



3DEXPERIENCE®

# CST STUDIO SUITE ELECTROMAGNETIC FIELD SIMULATION SOFTWARE

# WHY SIMULATE?

Electromagnetic (EM) components are crucial to the success of an ever-increasing range of products. Not only are long established industries such as automotive and communications being disrupted by new electrical and electronic devices, advances in technology are opening entirely new markets in fields such as medical equipment, renewable energy and metamaterials. Keeping up with these advances requires both visionary designs and rapid, flexible development cycles.

Simulation allows engineers to experiment with virtual prototypes even at the earliest stages of the design process, to compare the performance of different configurations, and to optimize their products. Simulation can reduce the number of physical prototypes required and shorten the development process, cutting both costs and time-to-market. Products can be simulated as part of a realistic system to analyze their installed performance and verify they meet legal electromagnetic compatibility (EMC) and exposure limits, potentially avoiding time-consuming redesigns or costly and embarrassing recalls.

Electromagnetics is just one field of physics, but one that overlaps with many others. Motors for instance use magnets and electrical coils to produce motion, while a microwave oven uses high-frequency EM fields to heat up food. EM simulation is one tool in a set of simulation technologies that can be used together for a fuller multiphysics simulation workflow.

## CST Studio Suite

CST Studio Suite is a best-in-class software package for EM and multiphysics simulation used in leading technology and engineering companies around the world. With solvers that span the frequency spectrum, CST Studio Suite offers a wide range of tools for designing, analyzing and optimizing products. The new Electromagnetics Analyst role, available in **3DEXPERIENCE R2018x**, allows CST Studio Suite to be integrated into collaborative workflows on the **3DEXPERIENCE** platform.

## KEY BENEFITS

### Electromagnetic simulation

- From statics to high frequency
- Specialized solvers for applications such as motors, circuit boards, cable harnesses and filters
- Coupled simulation: System-level, hybrid, multiphysics, EM/circuit co-simulation

### Modeling

- All-in-one fully parametric design environment
- Import/export wide variety of CAD and EDA files
- Wide range of complex material models

### Analysis

- Powerful post-processing and visualization tools
- Built-in optimizers

### High-Performance Computing

- Workstation: multithreading, GPU and hardware acceleration
- Cluster: Distributed computing and MPI

### Electromagnetics Analyst Role on 3DEXPERIENCE R2019x

- Setup a collaborative space, add people and everyone works on the same set of data; it's synchronized and version controlled as you work
- Lightweight visualization of model, mesh, scenario and results; help decision makers experience results and reduce time generating reports
- Direct access to geometry
- Web-based portal to submit and monitor CST Studio Suite jobs from anywhere
- Run CST Studio Suite in a "connected" mode, leveraging 3DEXPERIENCE
- Capabilities for collaboration, visualization, version control and knowledge capture
- Supports all CST Studio Suite capabilities including continued openness to run any custom plug-ins or scripts.
- Configure, submit and monitor CST Studio Suite Solvers from 3DEXPERIENCE.



**High-Tech:** Imported simulation model of an integrated chip package.

# DESIGN ENVIRONMENT

## Modeling

CST Studio Suite offers a powerful and fully parametric CAD interface for constructing and editing simulation models. Import and export tools mean that models can be imported from a wide range of CAD and electronic design automation (EDA) software. The fully parametric two-way link to SOLIDWORKS means that design changes made in CST Studio Suite can be imported directly back into the SOLIDWORKS project, and vice versa.

## Materials

There are many application areas, such as magnetics, photonics and biological physics, where the characteristic electromagnetic effects come about as a result of complex non-linear material properties. CST Studio Suite includes numerous material models to allow a vast array of phenomena to be simulated, including plasmonic and photonic effects, ferromagnetism, secondary electron emission and biological heating.

## Body models

The interaction of EM fields in the human body is a crucial design consideration for many devices, and informs both product performance and safety – especially in healthcare and life sciences. CST Studio Suite includes both voxel-based and

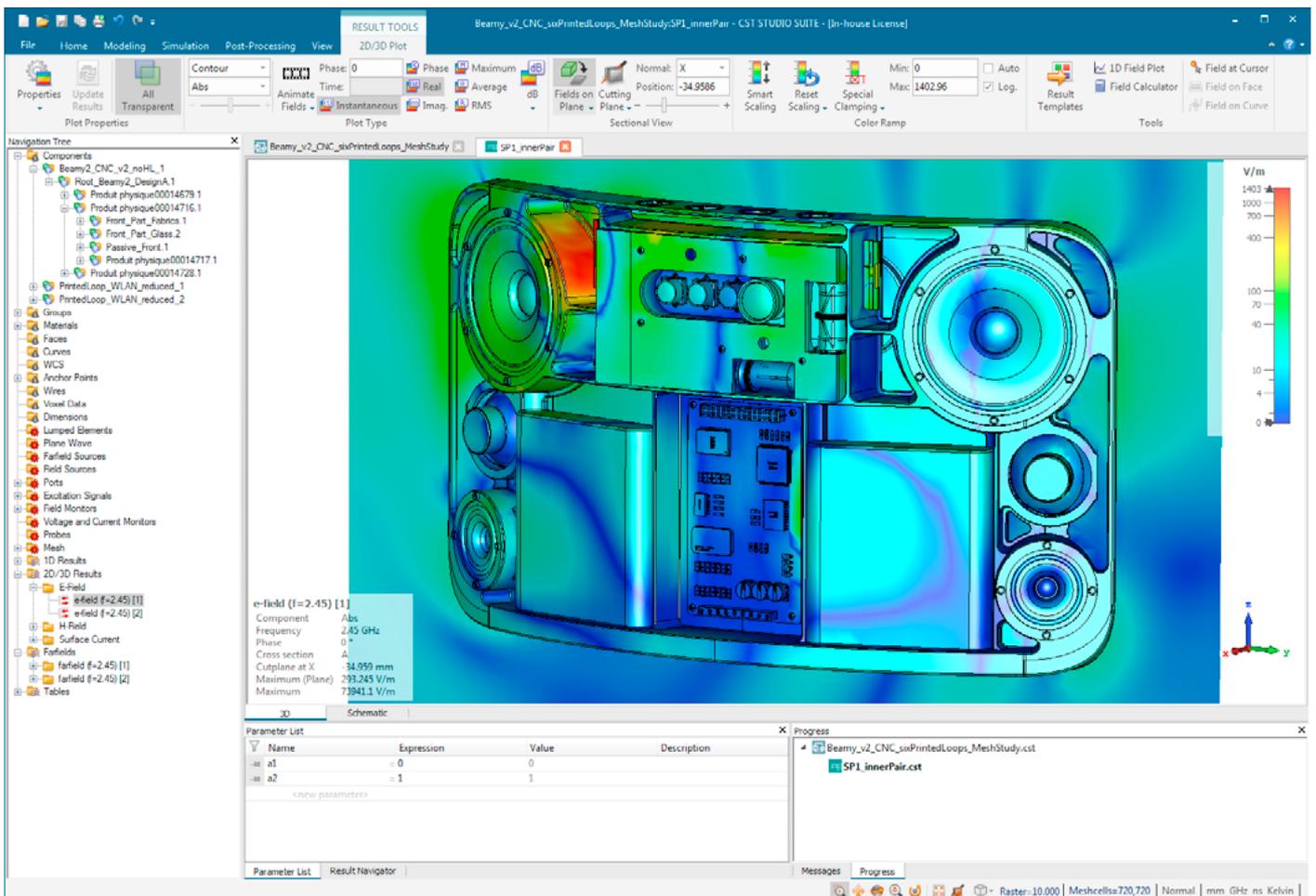
CAD-based body models with detailed internal structure and realistic EM and thermal properties, allowing the human body to be taken into consideration.

## Meshing

Accurate meshing is an essential part of the simulation process. CST Studio Suite provides fast, automatic meshing, with mesh refinement and automatic adaptation to increase the quality of the mesh in critical parts of the model. The proprietary Perfect Boundary Approximation (PBA)<sup>®</sup> used by CST Studio Suite retains the speed advantages associated with a conventional staircase mesh, even for models with billions of mesh cells, but allows curved structures and complex CAD data to be modeled accurately.

## Synthesis

CST Studio Suite offers a range of synthesis tools for automatically building models of potential designs. These include Filter Designer 2D for planar filters, Filter Designer 3D for cross-coupled cavity filters and the Array Wizard for antenna arrays. In addition, the software offers links to the SIMULIA electromagnetic tools Antenna Magus for antenna design and FEST3D for waveguide design.



# SIMULATION

## Solvers

The solvers are the foundation of CST Studio Suite. From the general purpose solvers like the Time Domain and Frequency Domain Solvers, suitable for a wide range of scenarios, to more specialized ones for applications such as electronics, electron devices, motors and cables, CST STUDIO SUITE offers best-in-class solvers for EM simulation. Multiphysics effects can also be simulated using the thermal and structural mechanics solvers, which can be coupled with the EM solvers for an integrated workflow.

## Optimizers

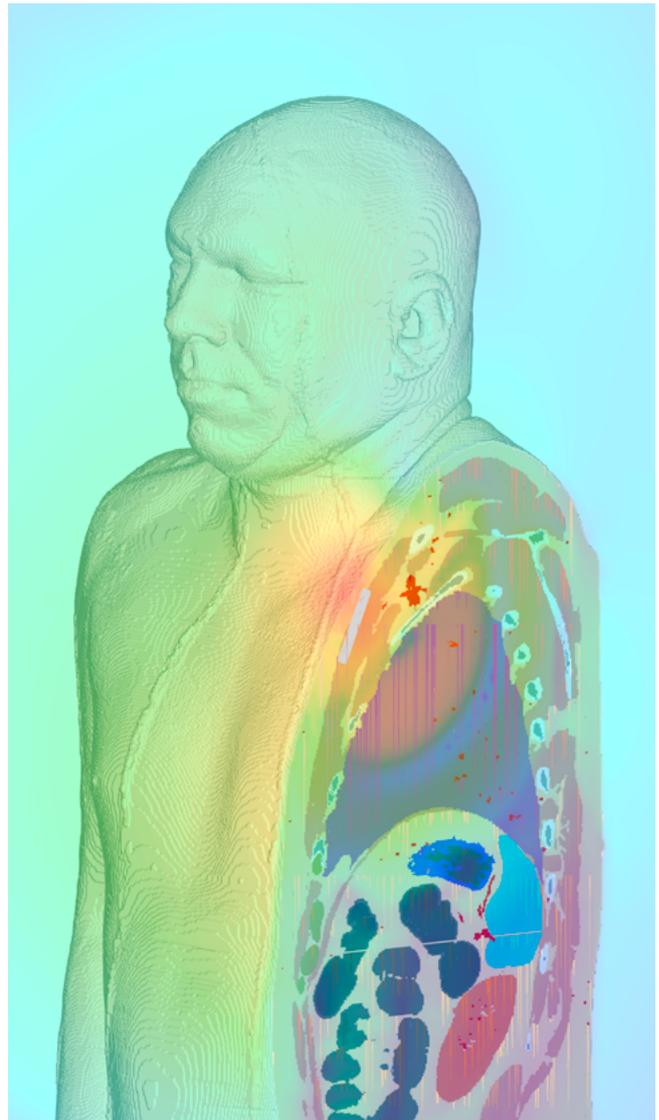
One key benefit of simulation is that devices can be optimized in order to improve their performance, tune them to stringent specifications, or reduce production cost. CST STUDIO SUITE includes built-in local and global optimizers, which can be used with all solvers to optimize any design parameters of the model.

## Post-Processing

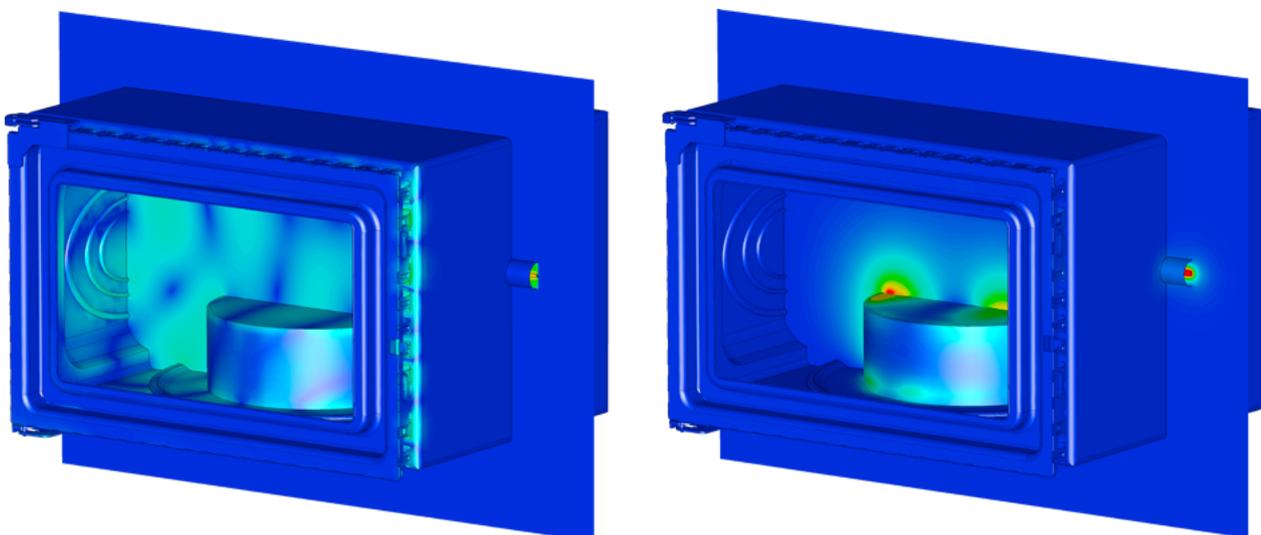
Post-processing allows simulation results to be used in a wide range of analysis to replicate common measurements and figures of merit. The post-processing templates in CST Studio Suite offer solutions for common workflows such as eye diagrams for electronics, efficiency mapping for motors and field analysis for MRI, as well as versatile general purpose templates for creating custom workflows.

## Hybrid and System Simulation

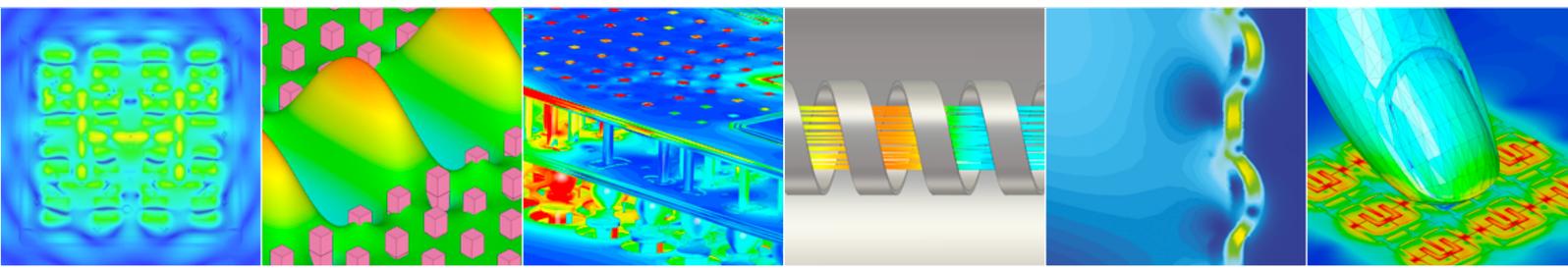
Different aspects of simulation are often well suited to different solvers. For example, antennas are often best simulated by the Time Domain Solver, but large platforms such as vehicles are better suited to the efficient Integral Equation Solver – an analysis of the installed performance of a vehicle-to-vehicle (V2V) antenna on a car includes both. System Assembly and Modeling (SAM) in CST Studio Suite allows simulations to be combined into a single 3D model or a linked automatic workflow, and the Hybrid Solver Task allows multiple solvers to be combined in a single simulation task.



**Life Sciences:** Electric field from a pacemaker antenna inside the human body.



**Industrial Equipment:** EM (left) and thermal (right) simulation of a microwave oven in use.



## INDUSTRY APPLICATIONS

### Aerospace and Defence

- Installed antenna performance
- Lightning strike and environmental electromagnetic effects (E3)
- Radar
- Co-site interference

### Construction, Cities and Territories

- Building shielding
- Cabling
- Lightning protection

### Energy and Materials

- High-voltage components
- Generators and motors
- Solar panel optimization
- Transformers

### Industrial Equipment

- RFID
- Non-destructive testing (NDT)
- Motors and actuators
- Welding and lithography

### Life Sciences

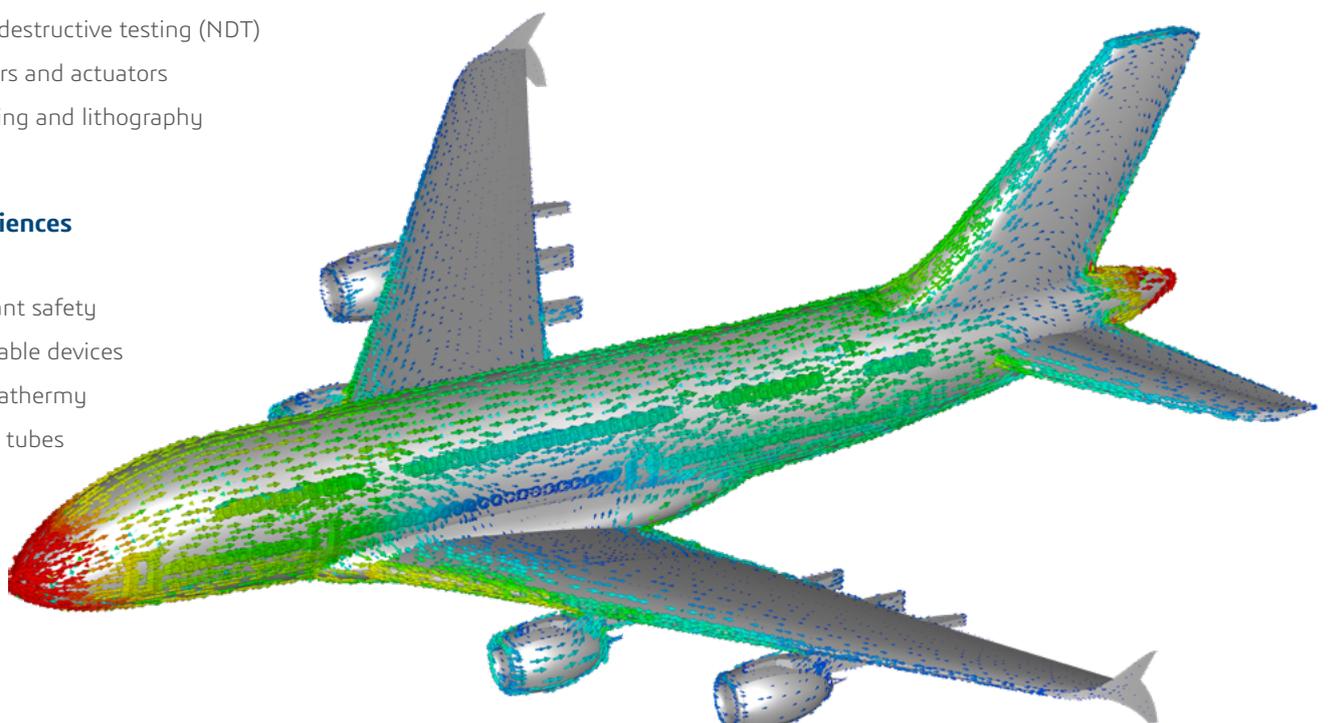
- MRI
- Implant safety
- Wearable devices
- RF diathermy
- X-ray tubes

### High Tech

- Antenna performance
- Microwave and RF components
- Electromagnetic compatibility (EMC)
- Signal and power integrity (SI/PI)
- Touchscreens
- Cables and connectors
- Specific absorption rate (SAR) exposure

### Transportation and Mobility

- Antenna installed performance
- Cable harness
- Automotive radar
- Electric motors
- Wireless charging
- Onboard electronics
- Sensors



**Aerospace and Defence:** Surface currents on an aircraft during a lightning strike.