

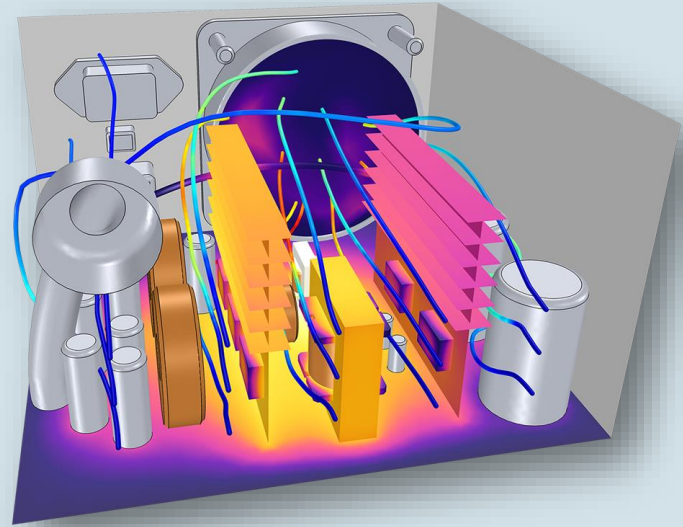
# Introduction to COMSOL Multiphysics

Andreas Bick

Applications Engineer  
Comsol Multiphysics GmbH

# What to look forward to?

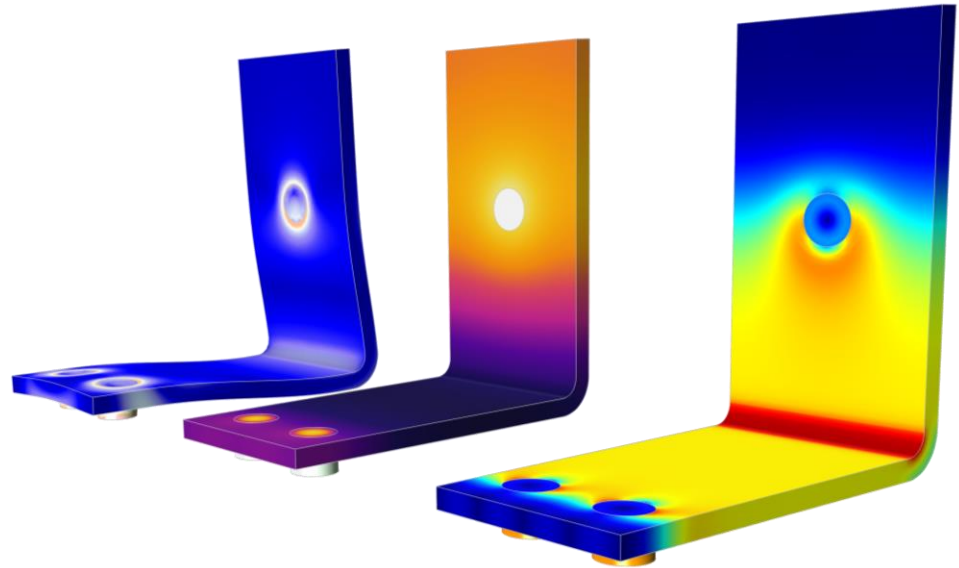
- What is COMSOL and what can it do?
- Demo: *Analysis of a micro resistor beam*
- Your start with COMSOL Multiphysics
- Hands on session



Active convective cooling of a power supply  
[COMSOL Application Gallery](#)

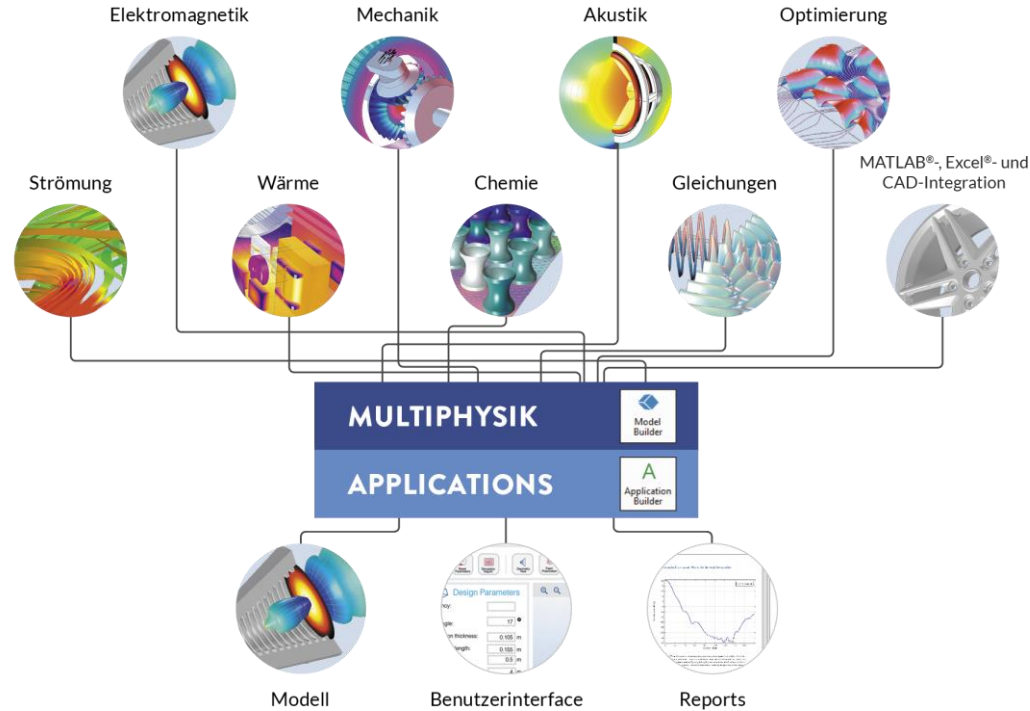
# One example for a multiphysical model

- A bus bar for conducting high currents
- For a realistic description we need a multiphysical model
  - Electric current
  - Joule heating
  - Thermal expansion
- So what is COMSOL?



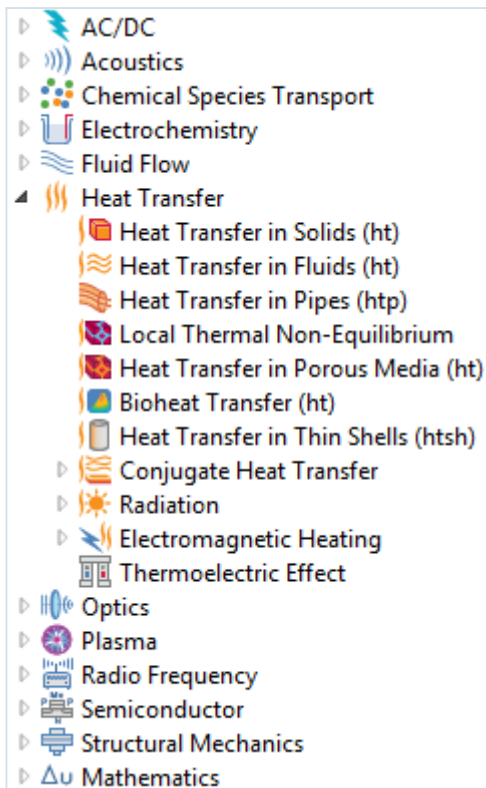
*L.t.r.: Deformation & Mises-Stress,  
temperatur and current distribution in a  
busbar*

# COMSOL Multiphysics®



# Working with COMSOL Multiphysics

- The equations are predefined in so called *physics interfaces*
- A interface contains the equations needed to describe a certain physical phenomenon
- You can combine the interfaces as needed which shows the modular approach
- You can add your own equation if necessary



# Die COMSOL®- Software Produktpalette

COMSOL  
MULTIPHYSICS®

Das Plattform-Produkt.  
Verstehen, Vorhersagen  
und Optimieren  
physikbasierter Designs  
und Prozesse mit  
numerischer Simulation.

COMSOL COMPILER™

Für jeden ausführbare eigenständige  
Simulations-Applications mit  
diesem Add-On erzeugen.

COMSOL  
SERVER™

Zugang zu Applications  
für Ihre Organisation  
und Verwaltung mit  
Admin-Tools.

## ADD-ON-PRODUKTE

### ELEKTROMAGNETIK

- AC/DC Module
- RF Module
- Wave Optics Module
- Ray Optics Module
- Plasma Module
- Semiconductor Module

### STRÖMUNG & WÄRME

- CFD Module
  - Mixer Module
- Subsurface Flow Module
- Pipe Flow Module
- Microfluidics Module
- Molecular Flow Module
- Heat Transfer Module

### MECHANIK & AKUSTIK

- Structural Mechanics Module
  - Nonlinear Structural Materials Module
  - Composite Materials Module
  - Geomechanics Module
  - Fatigue Module
  - Multibody Dynamics Module
  - Rotordynamics Module
- MEMS Module
- Acoustics Module

### VERFAHRENSTECHNIK

- Chemical Reaction Engineering Module
- Batteries & Fuel Cells Module
- Electrodeposition Module
- Corrosion Module
- Electrochemistry Module

### MULTIFUNKTIONAL

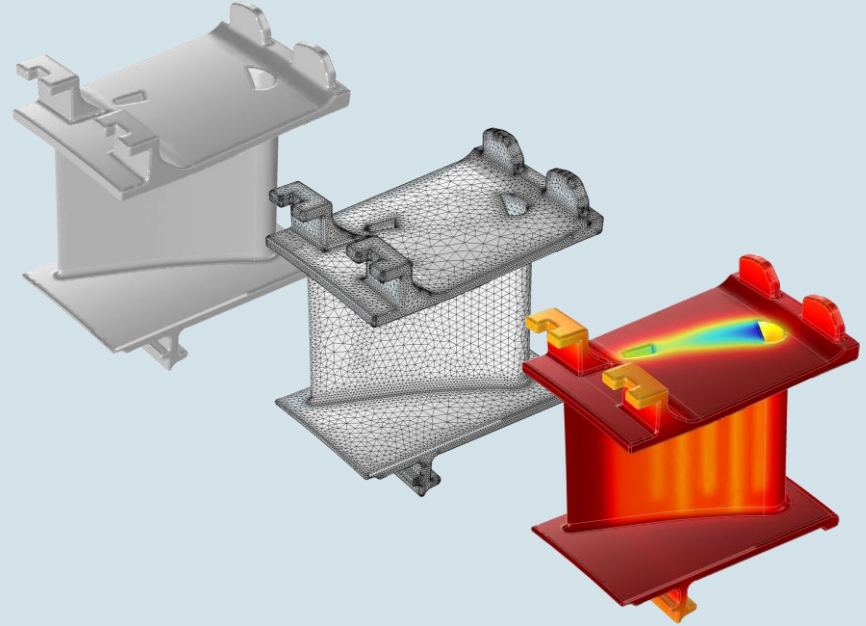
- Optimization Module
- Material Library
- Particle Tracing Module

### SCHNITTSTELLEN

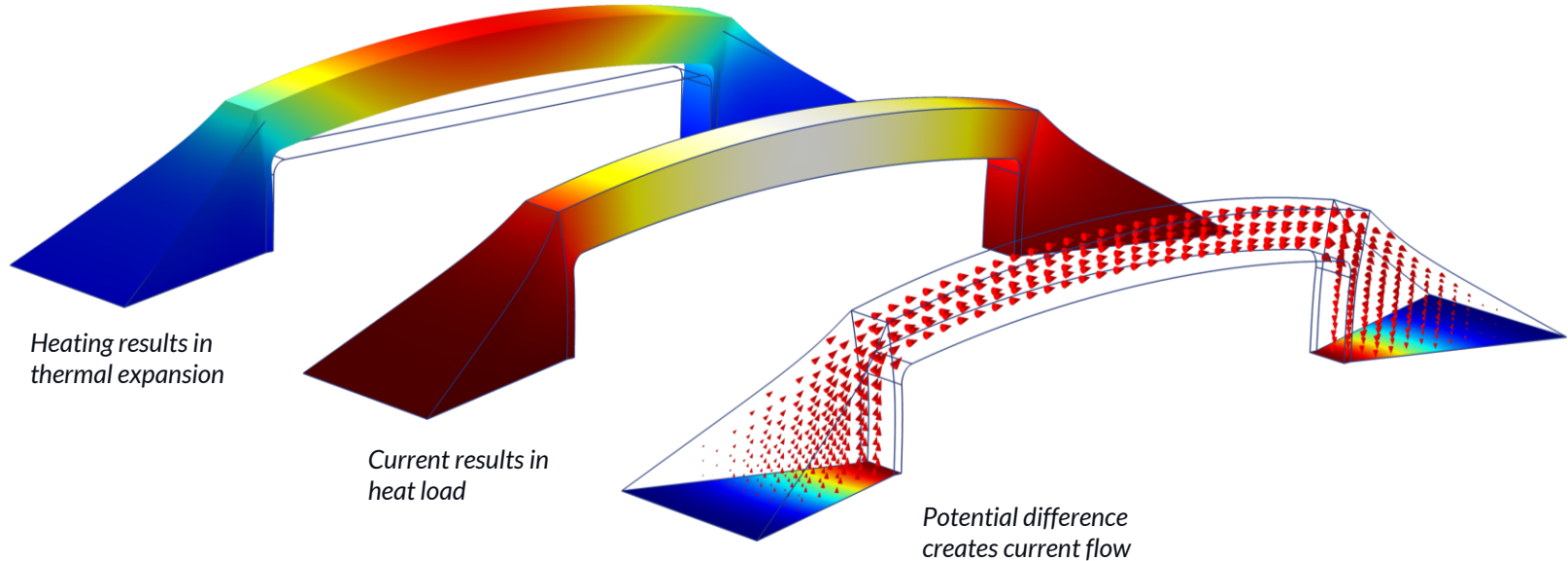
- LiveLink™ for MATLAB®
- LiveLink™ for Excel®
- CAD Import Module
- Design Module
- ECAD Import Module
- LiveLink™ for SOLIDWORKS®
- LiveLink™ for Inventor®
- LiveLink™ for AutoCAD®
- LiveLink™ for Revit®
- LiveLink™ for PTC® Creo® Parametric™
- LiveLink™ for PTC® Pro/ENGINEER®
- LiveLink™ for Solid Edge®
- File Import for CATIA® V5

# Towards the simulation result

1. Create geometry
2. Assign materials
3. Define physics
4. Meshing
5. Solving
6. Analyze the results



# Demo: Analysis of a Micro Resistor Beam





# Your Start with COMSOL

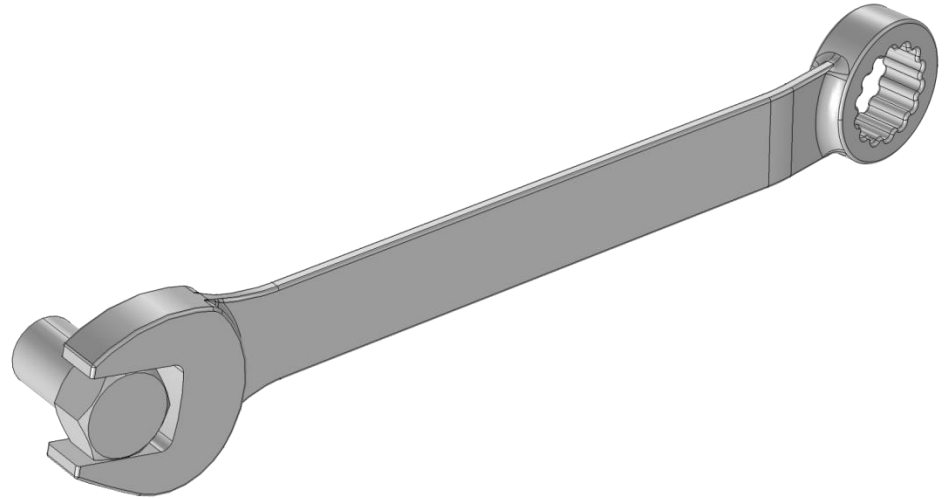
- [COMSOL Learning Center](#)
  - Learn COMSOL Multiphysics® at your own pace
- [COMSOL Application Galerie](#)
  - Step by step instructions
  - Advanced topics
- [COMSOL Videogalerie](#)
  - Conference Keynotes
  - Archived webinars
  - Tutorials
- [COMSOL Blog](#)
  - Daily posts to all kind of simulation topics



# Hands On Section

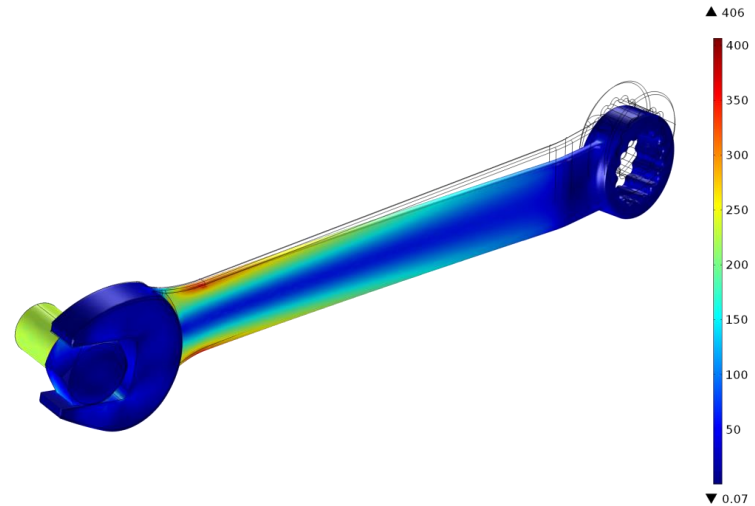
Tutorial Model

# WRENCH



# Mechanical Analysis

- Steel wrench is loaded with 150N
- Goal is to obtain the stress distribution



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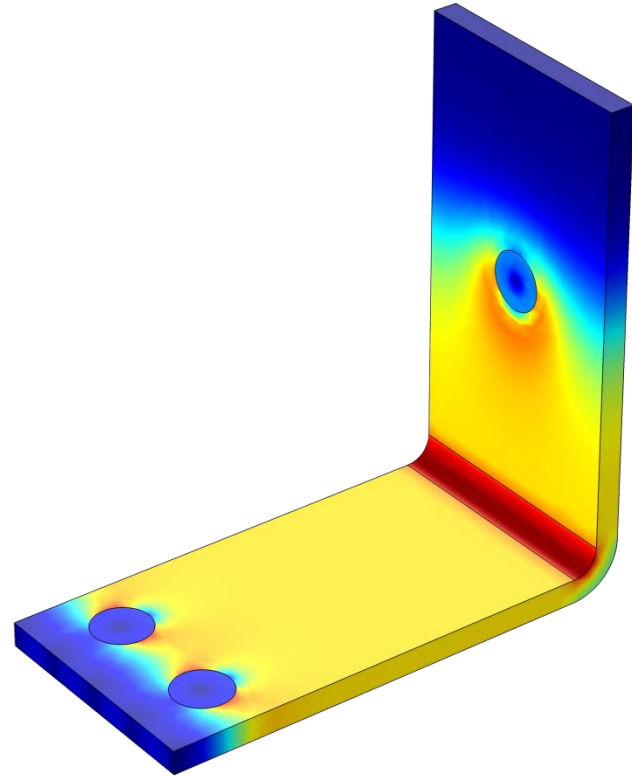
Tutorial Mode – Wrench

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**IntroductionToCOMSOLMultiphysics.pdf**

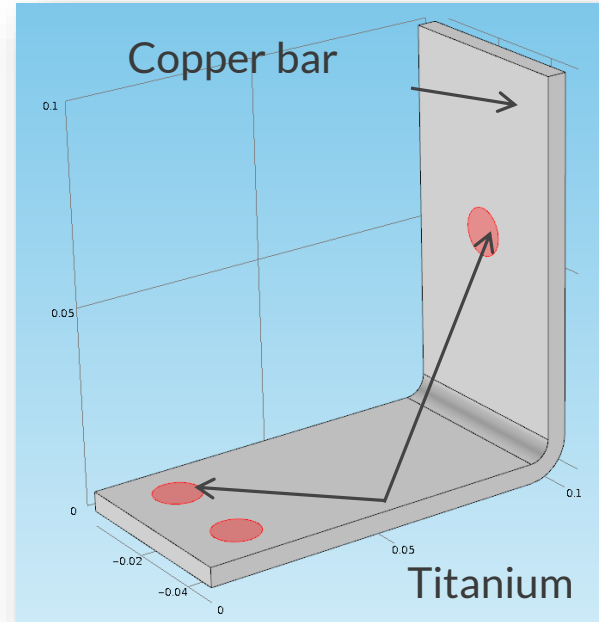


Tutorial Model

# BUS BAR

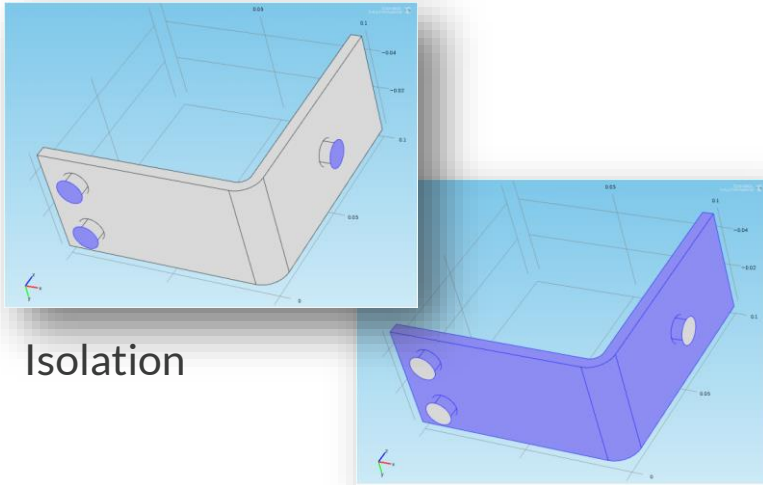


# Joule Heating



# Boundary conditions

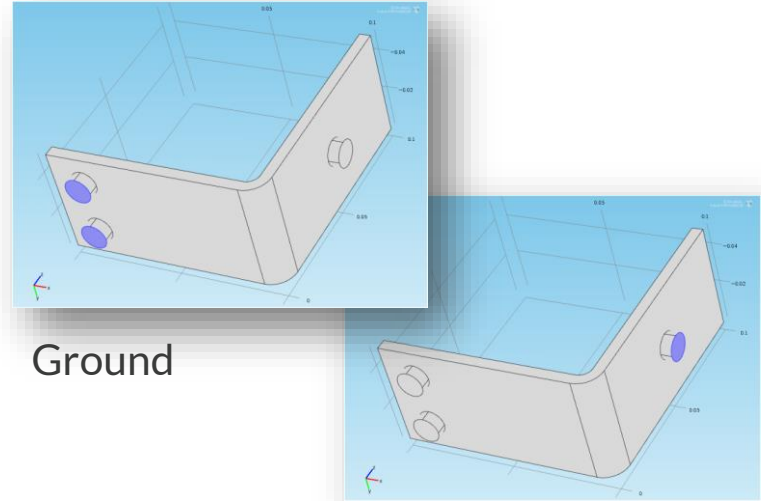
- Thermal:



Isolation

Heat flux

- Electrical:



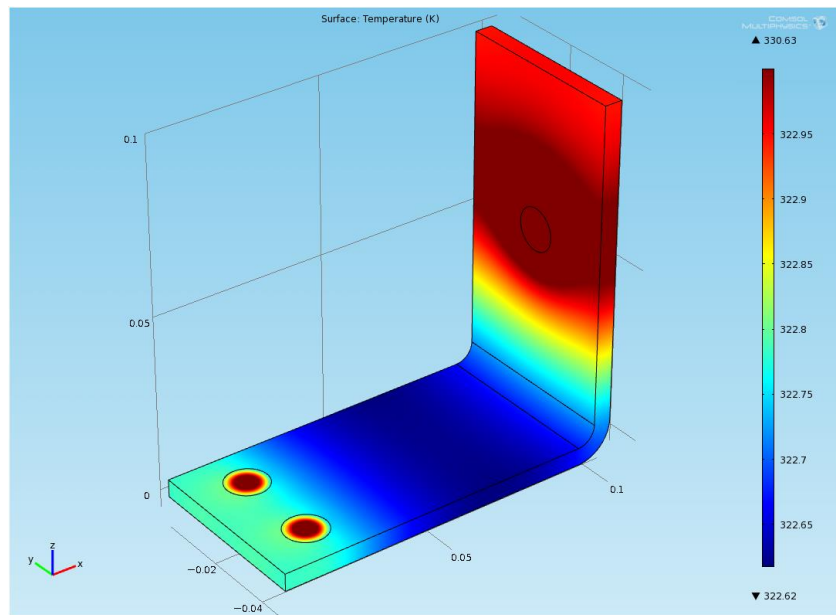
Ground

Electrical potential

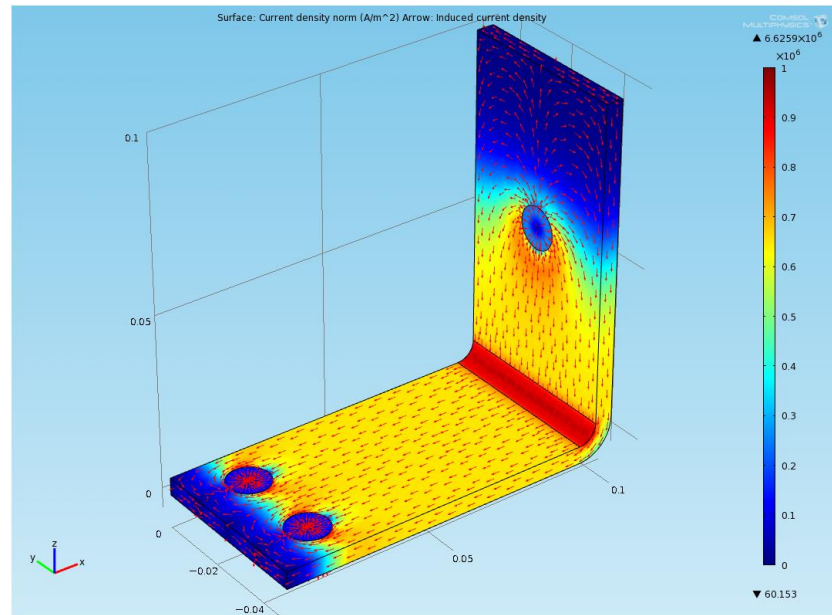


# Results

## Temperature



## Current density



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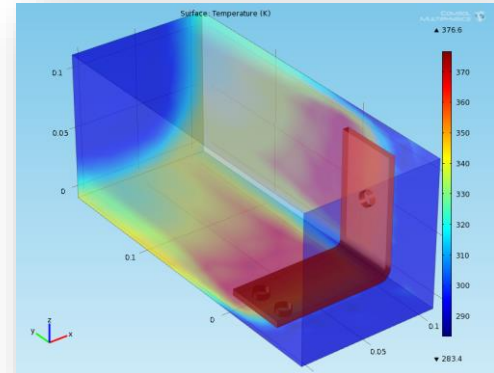
Tutorial Mode – Bus Bar

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# Further extension

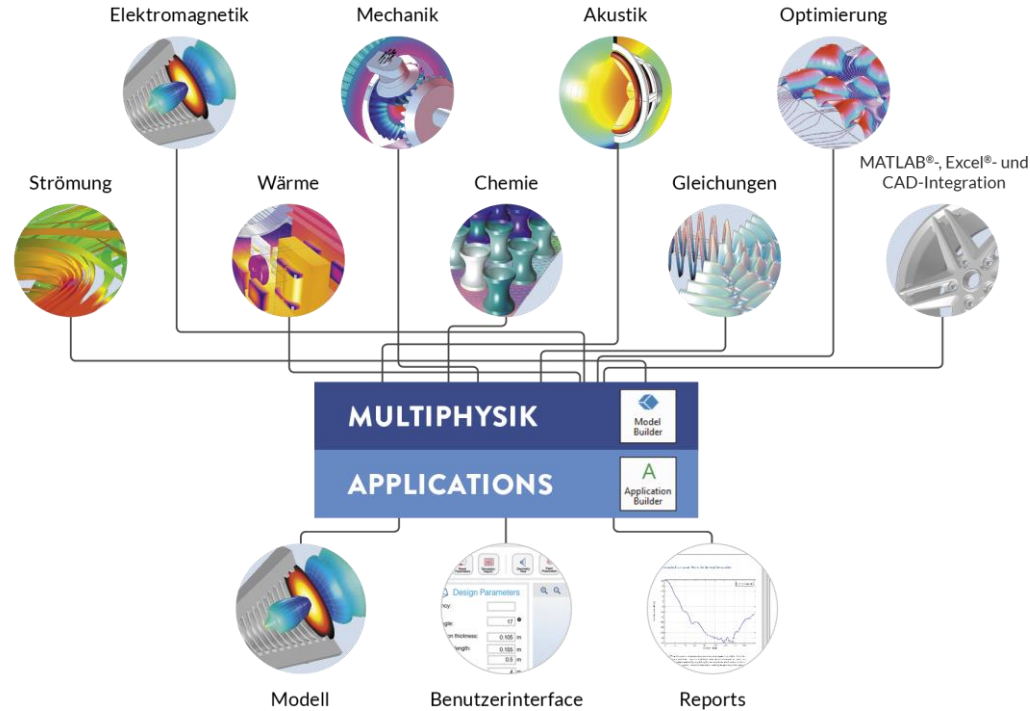
- Parameters, variables, functions, ...
- User defined materials
- Meshing sequence
- Parametrize the geometry
- Mechanics: Thermal expansion
- Fluid flow: convective cooling
- Parametric studies
- And many more



# Let's get started!

Have fun with COMSOL!

# COMSOL Multiphysics®



# Automatically Create a Geometry

- How to Create a Randomized Geometry Using Model Methods

- <https://www.comsol.com/blogs/how-to-create-a-randomized-geometry-using-model-methods/>

- Automate Model Preprocessing with the Application Builder

- <https://www.comsol.com/blogs/automate-model-preprocessing-with-the-application-builder/>

