beam envelope method and how it contrasts with full-wave models. Optical scattering from periodic structures, such as gratings, will also be covered.

CHARGED PARTICLE TRACING

Friday, October 5, 8:00AM

Learn how to use the Particle Tracing Module to compute the paths of ions and electrons in external electric and magnetic fields. The external fields can be entered as expressions or solved for using a different physics interface, then coupled to the Charged Particle Tracing interface. Typical applications include mass spectrometry, accelerator physics, ion optics, and etching. You will learn how to use a probabilistic approach to simulate the collisions between these ions or electrons and a rarefied background gas. We will also discuss the analysis of nonlaminar charged particle beams and self-consistent modeling of bidirectionally coupled particle-field interactions.

SEMICONDUCTOR MODELING

Friday, October 5, 8:00AM

The Semiconductor Module enables the drift-diffusion modeling of semiconductor devices and modeling quantum systems with the Schrödinger equation. This minicourse focuses on practical topics such as model setup, results visualization, circuit and multiphysics couplings, and best practices, by examining a few tutorial models selected from the Application Libraries.

PLASMA MODELING

Friday, October 5, 9:30AM

This course will introduce some of the most common types of plasmas, including inductively coupled, DC, microwave, and capacitively coupled plasmas. In addition to learning about the differences between each type of discharge, the minicourse will show how to set up a model of a capacitively coupled plasma using a revolutionary new method available in the Plasma Module.

RAY OPTICS MODELING

Friday, October 5, 1:30PM

In this minicourse, you will learn how to use the Ray Optics Module to trace rays of light and other high-frequency radiation through optically large systems. We will explain how to model ray propagation in homogeneous and graded-index media; analyze ray intensity and polarization; and apply boundary conditions including refraction, diffuse reflection, and specular reflection. We will discuss application areas including cameras, telescopes, laser focusing systems, spectrometers, and concentrated solar power systems. You will also learn how to apply the Ray Optics Module in a multiphysics context by considering structural and thermal effects.

MECHANICAL & ACOUSTICS

STRUCTURAL MECHANICS AND MULTIPHYSICS

Wednesday, October 3, 2:30PM

Many different physical phenomena are coupled to the deformation of solids. In this minicourse, you will get an overview of how to model fluid-structure interaction, thermal stresses and thermoelastic damping, electromechanical forces, magnetostriction, piezoelectricity, poroelasticity, and acoustic-structure interaction. The built-in multiphysics couplings are highlighted, together with examples of how to create your own couplings.

STRUCTURAL DYNAMICS MODELING

Wednesday, October 3, 4:00PM

In this minicourse, you will learn how to model problems within the field of structural dynamics. The course covers eigenfrequency analysis, frequency-domain analysis, time-domain analysis, and modal superposition. You will learn how to select appropriate and efficient methods. Damping models, nonlinearities, linearization, and prestressed analysis are other important topics. You will also get a brief overview of the Multibody Dynamics Module and Rotordynamics Module.

MODELING SPEAKERS, MICROPHONES, AND OTHER TRANSDUCERS

Friday, October 5, 8:00AM

This minicourse is focused on modeling all kinds of transducers. The transduction from an electric signal to an acoustic signal, including the mechanical path, is a true multiphysics application. We will set up a simple model using the built-in multiphysics couplings and also look at other modeling techniques, like combining lumped models with FEM or BEM. The analysis can be done in the frequency domain or extended to the time domain, where nonlinear effects can be included. You will also learn about recent news and additions to the COMSOL Multiphysics® software relevant to the topic. Application areas include, but are not limited to, mobile devices, piezotransducers, loudspeakers, headsets, and speaker cabinets.

MODELING ACOUSTIC PROPAGATION IN SMALL AND LARGE FLUID DOMAINS

Friday, October 5, 9:30AM

In this minicourse, we will study different classes of problems involving acoustic propagation in fluids. This ranges from propagation in large domains, such as rooms or the ocean, to transmission through small perforations where thermal and viscous losses are important. Detailed modeling of the propagation in moving fluids is also discussed. This is, for example, the case in a muffler with a nonisothermal background flow. You will also learn about recent news and additions to the COMSOL Multiphysics® software relevant to the topic. Application areas include, but are not limited to, muffler design, sound insulation materials, room and car acoustics, and flow meters.

MATERIAL MODELS IN STRUCTURAL MECHANICS

Friday, October 5, 1:30PM

COMSOL Multiphysics® contains a large number of built-in material models for solid materials. In this minicourse, you will get an overview of common material models for metals, elastomers, soils, concrete, and shape memory alloys. Phenomena like plasticity, creep, viscoplasticity, hyperelasticity, and damage will be discussed. You will also learn how to augment the capacity of the program by creating your own material models, either by equation-based modeling or by programming in C-code. Finally, the relation between measurements and material properties will be discussed.

FLUID & HEAT TRANSFER

CONDUCTION AND CONVECTION

Wednesday, October 3, 9:30AM

In this minicourse, you will learn about modeling conductive and convective heat transfer with COMSOL Multiphysics®, the Heat Transfer Module, the CFD Module, and the Subsurface Flow Module. Conductive heat transfer modeling addresses heat transfer through solids and can include heat transfer in thin layers, contact thermal resistance, and phase change. Convective heat transfer addresses heat transfer in solids and fluids. We will also address natural convection induced by buoyancy forces.

LAMINAR AND MICROFLUIDIC FLOW

Wednesday, October 3, 9:30AM

In this minicourse, we will cover the Microfluidics Module, which features custom interfaces for the simulation of microfluidic devices and rarefied gas flows. Single-phase flow capabilities include both Newtonian and non-Newtonian flow. Beyond its single-phase flow capabilities, this module also allows for two-phase flow simulations to capture surface tension forces, capillary forces, and Marangoni effects. Typical applications include lab-on-a-chip (LOC) devices, digital microfluidics, electrokinetic and magnetokinetic devices, inkjets, and vacuum systems.

RADIATION AND AMBIENT CONDITIONS MODELING

Wednesday, October 3, 1:00PM

Radiative heat transfer is one of the three types of heat transfer and plays a major role in many applications. During this session, we will focus on the features for modeling surface-to-surface radiation for gray surfaces or multiple spectral bands, such as solar and infrared radiation. We will discuss different examples in order to help identify cases where thermal radiation has to be accounted for.

Defining ambient conditions is a key point in the model definition, especially when solar radiation is accounted for, but there are also other cases. We will review the different means to define the ambient condition and how use them for conduction, convection, and radiation in heat transfer models.

TURBULENT AND HIGH MACH NUMBER FLOW

Wednesday, October 3, 1:00PM

Learn how to efficiently simulate incompressible and compressible turbulent flows in this CFD minicourse. The CFD Module allows for accurate multiphysics flow simulations, such as conjugate heat transfer with nonisothermal flow and fluid-structure interactions. We will also discuss physics interfaces for simulating flow in porous media, discrete and homogeneous two-phase flow, and flow in stirred vessels with rotating parts.

MOISTURE TRANSPORT AND HEAT TRANSFER WITH PHASE CHANGE

Wednesday, October 3, 4:00PM

Changes in the temperature of a material can lead to a change in material phase, from solid to liquid to gas. The evaporation and condensation of water are very common cases of phase change. This minicourse will introduce you to moisture transport and the various types of phase change modeling that can be done with COMSOL Multiphysics® and the Heat Transfer Module. We will address the relative merits and tradeoffs between these techniques.

PARTICLE TRACING IN FLUIDS

Friday, October 5, 9:30AM

Lagrangian particle tracking is often used as a complement to Eulerian methods that solve for fluid flow fields. In this course, we will explain how to use the Particle Tracing Module to predict the motion of solid particles, droplets, and bubbles in a surrounding fluid. We will outline some of the myriad built-in forces included in the Particle Tracing for Fluid Flow interface, including lift, drag, electromagnetic, thermophoretic, and acoustophoretic forces. You will also learn how to accurately model particle dispersion in a turbulent flow.

POROUS MEDIA FLOW

Friday, October 5, 1:30PM

Porous media surrounds us, whether it is the ground beneath us, paper products, filters, or even biological tissue. In this minicourse, we will explore flow and diffusion in porous media as well as how to treat partially saturated media. We will also cover coupled systems including linked free and porous flows; poroelasticity; and mass convection-diffusion in forced, gravity-fed, and density-driven flows.

CHEMICAL

CHEMICAL REACTION ENGINEERING

Friday, October 5, 8:00AM

In this minicourse, you will learn how to define chemical kinetics, thermodynamic properties, and transport properties for models of reacting systems using the Chemical Reaction Engineering Module. We will address topics including homogeneous and surface reactions, diffusion and convection in diluted and concentrated solutions, thermal effects on transport and reactions, and mass and heat transfer in heterogeneous catalysis.

ELECTRODEPOSITION AND CORROSION

Friday, October 5, 9:30AM

In this minicourse, you will learn how to define and solve problems in electrodeposition, corrosion protection, and corrosion studies. These systems all involve mass and charge transfer coupled to electrochemical reactions at deforming metal surfaces. We will look at two different approaches: one that treats the surface deformation as a variable and a second approach that treats the surface deformation with moving mesh. The most common type of study for these systems is the time-dependent study, but we will also briefly look at electrochemical impedance spectroscopy (EIS) studies.

BATTERY MODELING

Friday, October 5, 1:30PM

In this minicourse, you will learn to model batteries with a focus on lithium-ion batteries, including transport of ions, porous electrodes, and electrode reactions. You will also get an introduction to the corresponding couplings to heat transport for performing thermal simulations. We will address how to simulate various transient phenomena such as constant current-constant voltage (CCCV) charge/discharge cycling, electrochemical impedance spectroscopy (EIS), and capacity fade.

UPDATE TRAINING

CAD AND MESHING

Thursday, October 4, 9:00AM

In this minicourse, we will discuss and demonstrate recent additions to the functionality for creating and importing geometry and generating meshes in COMSOL Multiphysics®. We will cover topics such as the automatic removal of small details from geometry, using variable dependent size expressions for mesh generation, defining coordinate systems based on work planes and geometry orientations, setting up selections during the import of printed circuit board geometries, and more.

ELECTRICAL

Thursday, October 4, 9:00AM

Join this update training minicourse to learn about major upgrades to the electromagnetics simulation tools. Both low- and high-frequency modeling capabilities will be covered. Products featured include the AC/DC Module, RF Module, Wave Optics Module, and Ray Optics Module.

FLUID AND CHEMICAL

Thursday, October 4, 9:00AM

Stay current with new modeling capabilities for fluid flow and chemical simulations through this update training minicourse.

STRUCTURAL AND ACOUSTICS

Thursday, October 4, 5:00PM

Attend this update training minicourse for a roundup of major news for acoustics and structural analysis.

THERMAL

Thursday, October 4, 5:00PM

Learn about news for thermal modeling in this update training minicourse. Upgrades of the Heat Transfer Module will be discussed as well as its multiphysics couplings with other modules for electromagnetics, structural, and fluid flow simulation.

SPONSORED WORKSHOPS

MODELING MECHANICAL BEHAVIOR OF RUBBERS AND THERMOPLASTICS IN COMSOL MULTIPHYSICS®
By Veryst Engineering

Wednesday, October 3, 9:30AM

The nonlinear strain-rate- and temperature-dependent response of polymers can be accurately captured using the COMSOL Multiphysics® software, either through the built-in material models or the PolyUMod library (linked to the COMSOL Multiphysics® software via the External Material Model interface). In this workshop, we will demonstrate how to accurately predict the thermomechanical response of different polymeric materials, including cases where we recommend material models from the PolyUMod library. The examples will include all steps, from experimental testing and material model selection and calibration to COMSOL Multiphysics® software simulations.

SYNOPSYS SIMPLEWARE™: FROM 3D IMAGES TO MODELS
By Synopsys

Wednesday, October 3, 2:30PM

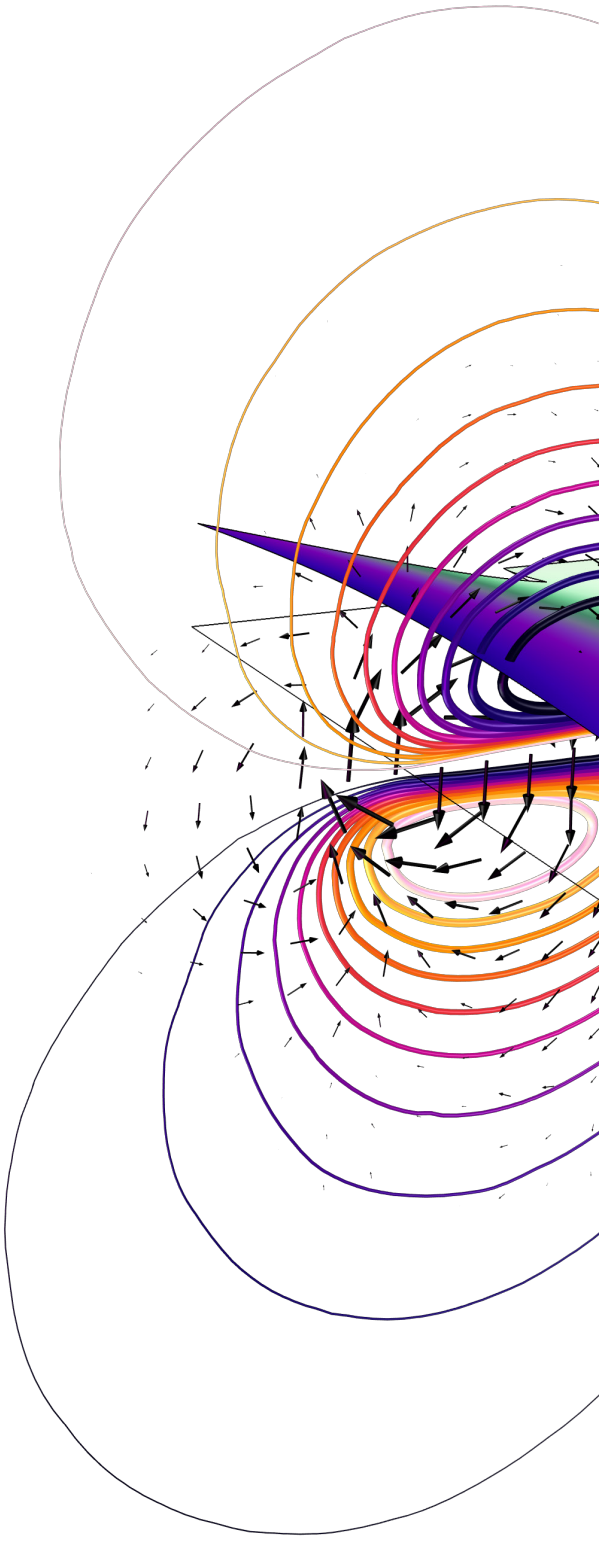
This minicourse demonstrates the ease of obtaining high-quality models from 3D image data in the Synopsys Simpleware™ software for use in the COMSOL Multiphysics® software. The workflow of processing 3D image data (e.g., from MRI, CT, Micro-CT, and FIB-SEM) to create models for life sciences, materials, and manufacturing applications will be outlined and demonstrated. Learn about the capabilities of the Simpleware™ software for image visualization, segmentation, analysis, and model generation. Examples will also be shown of workflows and case studies combining the Simpleware™ software and the COMSOL Multiphysics® software.

Simpleware is a trademark of Synopsys, Inc. in the U.S. and/or other countries.

BEST PRACTICES FOR USING COMSOL MULTIPHYSICS®: INTERPRETING SOFTWARE FEEDBACK
By AltaSim

Thursday, October 4, 5:00PM

No matter how well COMSOL developers build COMSOL Multiphysics®, there are times when the software does not respond the way the user desires. Often, these unexpected responses are driven by user input. This class addresses methods to identify user mistakes during model development based on feedback provided by the software. The course material will provide valuable insights into interpreting errors, warnings, and other feedback from COMSOL Multiphysics®. Utilizing our experience and extensive use of the software as a COMSOL Certified Consultant, this course will examine common error messages and provide solutions to understanding and addressing these issues.

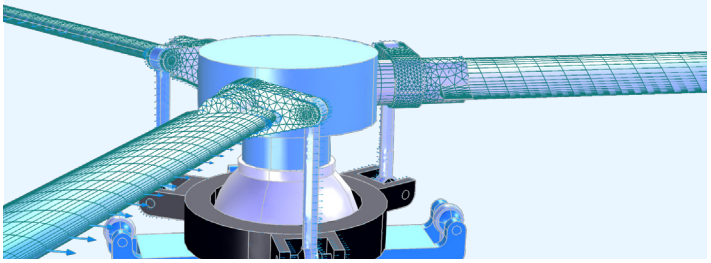


Materials Processing and Additive Manufacturing

Wednesday, October 3, 1:00PM - 2:00PM

Moderator: Jeff Crompton, *Altasim Technologies*
Panelists: Kelvin Leung, *Technical Data Analysis*
Erica Coenen, *Reveal Energy Services*
Paris von Lockette, *Pennsylvania State University*
Nicholas Feng, *MIT/BMF Material Technology*

Additive manufacturing (AM) offers an almost unparalleled opportunity to produce complex three-dimensional objects with minimal waste and without significantly increasing production costs. AM technology has matured from its origins in manufacturing prototypes to the successful production of customized, commercial-scale products. During this time, it has demonstrated the potential to transform the rules of component design and manufacture by reducing or eliminating the constraints of traditional molds, presses, and dies. In this discussion, we will examine the current trends in AM and the role of virtual prototyping in extending the impact of this transformative technology.

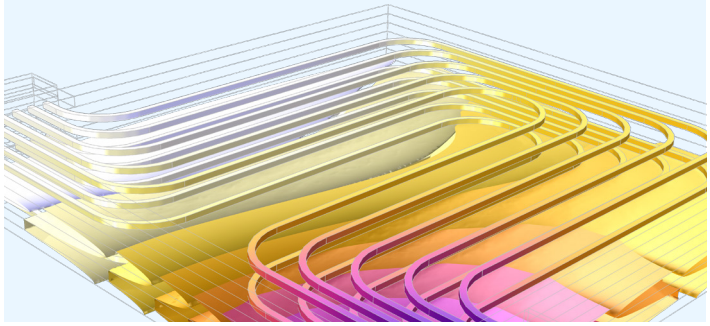


Batteries and Fuel Cells

Wednesday, October 3, 2:30PM - 3:30PM

Moderator: Ralph White, *University of South Carolina*
Panelists: Karen Thomas-Alyea, *Samsung Research America*
Taylor Garrick, *General Motors Global Propulsion Systems*
Ed Fontes, *COMSOL*

Legislation for air pollution and carbon dioxide emission targets have accelerated the development of hybrid and electric cars. This development has also put focus on battery and fuel cell research and development, where modeling and simulation are proven methods for obtaining fast results. In this session, we will discuss the latest requirements and the trends regarding the processes — for example, thermal management, performance degradation, short circuiting, and fast recharge — which are important to study through modeling and simulations. simulations.

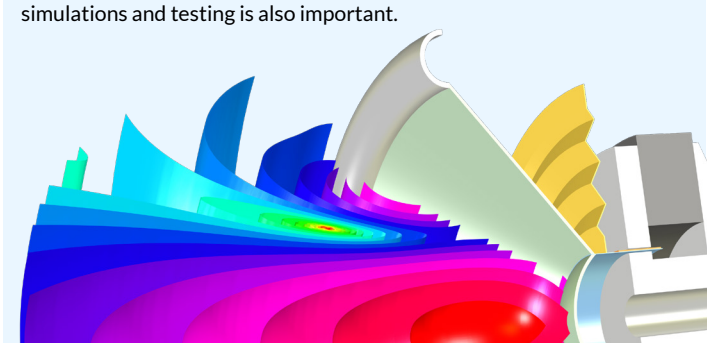


Modeling Strategies for Acoustics Simulations

Thursday, October 4th, 9:00AM -10:00AM

Moderator: Nagi Elabbasi, *Veryst Engineering*
Panelists: Nikolai Pastouchenko, *GE Global Research*
Daniel Warren, *GN Hearing*
Patrick Dennis, *Nissan*
Kirill Shaposhnikov, *COMSOL*

Virtual prototypes and digital twins play a major role in the development process across industries. This is also true when dealing with acoustics, from designing audio systems in cars and optimizing miniature transducer performance in mobile devices to designing muffler systems. Common to these applications is the need to use different modeling strategies depending on the frequency range, model size, and details included in the physics used. The integration of simulations and testing is also important.

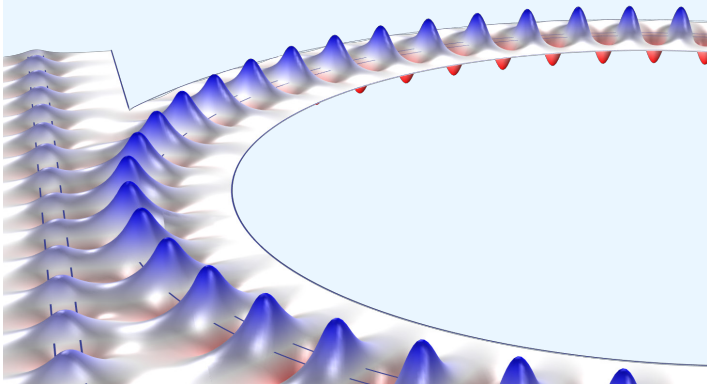


Optics and Photonics

Thursday, October 4th, 10:30AM -11:30AM

Moderator: Kyle Koppenhoefer, *Altasim Technologies*
Panelist: Alexander Kildishev, *Purdue University*

The use and processing of light is at the heart of technologies enabling many of today's high-tech devices and products. This includes implantable biophotonic medical devices, nanophotonic sensors and photodetectors, laser gyro navigation devices, OLED displays, and more. This panel discussion will focus on simulation of optical applications using the entire spectrum of full-wave, wave optics, and ray optics methods.

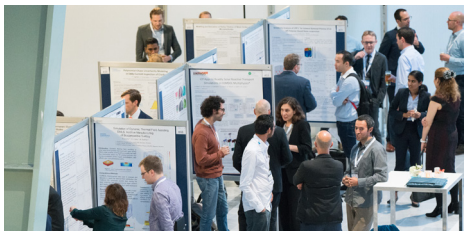


EXHIBITION

See what is being offered from the many exhibitors during the event. COMSOL Certified Consultants, software and hardware providers, and others are available to show how their services can help you improve and speed up your design work.

Growing List of Exhibitors

AltaSim Technologies
Digital Engineering
IEEE Spectrum
Mercury Learning
Microway
Noumenon
Numerical Design Inc
Physics Today
Rescale
SIMTEC
Synopsys
Total CAE
Tech Briefs
Veryst Engineering
and more!

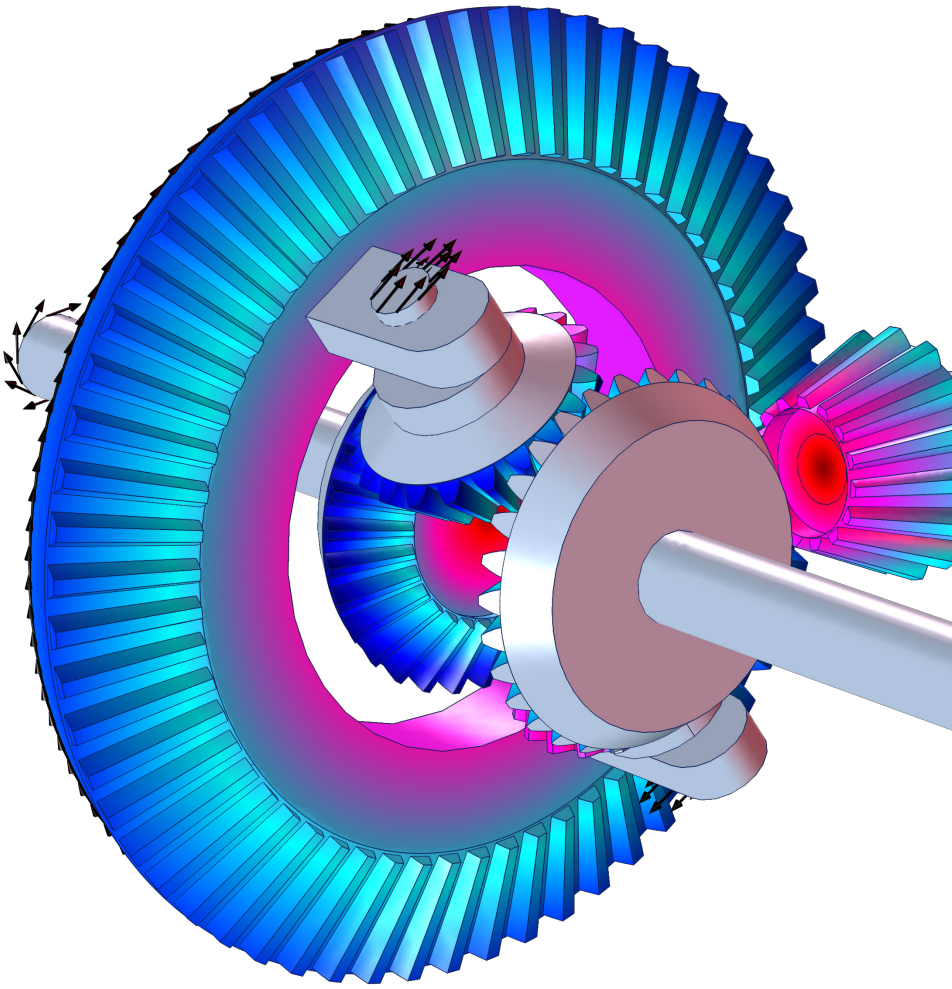


USER PRESENTATIONS AND POSTER SESSIONS

There are many ways engineers and researchers are using COMSOL Multiphysics. Check out more than 200 individual presentations held throughout the conference. Posters will be on display in the exhibition hall starting at 1 p.m. on Wednesday and oral presentations are scheduled throughout the day on Thursday.

DEMO STATIONS

Get assistance from our applications engineers at the demo stations. Show them your simulations or ask questions to receive tips and solutions on how to use COMSOL Multiphysics most effectively for your specific application.



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